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# Essays on Exchange Rate Regimes and Fiscal Policy

Mousse Ndoye Sow

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# **Essays on Exchange Rate Regimes and Fiscal Policy**

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*La faculté n'entend donner aucune approbation ou improbation aux opinions émises dans cette thèse. Elles doivent être considérées comme propres à leur auteur.*

*À Papa et Maman,  
À Adja et Peulh.*

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## **Résumé analytique et contribution**

Cette thèse est rédigée en deux parties principales. La première s'intéresse à la politique de change, et aux régimes de change en particulier. La seconde partie, quant à elle, traite de la politique budgétaire et des questions de décentralisation budgétaire.

La littérature sur les régimes de change et la politique budgétaire reste marquée par de vives controverses. Cette thèse, principalement empirique, revisite des questions relatives à la politique de change et à la politique budgétaire, jusque là, très peu documentées. Nous nous intéressons principalement aux pays en développement, y compris les pays émergents, mais pas exclusivement. Entre autres questions étudiées, cette thèse étudie les propriétés stabilisatrices des régimes de change, et la relation entre régimes de change, crises économiques et politiques fiscales. Par ailleurs, cette thèse se concentre sur l'impact de la dette publique et des règles budgétaires sur la conduite de la politique budgétaire en période de crise. Pour finir, cette thèse contribue à la littérature sur la décentralisation budgétaire.

## **Structure de la thèse et principaux résultats**

La première partie s'intéresse donc à la politique de change et est constituée de trois chapitres. Se basant sur un panel de 30 pays émergents et 90 pays en développement, le chapitre premier étudie les propriétés stabilisatrices des régimes de change, sur la période 1980-2007. Après avoir confirmé le caractère pro cyclique de la politique budgétaire dans les pays de notre échantillon, nous trouvons que les régimes de change fixe réduisent l'amplitude de la pro cyclicité. Cette propriété stabilisatrice des régimes de change fixe, en comparaison aux régimes de change intermédiaires/flexibles, résulte de la contrainte de politiques discrétionnaires, induite par l'adoption du change fixe. En période d'expansion économique, l'adoption du change fixe freine toute tendance à une politique budgétaire laxiste et des dépenses excessives pouvant accélérer l'inflation et fragiliser la fixité du taux de change. Les coûts liés à une déstabilisation de la parité fixe sont supérieurs aux supposés bénéfices (politiques, sociaux) d'un assouplissement de la politique budgétaire. Il est à noter que cette propriété stabilisatrice des régimes de change fixe est plus prononcée dans les pays en développement, et est conditionnelle à la classification des régimes de change et à l'instrument de mesure de la politique budgétaire.

Se basant sur les controverses existantes, le deuxième chapitre revisite l'hypothèse de la vision bipolaire des régimes de change selon laquelle, les régimes de change intermédiaires sont plus vulnérables aux crises, comparés aux régimes de change fixes ou flexibles. L'étude est réalisée sur un échantillon de 90 pays développés et en développement et utilise la méthode des variables qualitatives. L'horizon temporel est constitué de dix sous-périodes de trois ans. Les variables de crises (bancaire/financière, de change et de dette) proviennent principalement de la base de données de Reinhart et Rogoff (2010), mais aussi de celle de Laeven et Valencia (2012). Pour ce qui est des régimes de change, nous utilisons la classification du Fonds Monétaire International (FMI) et celle de Ilzetki, Reinhart et Rogoff (2010). Nos estimations révèlent que les régimes de change intermédiaires ne sont pas plus vulnérables aux crises que les solutions en coin (fixes ou flexibles), infirmant ainsi l'hypothèse de la vision bipolaire des régimes de change. Ces résultats sont robustes à la classification des régimes de change utilisée, au potentiel biais de variables omises, ainsi qu'au niveau de développement des pays étudiés. Plus important encore, ce chapitre montre que les fondamentaux macroéconomiques comptent parmi les principaux déterminants des crises. Une cause essentielle des crises bancaires/financières est la volatilité des crédits au secteur privé. Par ailleurs, le mécanisme de financement du déficit constitue la source majeure des crises de change. La monétisation de la dette apparaît être un élément qui fragilise la fixité du change, et peut conduire *in fine* à une crise de change. Les crises de dette souveraine sont quant à elles induites par des ratios de dette-sur-PIB très élevés et des trajectoires d'endettement non soutenables, comme observé récemment dans les pays européens (Grèce, Ireland, Italie, Espagne), et dans une moindre mesure aux États-Unis.

Le troisième chapitre étudie le lien entre la politique de change et la politique fiscale. Suite à la libéralisation commerciale, qui s'est traduite par un allègement de la fiscalité sur le commerce international, les pays ont cherché à compenser la perte de recettes engendrée par cette réforme. La transition fiscale, i.e. le passage d'une fiscalité internationale à une fiscalité domestique a été l'une des stratégies mises en œuvre par les décideurs. Ce troisième chapitre s'appuie sur un panel de pays développés et de pays en développement, sur les deux dernières décennies et étudie l'impact du régime de change sur le processus de transition fiscale. Il ressort de notre analyse que les pays à change fixe ont une plus grande probabilité de transition fiscale, comparés à leurs pairs en change intermédiaire ou flexible. Cette transition fiscale se

manifeste le plus souvent par l'adoption de la TVA. Deux hypothèses permettent d'étayer ce résultat. Premièrement, l'effet de substitution (*seigneurage vs. TVA*) suppose que les décideurs choisissent de mettre en place la TVA en remplacement des recettes de seigneurage très limitées (voire inexistantes) pour les pays qui sont en change fixe. La seconde hypothèse postule qu'en remplacement des recettes du commerce international, les pays en change fixe se concentrent sur la fiscalité domestique et collectent plus de TVA. Cette dernière, perçue comme moins distorsive permet une compensation progressive et une préservation de la compétitivité extérieure. Cet effet de compétitivité (*taxation internationale vs. TVA*) est renforcée par l'estimation d'un modèle de durée montrant que la probabilité d'adopter la TVA croît avec la fixité du taux de change. De plus, nos résultats révèlent une hétérogénéité significative à l'intérieur des régimes de change fixe. Plus le régime est contraignant et plus la probabilité d'adopter la TVA est importante.

La seconde partie de cette thèse se focalise sur la politique budgétaire et les questions de décentralisation budgétaire. Ainsi, le quatrième chapitre s'intéresse aux propriétés cycliques de la politique budgétaire et étudie le rôle de la dette publique et des règles budgétaires sur la cyclicité de la politique budgétaire en période de dette élevée. S'appuyant sur un échantillon de pays avancés et de pays émergents et en développement, sur la période 1990-2012, notre analyse confirme l'aspect contra-cyclique de la politique budgétaire, à l'image de Frankel *et al.* (2013) qui ont montré que les pays en développement transitent vers une politique budgétaire moins pro-cyclique, voire contra-cyclique. Plus important, le chapitre quatrième révèle que la contra cyclicité de la politique budgétaire n'est observée que lorsque le ratio dette-sur-PIB est inférieur à 54%. Lorsque ce ratio dépasse le seuil de 117%, la politique budgétaire devient pro cyclique. Cette réaction non-linéaire de la politique budgétaire, conditionnelle au niveau de la dette publique est confirmée par la méthode de Hansen (1999) qui estime un seuil moyen de 87%, au delà duquel la politique budgétaire perd toute propriété contra cyclique. Ce résultat semble en accord avec les travaux de Egért (2012), illustrant ce même effet non-linéaire pour les pays de l'OCDE. En poursuivant notre analyse, nous nous intéressons au rôle des règles budgétaires sur la relation entre la politique budgétaire et le niveau de dette publique. Pour ce faire, nous combinons la méthode de Aghion et Marinescu (2007) en deux étapes et les variables instrumentales. Nous estimons d'abord le coefficient de cyclicité et régressons par la suite ce coefficient estimé sur les règles budgétaires, en interaction avec la dette publique. De

ces estimations, il ressort que les règles budgétaires réduisent l'impact négatif de la dette publique sur le caractère cyclique de la politique budgétaire, et contribuent à restaurer la contracyclique de la politique budgétaire. Cet effet disciplinaire des règles budgétaires se manifeste *ex-ante* en préservant une trajectoire soutenable de la dette publique. Cependant, il est à souligner que cet effet disciplinaire n'est observé que pour certains types de règles budgétaires, notamment les règles d'or et les règles nationales. Contrairement, les règles supranationales et les règles avec clauses dérogatoires présentent des limites significatives quant à leur capacité à réduire les effets négatifs de la dette publique sur la cyclicité de la politique budgétaire.

Les deux derniers chapitres se consacrent à la décentralisation budgétaire. La décentralisation est mesurée par le ratio des dépenses (recettes) publiques des gouvernements locaux et celles du gouvernement central. Le cinquième chapitre montre que la décentralisation des dépenses publiques, accompagnée d'une décentralisation des recettes améliorent l'efficacité du service public dans les secteurs de l'éducation et de la santé. Par ailleurs, la décentralisation, pour être efficace, doit atteindre un seuil indicatif, estimé à 35.7%. En d'autres termes, pour améliorer la qualité des services publics dans le cadre de la décentralisation, les autorités doivent transférer un tiers des dépenses/recettes aux gouvernements locaux. De plus, un environnement politico-institutionnel sain (corruption limitée, promotion de la démocratie et de l'autonomie des gouvernements locaux) est indispensable pour la réussite de la décentralisation. Pour finir, le chapitre sixième explore l'impact de la décentralisation sur la cyclicité de la politique budgétaire et le solde budgétaire structurel. De nos estimations ressortent que la décentralisation peut avoir un effet positif sur le solde budgétaire structurel. Cependant, la décentralisation peut aussi avoir des effets déstabilisateurs sur la politique budgétaire, en réduisant (augmentant) la contracyclique (pro cyclicité) de la politique budgétaire. Nos résultats révèlent aussi qu'une décentralisation asymétrique, non proportionnelle (entre dépenses et recettes) est source de déséquilibres budgétaires verticaux, susceptibles de créer une dépendance des gouvernements locaux vis-à-vis des transferts et subventions du gouvernement central. Cette dépendance par rapport aux transferts a pour conséquence d'affaiblir le solde structurel du gouvernement central. Ce chapitre conclut que le processus de décentralisation doit être conduit de manière progressive, garantissant l'autonomie (financière) des gouvernements locaux.

En résumé, la première partie propose des recommandations relatives à la politique de change,

et plus principalement aux régimes de change. Le chapitre premier montre que les régimes de changes peuvent avoir un effet stabilisateur conditionnel sur la politique budgétaire. Le deuxième chapitre infirme la vision bipolaire des régimes de change et révèle que les régimes de change intermédiaires ne sont pas plus exposés aux crises économiques que les régimes de change fixes ou flexibles. Le chapitre troisième, quant à lui, révèle un impact significatif des régimes de change sur la décision de transition fiscale.

Dans la seconde partie de cette thèse, le chapitre quatrième montre que la cyclicité de la politique budgétaire est conditionnelle au niveau de dette publique. En moyenne, lorsque celle-ci dépasse le seuil de 87% du PIB, la politique budgétaire perd toute propriété contra cyclique. En retour, les règles budgétaires permettent de mitiger cet impact négatif de la dette, et de restaurer la contra cyclicité de la politique budgétaire. Cet effet disciplinaire *ex ante* semble être spécifique à certains types de règles. Les deux derniers chapitres sur la décentralisation montrent que celle-ci peut améliorer la qualité du service public, si adéquatement mis en place. Une décentralisation proportionnelle (entre compétences transférées et ressources dévolues) et progressive, à l'intérieur d'un environnement politico-institutionnel sain est essentielle. De plus, une décentralisation efficace nécessite le transfert d'un certain montant (estimé à un tiers) de ressources du gouvernement central vers les collectivités. Il est à noter que le niveau optimal de transferts dépend des spécificités de chaque pays, ainsi que des objectifs attendus de la réforme. Bien qu'aillant un impact déstabilisateur sur la politique budgétaire, au travers une réduction de la contra cyclicité, la décentralisation impacte positivement le solde budgétaire structurel du gouvernement central. Par ailleurs, nous soulignons la nécessité d'une autonomie financière des gouvernements locaux, afin de circonscrire les déséquilibres budgétaires verticaux qui, *in fine*, fragilisent la position du gouvernement central.

## **Analytical summary and contribution to the literature**

The thesis is organized in two main parts. Part one refreshes the exchange rate policy-related literature. The second part focuses on the cyclical reaction of fiscal policy in time of high debt, and on fiscal decentralization issues.

Notwithstanding the extensive literature on exchange rate regimes and fiscal policy, controversies remain harsh. The starting point of this thesis is to shed a fresh light, especially on the empirical ground, on exchange rate and fiscal policy-related issues barely documented or left aside by the existing literature. We mainly focus on developing countries, including low and lower middle income economies and emerging market economies, but not exclusively. The policy questions addressed here include the stabilizing property of exchange rate regimes; and the link between exchange rate regimes, economic crises and tax policy. This thesis also revives the recently debated role of fiscal policy and highlights important findings on the behavior of fiscal policy in time of high debt and the role of fiscal rules during these episodes. Finally, the thesis provides inputs to policy discussion regarding fiscal decentralization issues.

## **Outline and Main Results**

Part one, which includes three chapters focuses mainly on exchange rate policy-related issues. Chapter 1 studies the stabilizing property of exchange rate regimes within a panel of 30 emerging market and 90 low income countries over the period 1980-2007. After confirming the average pro-cyclical tendency of fiscal policy in these countries, we find that fixed or pegged exchange rate regimes reduce the magnitude of pro-cyclical fiscal policy. This stabilizing property of fixed regimes, compared to flexible regimes, is grounded by the restrictions of authorities' discretionary actions following the adoption of a fixed regime. Indeed, pegging the exchange rate alleviates the tendency of fiscal authorities to overspend, and prevents them from lax fiscal policy which could accelerate inflation and threaten the peg during booms. As a result, choosing a fixed regime ties policymakers' hands by preventing them from loose fiscal behaviors since the costs of the collapse of the peg might outweigh the expected (political or social) benefits of overspending. Additional findings state that the stabilizing property is more pronounced in low income countries, but sensitive to the exchange rate regime classification or fiscal policy indicator.

Building on the existing controversies, Chapter 2 revisits the bipolar hypothesis, stating that intermediate exchange rate regimes are more vulnerable to banking/financial, currency and debt crises than other regimes. We draw upon a panel of 90 developed and developing countries over ten sub-periods of three years each, and use qualitative variable method. Crisis variables are taken from Reinhart and Rogoff's (2010) dataset, and, for robustness purposes, from the database compiled by Laeven and Valencia (2012). Using alternatively the IMF's and Ilzetzi, Reinhart and Rogoff (2010) exchange rate regime classification, we unveil that intermediate exchange rate regimes are not more vulnerable to crises, than the corner regimes (to fix or to float). As a result, we clearly break down the bipolar view. This finding is neither driven by the choice of exchange rate regime variables nor the estimation methods and omitted variable bias. Additionally, this finding is robust to countries income-based classification. Interestingly, Chapter 2 shows that the critical determinants of crisis proneness are rather the macroeconomic fundamentals. Authorities need to reduce the volatility of private sector credit to limit the probability of banking/financial crisis. In the meantime, a deficit-financing mechanism based on debt monetization might threaten the exchange rate peg, and *in fine* lead to its collapse. Finally the debt-to-GDP ratio should be kept in a sustainable path to avoid sovereign debt crisis, as shown recently in Europe (Greece, Italy, Spain, Ireland), but also in the United States.

Chapter 3 explores the linkage between the exchange rate regime and tax policy. In the aftermath of trade liberalization, countries stepped to recover the resources lost through different channels, mainly by implementing tax transition reform, i.e. a shift from international to domestic taxation. Chapter 3 analyzes the role of exchange rate policy, and particularly the exchange rate regimes in the tax transition process using a panel of advanced and developing countries, over two recent decades. Based upon the appropriate estimation techniques, Chapter 3 emphasizes that countries with pegged exchange rate regimes have greater reliance on domestic taxation -*such as the VAT*- to make up for the loss of seigniorage revenue inherent to pegging the exchange rate to an external anchor. This result is understood as a substitution effect (*seigniorage revenue vs. VAT revenue*). Another important finding is that countries with pegged exchange rate regimes collect more VAT revenue, compared to their peers with intermediate and flexible regimes. To strengthen competitiveness, countries overcome the loss of border taxes with VAT revenue. This competitiveness effect (*international tax revenue vs.*

VAT revenue) through the VAT adoption helps countries avoid the distortive effects of alternative (domestic) taxation. Furthermore, Chapter 3 reveals that, through a duration model, pegging the exchange rate may accelerate the adoption of VAT. Our results point to a significant heterogeneity within the peg category. The more restrictive is the peg, the stronger is the reliance on domestic taxation.

The second part shifts the analysis towards fiscal policy and fiscal decentralization issues. We explore the cyclical behavior of fiscal policy in high debt periods and discuss the impact of fiscal decentralization on various fiscal outcomes. Chapter 4 starts with reconsidering the cyclical reaction of fiscal policy and the role of public debt and fiscal rules. To this end, we use a sample of 56 advanced economies and emerging market and developing countries over twenty two years starting from 1990. First, our results refreshed the finding of averaged counter-cyclical fiscal policy in the sample. This result is in line with the result of Frankel *et al.* (2013), emphasizing that developing countries are graduating toward less pro-cyclical or even counter-cyclical fiscal policy. Further, GMM-system based estimations show that fiscal policy remains counter-cyclical when the debt-to-GDP ratio is below 54%. However, fiscal policy turns pro-cyclical when the public debt goes beyond 117% in share of GDP. This evidence of non-linear cyclical reaction of fiscal policy induced by the debt-to-GDP ratio is strengthened by the panel threshold regressions *à la* Hansen (1999), which illustrate that fiscal policy becomes pro-cyclical when the public debt-to-GDP ratio is above the average endogenously-estimated threshold of 87%. This finding seems in line with the recent finding of Egert (2012) for OECD countries. Chapter 4 takes the study a step further and identifies a way of mitigating the destabilizing effect of public debt on fiscal policy. We draw upon the two-stage method of Aghion and Marinescu (2007), combined with the instrumental variable techniques. It comes out that fiscal rules help easing the detrimental effects of high public debt and restoring counter-cyclicality of fiscal policy. This discipline-enhancing effect of fiscal rules operates *ex ante* by keeping the debt path within a reasonable band, thus preserving the debt sustainability. It's worth mentioning that not all types of rules are discipline-enhancing. While golden rules and national fiscal rules prove their superiority, supra-national rules and rules with escape clause show inefficient for fiscal policy stabilization purposes in times of high debt.

In the last two chapters, we analyze the effect of fiscal decentralization on the efficiency of public service delivery, and fiscal policy performance. In line with the existing literature, we



adopt the conventional measurement of fiscal decentralization which is taken as the share of local government expenditure (or revenue) over the central government expenditure (or revenue). In chapter 5, we highlighted that expenditure decentralization, combined with sufficient level of revenue decentralization, increases the efficiency of public service delivery in health and education sectors. Further, we found that, to be effective, fiscal decentralization needs to reach an indicative threshold, which is estimated at 35%. In other words, central government needs to share at least one third of expenditure or revenue responsibilities with the local levels. Moreover, the political and institutional environment is found to be critical for fiscal decentralization to deliver positive outcomes. Next, Chapter 6 explores the impact of decentralization on the cyclical aspect of fiscal policy and the structural fiscal balance. We notice that decentralization helps strengthening the structural fiscal stance. However, decentralization appears to be destabilizing in the sense that it reduces (increases) the counter-cyclical (pro-cyclical) of fiscal policy. Finally our estimates report that the asymmetry between expenditure assignments and revenue capacities of local governments generates vertical fiscal imbalances. These imbalances are bridged through transfers from the central level. Therefore, the greater the imbalances, the higher the transfer dependency. As a consequence, this transfer dependency weakens the structural balance of the general government as a whole. These findings emphasized the need for policy-makers to proceed timely with fiscal decentralization, monitor the pace of the reform and match adequately the expenditure assignments with the revenue capacities of the local entities.

In sum, the first part of the thesis provides answers and recommendations on exchange rate-policy related issues. Chapter one shows that fixed exchange rate regimes can have conditional stabilizing effect on fiscal policy. In addition, Chapter two challenges the bipolar prescription advocating that intermediate regimes are more vulnerable to crises. Chapter three in turn reveals a significant link between exchange rate regimes and tax policy, especially when it comes to operating tax transition.

On the fiscal policy side, the second part of the thesis comes with the following conclusions. The reaction of fiscal policy to the business cycle is non-linear and constrained by the outstanding public debt-to-GDP ratio. When this ratio goes beyond a certain threshold 87%, fiscal policy loses its counter-cyclical behavior, and in some cases, turns pro-cyclical. Fiscal rules help restoring the counter-cyclical. In the last two chapters, we emphasizes that the

combination of sufficient level of expenditure and revenue decentralization, within a healthy political and institutional environment, improves the efficiency of public service delivery. In addition fiscal decentralization impacts positively the structural fiscal balance of the general government. However, transfer-dependency between the central and local levels caused by vertical fiscal imbalances hurts the fiscal balance. Finally we find that fiscal decentralization may have destabilizing effect, by reducing (increasing) the counter-cyclicality (pro-cyclicality) of fiscal policy.

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# **PART I:**

# **Exchange Rate Regimes**

*“There is no single currency regime that is right for all countries or at all times...”*  
Frankel (1999)

# Introduction

The choice of an optimal exchange rate regime has been contentiously debated up until recently in the policy-making scene, but academically as well. In this regard, Frankel (1999) argued that there is no single currency regime that is right for all countries or at all times. The appropriate exchange rate regime varies depending on the specific circumstances of each country. Part one of this thesis refreshes the debate on the choice and consequences of exchange rate regimes and explores recent exchange rate policy-related issues undergoing harsh controversies or barely documented so far.

Till the early seventies, the pegged exchange regimes, fueled by the Bretton Woods system prevailed as the most workable monetary arrangement. This fixed exchange rate arrangement has been deemed credible in delivering macroeconomic performances, in terms of low inflation, exchange rate stability and low volatility. In the late nineties and early two thousands, the virulence of the East Asian and Latin American crises threatened the viability of the Bretton Woods's exchange rate system as a credible monetary arrangement. As a consequence, the Bretton Woods's trimmed back in favor of intermediate and more flexible monetary arrangements. In addition the recent financial crash, which originated from the country with the most flexible monetary arrangement—*the US*—, and spread to countries within monetary unions—*the Euro area*—called for a look-back to the role of ERR in preventing financial and sovereign debt crises.

Recently, several developing economies recorded single-digit inflation, with increased financial deepening (IMF, 2014). As a result, these countries moved toward more flexible and forward looking monetary policy frameworks, devolving therefore a greater role to exchange rate policy and inflation objective. This phenomenon is also characterized in several emerging market economies considering inflation targeting as their monetary arrangement.<sup>1</sup> This shift reflected the sophistication of domestic financial markets in

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<sup>1</sup> For a thorough discussion on inflation targeting regimes, see Mishkin (2000), Mishkin and Schmidt-Hebbel (2002), Rose (2007), and Minéa and Tapsoba (2014).

developing and emerging markets economies, but emphasized the evolution of global thinking and practice vis-à-vis the exchange rate and monetary policy.

Traditionally, the empirical literature relies upon the classification of alternative exchange rate regimes to assess their macroeconomic impacts. The widely spread IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) stands among the main sources of information about the exchange rate policies pursued by the IMF member countries. Two types of classification are reported therein. The official regime classification is made according to the information officially provided by each member country. This official classification, also known as the "*de jure*" classification is subject to several criticisms. In fact, the deeds of governments in managing the exchange rate may sometimes be at odds with their official announcements. As a consequence, policy outcomes are misleadingly attributed to the official *de jure* regime. Recently, the IMF published new exchange rate regime classification based on countries' behaviors on the exchange market. This "*de facto*" classification, which describes the facts in countries' exchange rate policy is based on the evolution of core variables such as, the foreign exchange interventions and the exchange rate/interest rate movements (Calvo and Reinhart (2000b); Levy-Yeyati and Sturzenegger (1999)). The empirical literature emphasizes the accuracy of this market-based classification, which seems closer to describing the behavior of countries' exchange rate policy.

Table 1 below gives an up-to-date snapshot of the *de facto* exchange rate arrangements and monetary policy frameworks for IMF member countries. Remark that the monetary policy framework runs the gamut from exchange rate anchor to inflation targeting framework, including monetary aggregate targeting countries. Exchange rate anchor, which is the most prevailing monetary framework (89 countries), characterizes countries that are intervening in the exchange market to maintain a predetermined level of the nominal exchange rate. In some cases, the nominal exchange rate is (fully) market-determined. This framework can be broken into three main categories: pegged, intermediate and floating categories. As named, inflation targeters (34 countries) refer to countries that have set the inflation as the ultimate objective of the exchange rate policy. Under this framework, the nominal exchange rate is used to meet the (inflation) target formerly defined. The monetary aggregate targeting

framework (25 countries) is associated with countries that explicitly targeted the growth rate of a monetary aggregate such as the reserve money or broad money (M1, M2) and therefore use this target as the nominal anchor. The remaining “other” framework comprises countries that have no explicit nominal anchor, but monitor various indicators while conducting the monetary policy.

Broadly taken, the AREAER classifies the alternatives regimes into three coarse categories: the hard pegs, soft pegs, and floating, based on the members' actual exchange rate policy.<sup>2</sup> The hard peg category includes countries that have adopted an exchange arrangement with no separate legal tender; and those with a currency board arrangement. Within the soft peg group we distinguish countries with either conventional pegged arrangements, pegged exchange rate within horizontal bands, crawling pegs, crawl-like arrangements, or stabilized arrangements. The third floating category gathers countries with a managed or freely floating regime. Table 2 below displays the distribution of the alternative regimes over the period 2008-14.

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<sup>2</sup> A fourth category named “*Residual*” comprises countries running under other managed arrangement, not described in the three broad categories.

**Table 1. De facto classification of Exchange Rate Arrangements and Monetary Policy Frameworks**

| Exchange rate arrangement<br>(number of countries)      | Monetary Policy Framework  |   |   |   |  |  |  |   |   |
|---|--|---|---|---|--|--|--|---|---|
|   | Exchange rate anchor   |   |   |   | Monetary aggregate target<br>(25)                        | Inflation-targeting framework<br>(34)  | Other <sup>1</sup><br>(43)   |   |   |
|   | U.S. dollar<br>(43)  |   | Euro<br>(26)  |   |  |  |  | Composite<br>(12)   | Other<br>(8)  |
| <b>No separate legal tender (13)</b>                    | Ecuador<br>El Salvador<br>Marshall Islands<br>Micronesia                                     | Palau<br>Panama<br>Timor-Leste<br>Zimbabwe  | Kosovo<br>Montenegro  | San Marino  |  | Kiribati<br>Tuvalu   |  |   |   |
| <b>Currency board (12)</b>                              | Djibouti<br>Hong Kong SAR<br><br>ECCU<br>Antigua and Barbuda<br>Dominica<br>Grenada          | St. Kitts and Nevis<br>St. Lucia<br>St. Vincent and the Grenadines  | Bosnia and Herzegovina<br>Bulgaria  | Lithuania <sup>2</sup>  |  | Brunei<br>Darussalam   |  |   |   |
| <b>Conventional peg (44)</b>                            | Aruba<br>The Bahamas<br>Bahrain<br>Barbados<br>Belize<br>Curaçao and Sint Maarten<br>Eritrea | Jordan<br>Oman<br>Qatar<br>Saudi Arabia<br>South Sudan<br>Turkmenistan<br>United Arab Emirates<br>Venezuela | Cabo Verde<br>Comoros<br>Denmark <sup>2</sup><br>São Tomé and Príncipe<br><br>WAEMU<br>Benin<br>Burkina Faso<br>Côte d'Ivoire<br>Guinea-Bissau<br>Mali<br>Niger | Senegal<br>Togo<br><br>CEMAC<br>Cameroon<br>Central African Rep.<br>Chad<br>Rep. of Congo<br>Equatorial Guinea<br>Gabon | Fiji<br>Kuwait<br>Libya<br>Morocco <sup>3</sup><br>Samoa | Bhutan<br>Lesotho<br>Namibia<br>Nepal<br>Swaziland   |  | Solomon Islands <sup>4</sup>  |   |
| <b>Stabilized arrangement (21)</b>                      | Guyana<br>Iraq<br>Kazakhstan (02/14)<br>Lebanon  | Maldives<br>Suriname<br>Trinidad and Tobago   | FYR Macedonia   |   | Singapore<br>Vietnam <sup>5</sup>                        | Bangladesh <sup>5</sup><br>(02/13)<br>Burundi <sup>5</sup><br>(03/13)<br>Democratic Rep. of the Congo <sup>5</sup><br>Guinea <sup>5</sup><br>(08/13)<br>Sri Lanka <sup>5</sup><br>(10/13)<br>Tajikistan <sup>5</sup><br>Yemen <sup>5</sup> |  | Angola <sup>5</sup><br>Azerbaijan <sup>5</sup><br>Bolivia <sup>5</sup><br>Egypt <sup>5</sup><br>(07/13)   |   |
| <b>Crawling peg (2)</b>                                 | Nicaragua  |   |   |   | Botswana   |  |  |   |   |
| <b>Crawl-like arrangement (15)</b>                      | Honduras<br>Jamaica  |   | Croatia   |   |  |  | China <sup>5</sup><br>Ethiopia <sup>5</sup><br>Uzbekistan <sup>5</sup> | Armenia <sup>5</sup><br>(03/13)<br>Dominican Republic <sup>5</sup><br>Guatemala <sup>5,6</sup><br>(11/12) | Argentina <sup>5</sup><br>Belarus <sup>5,6</sup><br>(09/12)<br>Haiti <sup>5</sup><br>Lao P.D.R. <sup>5</sup><br>Switzerland <sup>7</sup><br>(05/13)<br>Tunisia <sup>4,8</sup> |
| <b>Pegged exchange rate within horizontal bands (1)</b> |  |   |   |   | Tonga  |  |  |   |   |



| Exchange rate arrangement<br>(number of countries) | Monetary Policy Framework     |              |                          |              |   |   |  |
|--|-------------------------------|--------------|--------------------------|--------------|---|---|--|
|  | Exchange rate anchor          |              |                          |              | Monetary aggregate target<br>(25)   | Inflation-targeting framework<br>(34)   | Other <sup>1</sup><br>(43)   |
|  | U.S. dollar<br>(43)           | Euro<br>(26) | Composite<br>(12)        | Other<br>(8) |   |   |  |
| <b>Other managed arrangement</b><br>(18)           | Cambodia<br>(7/13)<br>Liberia |              | Algeria<br>Iran<br>Syria |              | The Gambia<br>Myanmar<br>Nigeria<br>Rwanda  | Czech Rep.<br>(11/13)   | Costa Rica<br>(08/13)<br>Kyrgyz Rep.<br>Malaysia<br>Mauritania<br>Pakistan<br>(12/13)<br>Russia <sup>B</sup><br>Sudan<br>Vanuatu <sup>6</sup>  |
| <b>Floating</b> (36)                               |                               |              |                          |              | Afghanistan<br>Kenya<br>Madagascar<br>Malawi <sup>6</sup><br>(05/12)<br>Mozambique<br>Papua New Guinea<br>Seychelles <sup>9</sup><br>(03/14)<br>Sierra Leone<br>Tanzania<br>Ukraine<br>(02/14)<br>Uruguay | Albania<br>Brazil<br>Colombia<br>Georgia<br>(11/13)<br>Ghana<br>Hungary<br>Iceland<br>Indonesia<br>(08/13)<br>Israel (05/13)<br>Korea<br>Moldova<br>New Zealand<br>Paraguay<br>(07/13)<br>Peru<br>Philippines<br>Romania<br>Serbia<br>South Africa<br>Thailand<br>Turkey<br>Uganda <sup>6</sup> | India<br>Mauritius<br>Mongolia<br>Zambia   |
| <b>Free floating</b><br>(29)                       |                               |              |                          |              |   | Australia<br>Canada<br>Chile<br>Japan<br>Mexico<br>Norway<br>Poland<br>Sweden<br>United Kingdom   | Somalia<br>United States<br><br><b>EMU</b><br>Austria<br>Belgium<br>Cyprus<br>Estonia<br>Finland<br>France<br>Germany<br>Greece<br>Ireland<br>Italy<br>Latvia<br>(01/14)<br>Luxembourg<br>Malta<br>Netherlands<br>Portugal<br>Slovak Rep.<br>Slovenia<br>Spain |

Source: IMF.

Note: If the member country's de facto exchange rate arrangement has been reclassified during the reporting period, the date of changes is indicated in parentheses. CEMAC= Central African Economic and Monetary Community; ECCU = Eastern Caribbean Currency Union; EMU = European Economic and Monetary Union; WAEMU = West African Economic and Monetary Union.

<sup>1</sup> Includes countries that have no explicitly stated nominal anchor, but rather monitor various indicators in conducting monetary policy.

<sup>2</sup> The member participates in the European Exchange Rate Mechanism (ERM II).

<sup>3</sup> Within the framework of an exchange rate fixed to a currency composite, the Bank Al-Maghrib adopted a monetary policy framework in 2006 based on various inflation indicators with the overnight interest rate as its operational target to pursue its main objective for price stability.

<sup>4</sup> The country maintains a de facto exchange rate anchor to a composite.

<sup>5</sup> The country maintains a de facto exchange rate anchor to the U.S. dollar.

<sup>6</sup> The exchange rate arrangement or monetary policy framework was reclassified retroactively, overriding a previously published classification.

<sup>7</sup> The country maintains a de facto exchange rate anchor to the euro.

<sup>8</sup> The central bank has taken preliminary steps toward inflation targeting.

<sup>9</sup> The exchange rate arrangement was reclassified twice during this reporting period, reverting back to the classification in the previous year's report.

It appears that the most popular regimes are the soft pegs and the floating regimes. On average, 22% among the 188 IMF member countries have adopted continuously a conventional pegged arrangement as monetary policy framework. Besides, the floating category is widely used with 20.2% and 19.7% adopting respectively a floating or freely floating regime. Notice that, this proportion decreases over time and ended respectively with 18.8% and 15.2%. It's worth noting that less than 3% of countries ruled under a crawling peg or have used an exchange rate with horizontal band. The time pattern shows a shrinking share of these categories, with less than 1% still ruling under these frameworks in 2014.

**Table 2. Exchange Rate Arrangements (percentage of IMF members<sup>1</sup>)**

| Exchange Rate Arrangement                    | 2008 <sup>2</sup> | 2009 <sup>3</sup> | 2010 <sup>4</sup> | 2011 <sup>5</sup> | 2012 <sup>5</sup> | 2013        | 2014        |
|--|-------------------|-------------------|-------------------|-------------------|-------------------|-------------|-------------|
| <b>Hard peg</b>                              | <b>12.2</b>       | <b>12.2</b>       | <b>13.2</b>       | <b>13.2</b>       | <b>13.2</b>       | <b>13.1</b> | <b>13.1</b> |
| No separate legal tender                     | 5.3               | 5.3               | 6.3               | 6.8               | 6.8               | 6.8         | 6.8         |
| Currency board                               | 6.9               | 6.9               | 6.9               | 6.3               | 6.3               | 6.3         | 6.3         |
| <b>Soft peg</b>                              | <b>39.9</b>       | <b>34.6</b>       | <b>39.7</b>       | <b>43.2</b>       | <b>39.5</b>       | <b>42.9</b> | <b>43.5</b> |
| Conventional peg                             | 22.3              | 22.3              | 23.3              | 22.6              | 22.6              | 23.6        | 23          |
| Pegged exchange rate within horizontal bands | 1.1               | 2.1               | 1.1               | 0.5               | 0.5               | 0.5         | 0.5         |
| Stabilized arrangement                       | 12.8              | 6.9               | 12.7              | 12.1              | 8.4               | 9.9         | 11          |
| Crawling peg                                 | 2.7               | 2.7               | 1.6               | 1.6               | 1.6               | 1           | 1           |
| Craw-like arrangement                        | 1.1               | 0.5               | 1.1               | 6.3               | 6.3               | 7.9         | 7.9         |
| <b>Floating</b>                              | <b>39.9</b>       | <b>42</b>         | <b>36</b>         | <b>34.7</b>       | <b>34.7</b>       | <b>34</b>   | <b>34</b>   |
| Floating                                     | 20.2              | 24.5              | 20.1              | 18.9              | 18.4              | 18.3        | 18.8        |
| Free floating                                | 19.7              | 17.6              | 15.9              | 15.8              | 16.3              | 15.7        | 15.2        |
| <b>Residual</b>                              |                   |                   |                   |                   |                   |             |             |
| Other managed arrangement                    | <b>8</b>          | <b>11.2</b>       | <b>11.1</b>       | <b>8.9</b>        | <b>12.6</b>       | <b>9.9</b>  | <b>9.4</b>  |

Source: IMF, Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) database 2014.

Note: <sup>1</sup> Includes 188 member countries and 3 territories: Aruba and Curacao and Sint Maarten (all in the Kingdom of the Netherlands) and Hong Kong SAR (China).

<sup>2</sup> As retroactively classified February 2, 2009; does not include Kosovo Tuvalu, and South Sudan, which became IMF members on June 29, 2009, June 24, 2010 and April 18, 2012, respectively.

<sup>3</sup> As retroactively classified February 2, 2009; does not include Kosovo Tuvalu, and South Sudan, which became IMF members on June 29, 2009, June 24, 2010 and April 18, 2012, respectively.

<sup>4</sup> As retroactively classified February 2, 2009; does not include Kosovo Tuvalu, and South Sudan, which became IMF members on June 29, 2009, June 24, 2010 and April 18, 2012, respectively.

<sup>5</sup> As retroactively classified February 2, 2009; does not include South Sudan, which became IMF members on April 18, 2012.

In figure 1, we present the distribution of the exchange rate arrangements within each category. The top left chart shows that almost 50% of *hard peggers* used the currency board as exchange rate arrangement. Such a regime requires the authorities to announce an official commitment to exchange domestic currency for a specified foreign currency at a fixed rate. This arrangement implies that domestic currency is usually fully-backed by foreign assets, eliminating therefore the traditional functions of the central bank such as monetary control and lender of last resort, and leaving little room for discretionary policies. The remaining 40% of the hard peg category adopted an exchange rate with no separate legal tender. In this case, the currency of another country circulates as the sole legal tender. Dollarization (Ecuador, El Salvador, Palau, Panama, etc.) and “Euroization” (Kosovo, Montenegro, etc.) are examples of this arrangement. This type of arrangement implies a complete surrender of

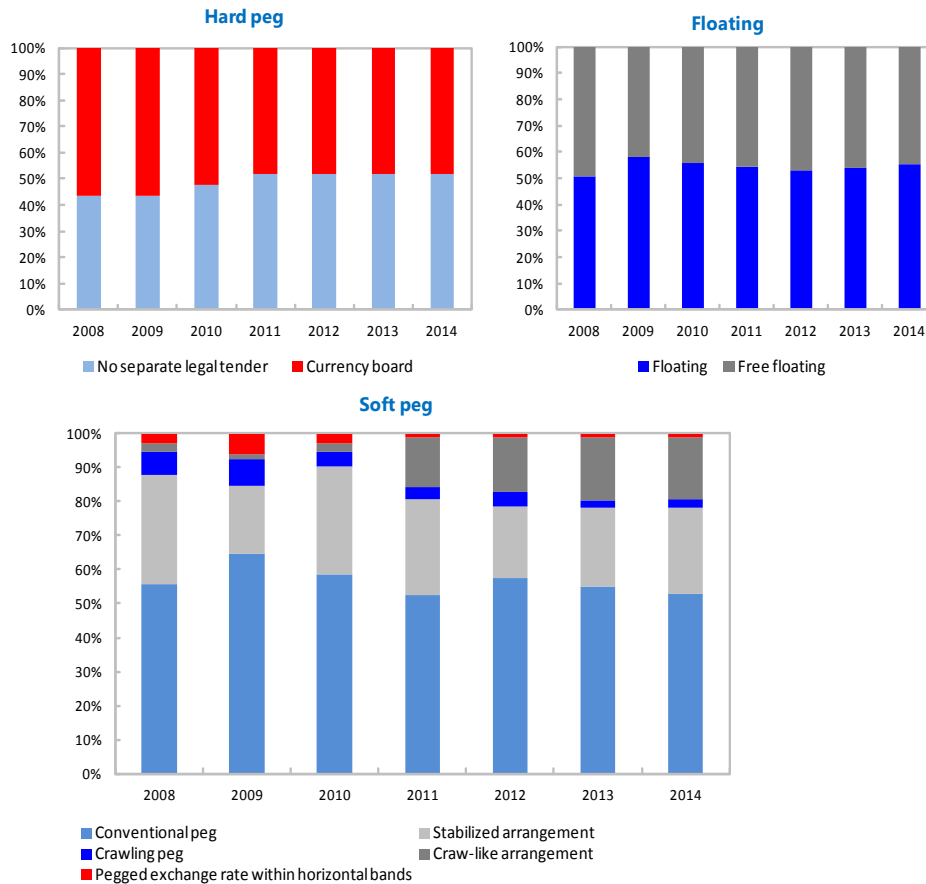
the monetary authorities control over domestic monetary policy. Notice that the share of currency borders is constantly decreasing since 2010 in favor of the latter arrangement.

The top right chart of figure 1 in turn describes the composition of the floating category. As for the precedent group, two main regimes can be listed here. Over the sample period, 50% of the floaters let their exchange rate to be fully determined by the exchange market. With this free-floating arrangement, authorities' intervention occurs only exceptionally and aims to address exchange market failures. The remaining 50% accounts for countries where the exchange rate is market-determined, but authorities may intervene either directly or indirectly to moderate the rate of changes or prevent undue fluctuations in the exchange rate.

The soft peg category, with its five types of exchange rate arrangements, is detailed in the bottom chart of figure 1. First, we distinguish countries that peg their exchange rate against anchor(s), but allows for a fluctuation band of at least  $\pm 1\%$  around a fixed central rate. A group of countries in the soft peg category adopted the crawling-peg. Countries involved in a *crawling-peg* arrangement adjust their exchange rate in small amounts at a fixed rate or in response to changes in selective indicators, such as past inflation differentials vis-à-vis major trading partners or differentials between the inflation targeted and expected inflation in major trading partners. The rate of crawl can be *backward looking* to generate inflation-adjusted changes in the exchange rate, or *forward looking*, i.e. set a predetermined fixed rate and/or below the projected inflation differentials. When the exchange rate is constrained to remain within a narrow margin of 2% relative to a statistically identified trend for at least six months, and the exchange rate arrangement cannot be considered as floating, then the IMF's classification identifies such arrangement as a *crawl-like arrangement*. Remark that these three types of regimes prevail in less than 20% of IMF member countries within the soft peg category. The major exchange rate arrangement, which shared more than 50% within the soft peg category is the *conventional peg*. This latter arrangement requires the countries to peg their exchange rate at a fixed rate to another currency or a basket of currencies of the major financial or trading partners. It also requires the authorities to maintain the fixed parity through direct intervention (purchase/sale of foreign exchanges in the market) or indirect intervention (exchange-rate-related use of interest rate policy, regulation of foreign exchange). However, there is no commitment to keep irrevocably the parity. Monetary

unions such as the CEMAC, the Euro Area and WAEMU are included in this arrangement, although the euro is considered to be freely floating vis-à-vis the major currencies.<sup>3</sup> Finally, *stabilized arrangement* accounts for roughly 25%-30% in this category. This type of arrangement entails a spot market exchange rate that remains within a margin of 2% for at least six months, but is not a floating arrangement. The required margin of stability can be met either with respect to a single currency or a basket of currencies.

Figure 1. Exchange Rate Arrangement 2008-2014



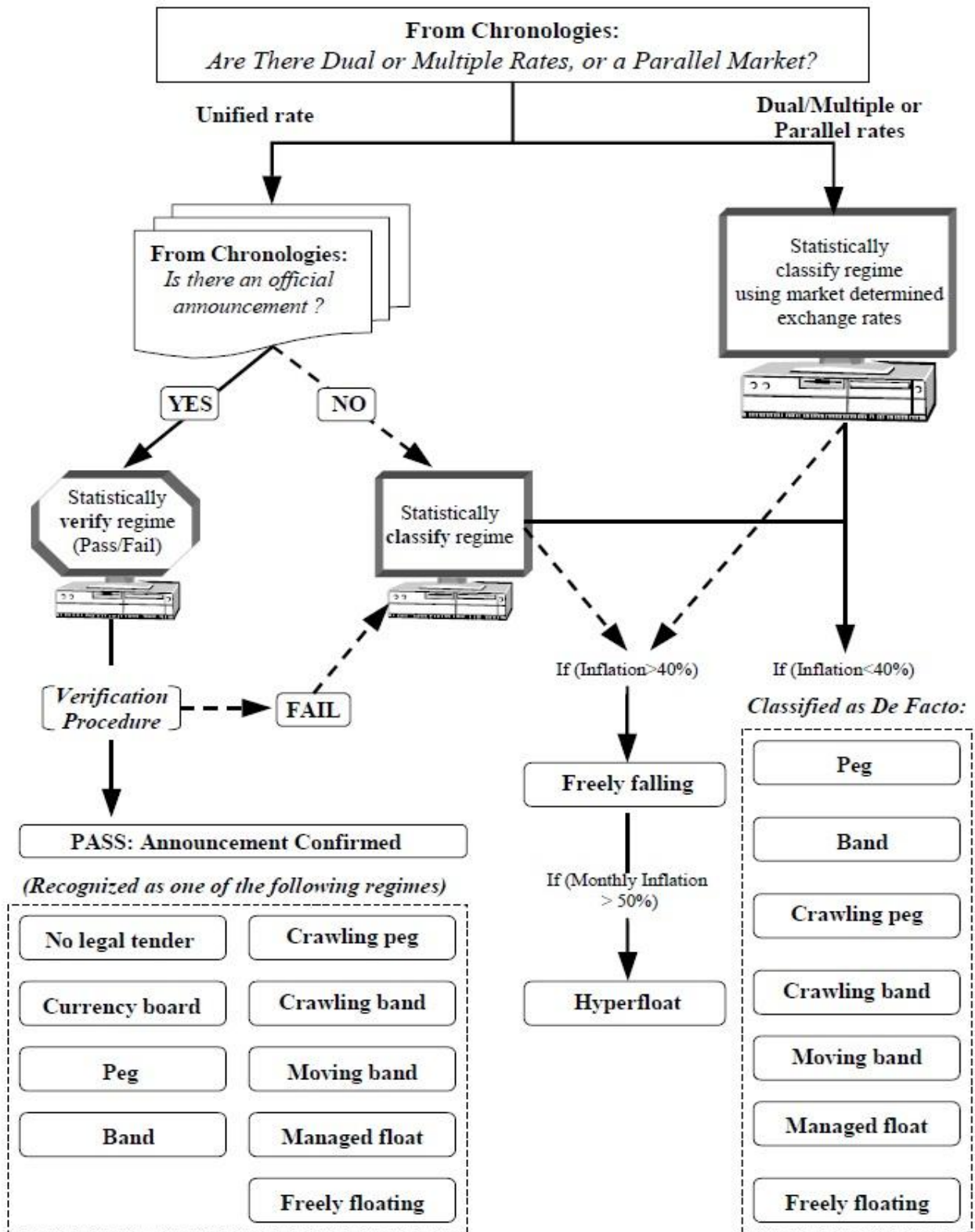
<sup>3</sup> CEMAC represents Central African countries sharing the CFA Franc as legal currency. It comprises Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, and Gabon, with the Central Bank for Central African States (BEAC) as the monetary authority. The Euro area comprises 19 countries sharing the same currency, the euro, introduced since 1999. The exhaustive list as of 2014 comprises: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Portugal, Slovenia, Slovakia and Spain. WAEMU represents West African countries (Benin, Burkina Faso, Cote d’Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo) sharing the same CFA Franc as the legal currency, with the BCEAO (Central Bank of West African State) responsible for implementing the exchange rate and monetary policy.

An alternative to the de facto classification of the IMF is the “*natural*” de facto classification developed by Reinhart and Rogoff (2002). The natural de facto classification builds upon an extensive database on market-determined or parallel exchange rates. This classification subdivided the exchange rate arrangements into seven regimes (*no legal tender, currency board, peg (crawling peg), band (crawling band), moving band, managed float and free floating*) and proceeds in three steps. First, it uses the chronologies to sort out countries with either official dual or multiple rates or active parallel (black) markets. Second, in the absence of dual or black market, it checks whether there exists an official pre-announced arrangement such as a peg or a band. If the announcement is consistent with the actual policy stance, then it is classified accordingly as a peg or a band. Otherwise, the classification uses a de facto coding algorithm, as described in figure 2 below. Third, in case of no official announcement, or a failure of the pre-announced path, the regime is then classified on the basis of the actual exchange rate behavior.

A noticeable difference with the IMF classification is that, this natural de facto classification includes a *freely falling* regime. This latter characterizes countries with twelve-month inflation rate above 40%. The *hyperfloat* regimes account for countries with 50% monthly inflation rate or more.

This de facto classification has the advantage of partially addressing the “fear of fixity” and “fear of floating” problems since, in some cases, it ends up re-coding pegged regimes as intermediate or floating, and vice versa. It also suggests that exchange rate arrangements matter for inflation, growth and trade. Recently Ilzetki et al., (2010) proposed a comprehensive database building upon the *natural de facto* classification scheme. This alternative classification is used throughout the first part to perform sensitivity analysis.

Figure 2. A Natural Exchange Rate Classification System



Source: Reinhart and Rogoff (2002)

The macroeconomic consequences of alternative exchange rate regimes have been thoroughly debated in the literature. On the theoretical ground, the traditional bipolar approach claimed that the corner regimes are safer than the intermediate regimes when it comes to prevent economic crises. Moreover, the optimum currency area theory argued that being in a monetary union might help countries promote trade, thanks to the stability of the exchange rate.<sup>4</sup> Empirical literature also flaunts the merits of fixed regime in delivering low inflation records, and credible monetary policy environment for private sector's forecasts (Ghosh *et al.* 1997 and Ghosh *et al.* 2002). On the other hand, flexible regimes are well known to have shock absorbing capacities, contrary to fixed regimes. Moreover, Klein and Shambaugh (2006) argued that pegged regimes exhibit greater bilateral exchange rate stability today and in the future. In the realm of trade, Rose (2000) and Klein and Shambaugh (2006) find that, currency unions and other fixed regimes stimulate trade. Benefits of pegged regimes are admittedly compelling, but without flexibility, external adjustment can be tough. In the context of macroeconomic stabilization, Shambaugh (2004) and Obstfeld *et al.* (2005) find that fixed exchange rates limit significantly monetary autonomy. Countries with pegged regimes lose the use of monetary policy as a stabilization tool. In the same line, Broda (2004) and Edwards and Levy-Yeyati (2005) find that exchange rate regime affects the transmission of terms of trade shocks. Trade imbalances are found to adjust significantly more slowly under both direct and indirect pegs than imbalances under floats. In addition, pegged regimes are considered to be crisis prone, though floating regimes are not immune.

All in all, there is important trade-offs in the choice of exchange rate regime. An ultimate stream of the recent literature points to the irrelevancy of exchange rate regimes, when it comes to contrasting macroeconomic performances (Obstfeld and Rogoff, 1998; Calvo and Reinhart, 2002; and Klein and Shambaugh 2006). This hypothesis is borne by the fact that several countries tend to deviate from their official announcements. The “*fear of fixity*” phenomenon, i.e. when countries officially announce to maintain a peg but do not act so causes the pegged regimes to be simply a mirage, but do not deliver the expected benefits. On the other side, the “*fear of floating*” phenomenon which states that floating regimes do not really float generates the conclusion that exchange rate regimes are, unimportant for general

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<sup>4</sup> See Rose (2000), Rose and Wincoop (2001), Persson (2001), and Alesina *et al.* (2002).



macroeconomic performances. These contrasting evidences on the impact of the exchange rate regimes calls for a re-examination of the common impression that, based on existing literature, exchange rate regimes are irrelevant.

Part I of this thesis consists of three chapters and reconsiders the role of exchange rate regimes in several aspects still subject to tight controversies or ignored by the existing literature so far. Chapter 1 explores the stabilizing property of exchange rate regimes in developing countries. The main hypothesis tested is whether the exchange rate regime at work influences the cyclical reaction of fiscal policy. The background idea is that the disciplinary effect of fixed exchange rate regimes may help reducing the overspending tendency of fiscal authorities especially in time of expansion. As a consequence, fixed regimes contribute to reduce the pro-cyclicality of fiscal policy in developing countries. Chapter 2 builds upon the existing controversies and the recent surge of the financial crisis, and reassesses the relevance of the bipolar hypothesis. This latter suggests that corner regimes (fixed or floating) are more immune to banking/financial, currency and debt crises. Chapter 3, in turn, is concerned with the interplay between exchange rate and tax policy. In the early 1990s, the trade liberalization process caused important resource loss for countries embarking on this reform. In the aftermath, countries tried to recover their resource loss through different channels, especially by shifting from international taxation (customs, trade taxes) to domestic taxation (VAT for example). The underlying hypothesis is that the VAT revenue levied in replacement to the international taxation are larger in countries with pegged regimes. *Peggings* give up the usage of seigniorage revenue and have to implement less border taxation to promote bilateral or intra-regional trade.

Before moving further away, two important remarks are worth considering. First, we give strong priority to the *de facto* classification when assessing the macroeconomic impact of exchange rate regimes. Although the *de jure* classification (*stated policy intentions of the monetary authorities*) emphasizes the importance of public pronouncements as a signal for private sector's expectations, difficulties arise in performances comparison based on this classification when the policy practices diverge from the official promises. The *de jure* classification based on country's policy statement is at best irrelevant and unhelpful at worst (IMF 2005). The *de facto* classification in turn has its own drawbacks, essentially the backward-looking nature. Nevertheless, several studies have suggested the use of the IMF and

IRR de facto classification (Rose, 2000; Klein and Shambaugh, 2006; and Ilzetzki *et al.*, 2010). In what follows we give deeper details on the usage of the alternative exchange rate regimes classifications at our disposal.

Second, this thesis is essentially empirical. Indeed, we recognize that theoretical approach offers several insights. However, it is very difficult to establish unambiguous relationships due to the abundance of possible linkages between the exchange rate regimes and macroeconomic performances. Therefore, the approach we adopted in this thesis is unabashedly empirical.

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# **CHAPTER 1:**

## **The Stabilizing Effect of Exchange Rate Regimes: An Empirical Investigation**

### **Abstract**

This chapter addresses the impact of exchange rate regimes on the cyclical aspect of fiscal policy, using a panel of developing countries over the period 1980-2007. We first show that fiscal policy is pro-cyclical in developing countries. Further, we find that the magnitude of pro-cyclicality is reduced for countries with pegged regimes, supporting the stabilizing effect hypothesis. However, the stabilizing effect is conditional to the measure of fiscal policy, as well as the classification of exchange rate regimes.

**Keywords:** cyclicity of fiscal policy, exchange rate regimes, stabilizing effect, generalized method of moments, developing countries.

## 1.1. Introduction

In the aftermath of the crisis, the debate among economists focused on how to prevent and/or face the detrimental effects of the crisis. Fiscal policy remains an important tool used to stem a deeper collapse of the global economy. It appears to be one the most effective policy instruments at the disposal of decision-makers. However, questions still linger regarding the stability of fiscal policy. The empirical literature thoroughly documents the various perspectives on this question. Keynesian theorists find that optimal fiscal policy should be counter-cyclical, while the Neo-classical view supports that fiscal policy has to be neutral or a-cyclical.<sup>5</sup>

A large body of work shows that fiscal policy in developing countries is pro-cyclical (Gavin and Perotti, 1997; Tornell and Lane, 1999; Talvi and Vegh, 2005; Thornton, 2008; and Diallo, 2009). Economists, generally, seem to support that pro-cyclicity can be harmful for economic activity in the sense that it may worsen economic fluctuations.<sup>6</sup> This pro-cyclicity also matters in terms of economic growth (Woo, 2006). The aforementioned authors find that pro-cyclicity can be mitigated by better access to international capital markets, less corruption, and stronger institutions. This chapter pursues this path of the literature and tests the hypothesis that stability of fiscal policy increases with the rigidity of the exchange rate regime (ERR).

The choice of an ERR remains of crucial importance and depends on countries' macroeconomic objectives. The post-Bretton Woods era in the early seventies was characterized by the free choice of ERR. The 90s witnessed the prevalence of the bipolar view consisting of choosing the corner solutions—*to peg or to float*—which seemed more workable and effective. Literature on the macroeconomic performance of alternative regimes is strongly controversial. While authors seem close to consensus on the fact that pegged regimes deliver better performance in terms of inflation, no consensus emerges regarding the growth performance of alternative regimes. Pegged regimes are considered to be *crisis-prone* after the episodes of numerous crises, even

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<sup>5</sup> Fiscal policy is considered to be pro-cyclical (counter-cyclical) if in case of recession, government reduces (increases) public expenditure. In the situation where fiscal policy evolves independently from the business cycle, it is seen as neutral or a-cyclical.

<sup>6</sup> However, in some situations pro-cyclicity might be desirable in a situation where fiscal multipliers are negative corresponding to a crowding out of private investments in case of fiscal expansion. Note that pro-cyclicity can also be seen as a “*second best*” optimum following Alesina *et al.* (2008).

though floating regimes are not spared.<sup>7</sup> Moreover, under pegged regimes, countries lose the use of monetary policy as a stabilization tool. This is highlighted by the well-known impossible trinity, which argues that there is no way for a country to experience a pegged regime combined with capital mobility and independent monetary policy.

Despite the striking disadvantages of pegged regimes, why do countries still adopt these (fixed) regimes? Our attempt is to analyze the consequences of ERR choice on the pro-cyclicality of fiscal policy. In other words, this chapter studies whether pegged regimes stabilize fiscal policy by reducing the magnitude of pro-cyclicality.

The rationale behind this stabilizing mechanism is attributable to the binding constraints imposed by pegged regimes. Such regimes contribute to reduce the tendency of fiscal authorities to overspend during booms (Ghosh *et al.*, 2010). In other words, pegged regimes tie the hands of policymakers, limiting their discretion and preventing them from conducting lax fiscal policy, resulting therefore in a more stable fiscal policy. However, the evidence on this issue is not clear-cut yet. Indeed, an influential strand of the literature suggests that pegged regimes are not discipline-enhancing and even less stabilizing (Schuknecht, 1999; Tornell and Velasco, 2000). More intriguing, Gavin and Perotti, 1997 and Kaminsky *et al.*, 2004, among others, find that neither pegged regimes nor flexible ones influence the cyclical behavior of fiscal policy. This chapter attempts to shed new light on the existing controversy relative to the effects of alternative regimes on the cyclical behavior of fiscal policy.

While the existing literature focuses on the level of fiscal variables, this chapter builds, rather, upon the cyclicity of fiscal policy. To the best of our knowledge, there are few papers analyzing the effect of alternative regimes on the cyclicity of fiscal policy (Ghosh *et al.*, 2010). This chapter extends the emerging literature and provides a more formal assessment of the relationship between ERR and cyclical fiscal policy.

The contribution of this chapter to the existing literature is threefold. First, we use various fiscal policy indicators. Second, in addition to the IMF's de jure and de facto classifications, we draw

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<sup>7</sup> Throughout the manuscript, the term “peggers” is used to describe countries that have a fixed exchange rate or peg the exchange rate against an anchor at a fixed rate. Likewise, floating and flexible regimes are used interchangeably to describe countries with freely floating regimes.

upon IRR's natural de facto classification within a composite sample of emerging market economies and low-income countries. We also tackle the crucial endogeneity problem relative to the choice of ERR, using the appropriate instrumental variable techniques. Our baseline estimations show that pegged regimes influence the cyclical behavior of fiscal policy by reducing the magnitude or even reversing the pro-cyclicality of fiscal policy. The stabilizing effect persists even when we operate an income level disaggregation within the sample. In addition, this stabilizing effect is more pronounced in low-income countries compared to other groups.

The rest of the chapter is organized as follows. Section 2 presents an overview of the related literature, while section 3 discusses the stabilizing mechanism of ERR. Section 4 details the empirical framework. Empirical findings and sensitivity analyses are detailed in section 5 and 6, respectively. Section 7 provides policy discussion before concluding.

## **1.2. Related literature**

This section broadly reviews the literature on fiscal policy and exchange rate regimes. As previously mentioned, the literature on the stabilizing effect of ER regimes is quite limited. Therefore, we focus on those papers that study the disciplinary effect of alternative regimes, as this latter effect seems closer to the stabilizing effect that we highlight here. If economists were widely in agreement regarding the cyclical properties of fiscal policy, results remain deeply controversial regarding exchange rate regime effects. While certain authors bring to the fore the disciplinary effects of fixed regimes, the so-called conventional wisdom, others support the opposite view that it is flexible regimes, rather than fixed, which are disciplinary. A third group emerges and argues that neither fixed regimes nor flexible ones are disciplinary and even less stabilizing. Such controversy seems to be perpetually renewed. We will, in turn, present the main streams of these three different views relative to the ER regimes' effects.

We proceed with those arguing that there is neither a significant disciplinary nor stabilizing effect. After addressing the cyclicity, Gavin and Perotti, in the late 90s, focused on ER regime effects on fiscal policy. They found that there is no significant relationship between fiscal policy and ER regimes. Contrary to conventional belief, fixed regimes are not disciplinary. In the same vein, Kaminsky *et al.* (2004) asked the question of whether the cyclical properties of



macroeconomic policy are different according to the ERR. Using the IRR natural de facto classification of regimes, they found that public expenditure behavior is not related to either regime.

Let us consider those advocating the disciplinary properties of fixed regimes. Conventionally, exchange rate-based stabilizations induce more discipline than money-based programs, in the sense that an exchange rate anchor imposes more macroeconomic discipline than do other anchors. This view is partly fueled by Canavan and Tommasi (1997). They use the theoretical Barro-Gordon model, with incomplete information, and show that serious stabilizers prefer more visible anchors, such as the nominal exchange rate. They take their study one step further and contend that, in some circumstances, stabilizers choose to fix the ER, even when fixing the ER has some costs. Moreover, Beetsma and Bovenberg (1998), through a theoretical paper, support that monetary unification reduces inflation, taxes, and public spending. These disciplining effects of monetary union become stronger as a union's membership increases. In the 2000s, Canzoneri *et al.* (2001) thought to distinguish Ricardian and Non-ricardian regimes. They found that under a Ricardian framework, ER regimes are disciplinary,<sup>8</sup> in the sense that a government respects its intertemporal fiscal constraint. Empirical studies also investigate the question with the same hypothesis that fixed regimes are disciplinary. Alberola *et al.* (2007) test the disciplinary effect of a fixed regime with a sample of emerging markets in the 90s. They found that announcing the peg has a deleterious effect on fiscal discipline. However, a de facto peg, which is not announced, delivers superior fiscal outcomes. They explain such phenomenon by the credibility shock produced by the announcement of the peg that makes the financing of the fiscal deficit less costly. Recently, Ghosh *et al.* (2010) show that fixed regimes have a disciplinary effect on fiscal policy. They point to the unsustainability of a pegged regime when government is money-financing the deficit. They also support that pegged regimes constrain the conduct of macroeconomic policy. Under such regimes, domestic monetary policy follows the anchor country's monetary policy. They qualify the pegged regimes as a double-edged sword: they are

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<sup>8</sup> Alberola and Molina (2004) showed that fixed regimes significantly reduce inflation and seignorage capacities. The combination of limited seignorage capacities and fiscal theory of price level justify the disciplinary effect of fixed regimes. However the link is somewhat weak. Ghosh *et al.* (2010) recently supported that pegged regimes impose sticky constraints in designing macroeconomic policies with monetary policy closely related to the anchor country.

useful for countries lacking institutional credibility and discipline but, by the same token, constrain the use of a stabilization tool, such as the interest rate, to offset the macroeconomic shocks that countries may face.

Lastly, few authors stand at odds with the conventional view and argue that fixed regimes are neither disciplinary nor stabilizing. On the theoretical side, Fatas and Rose (2001) document this issue and study the case of members of multilateral currency unions, dollarized countries, and currency boarders. They come to the conclusion that belonging to a currency area did not procure fiscal discipline. This non-disciplinary effect is especially pronounced for dollarized countries. Empirically, Tornell and Velasco (1995), analyzing the European and Sub-Saharan African countries' experience, strongly reject the conventional claim. They reach the same conclusion based on the Latin American experience in 1998. These authors support that under fixed regimes, bad behavior today (i.e. lax fiscal policy) leads to punishment in the future; however, under a floating regime, the costs of lax fiscal policy manifest themselves immediately. Therefore the difference lies on the inter-temporal distribution of the costs of lax fiscal policy. Under such a scenario, floating regimes, by forcing the cost to be paid up-front, provide more fiscal discipline. Therefore, the disciplinary effects of ERRs are conditional upon government behavior, in terms of lax fiscal policy costs. Schuknecht (1999), in line with these authors, tackles the question from the political angle. He supports that governments, in pre-election periods, increase public spending and run fiscal deficits in order to guarantee their re-election. Such expansionary policy is costless under a fixed regime with satisfactory foreign reserves. However, this behavior, *in fine*, results in devaluation (fall in foreign reserves and increasing indebtedness) and inflation. This raises doubts about the usefulness of fixed regimes to discipline the fiscal policy, in the sense that they ease government fiscal constraints, unless countries dispose a legal framework that constrains discretionary decisions. Flexible regimes considerably reduce the hope for fiscal stimulus, in that flexible regimes lead to inflation and depreciation, a situation that adversely affects government popularity. Alberola and Molina (2004) find a weak link between ERRs and fiscal discipline in emerging markets. They also demonstrate that fixing the ER offsets the disciplinary effects on fiscal policy by relaxing the constraints on a government's budget. Moreover, Duttagupta and Tolosa (2006) found, in turn, that a currency union as a fixed regime encourages over-spending and free-riding, unlike flexible regimes. Such behavior seems far from having a stabilizing effect.

Pegged regimes, by their institutional commitment, ensure the stability of the exchange rate. Based upon a three-way classification, Ghosh *et al.* (1997) document the macroeconomic performances of exchange rate regimes and show that fixed regimes are associated with lower exchange rate fluctuations, owing to the disciplinary effect of such regimes. This disciplinary effect is partly due to the political cost inherent in a collapse of the peg. However, their study was subject to several methodological criticisms from Edwards and Savastano (1998) and Mussa *et al.* (2000). First of all, Ghosh and co-authors did not take into account country-specific characteristics, such as capital mobility, country size, degree of integration, etc. To illustrate this, for example, one could argue that any correlation between inflation and exchange rate regime is only due to lax fiscal policies, rather than to the adoption of any particular regime. One other important issue is that the usage of only *de jure* classification rather than *de facto* can be misleading. Edwards *et al.* also criticized the hypothesis that regime choice is exogenous. They pointed out the reverse causality that arises from ER regime choice and macroeconomic performance. Levy-Yeyati and Sturzenegger (2005) argue that the use of fixed regimes is due to the credibility and discipline imposed on fiscal and monetary policy as well. However conflict with other objectives can be an obstacle to effectively supporting the peg. Yagci (2001) finds that fiscal discipline is positively related with a decline in flexibility. The following paragraph discusses the stabilizing mechanism and presents the hypothesis tested throughout the chapter.

To sum up, the literature related to ERR effects is quite sparse and does not provide clear-cut conclusions on this issue. Gavin and Perotti (1997), among others, show that ERRs are neither disciplinary nor stabilizing, whereas Ghosh *et al.* (1997) argue that fixed regimes are stabilizing regardless of the fiscal authorities' behavior and especially in developing countries. Tornell and Velasco (2000) support the opposite view. We present, in what follows, a discussion on the stabilizing effect of pegged regimes on the cyclical properties of fiscal policy and lay out the econometric model.

### **1.3. Theoretical background: the stabilizing mechanism of exchange rate regime**

The main purpose of adopting fixed regimes is that under such regimes fiscal and monetary policies are constrained, in the sense that lax fiscal or monetary policy leads, ultimately, to foreign reserves drying up and a collapse of the peg, which presents a huge political threat for

decision makers. Recently, the argument that fixed regimes are discipline-enhancing seems to be mitigated and called into question on theoretical and empirical grounds. In the early 2000s, Edwards (1997), Tornell and Velasco (2000), and Vuletin (2003) claimed that the disciplinary effect of fixed regimes is neither automatic nor guaranteed. The Mundell-Fleming framework predicts that, in the case of economic upturns, countries under fixed regimes limit public expenditure expansion, despite the fact that they have only one efficient policy tool. Therefore, an increase in public expenditure should be limited by way of the pro-cyclicality of fiscal policy.

We test whether fixed exchange rate regimes have stabilizing properties. The theory does not yet provide any clear reason why this would be so. The rationale behind such intuition is that governments under fixed regimes should act in accordance with their commitment and support the peg. In addition, with the loss of monetary policy, governments should also keep inflation down. Such scenarios tie the hands of fiscal authorities and force them to moderate public expenditure in order to deal with inflation levels. Moreover, authorities have a vested interest in supporting the pre-announced peg in order to avoid the political costs accompanying a collapse of the peg. The demise of the peg also undermines the credibility of the government on the international scene. As a consequence, the announcement of a fixed regime restrains the authorities from implementing lax fiscal policy. Cannavan and Tommasi (1997) explain the link between an ER anchor and discipline with a model assuming that the public can monitor the nominal ER more easily than it can do with the other variables. The ER is more visible than other anchors and, thus, provides a better barometer of the government's behavior. Private agents can gather and interpret information relative to this anchor. Therefore, pegging the exchange rate may have a stabilizing effect.

Our empirical work consists of answering the question whether ERR are stabilizing. The ensuing sections describe the econometric model and present the data and variables.

#### **1.4. Empirical framework**

To answer our research question we proceed with an econometric model that deals first with the cyclical reaction of fiscal policy, and further assesses the stabilizing property of ERR on the cyclicity of fiscal policy. To this end, we use the following specification:

$$F_{it} = \alpha + \beta F_{it-1} + \delta Y_{it}^* + \gamma_i (RC_{it} * Y_{it}^*) + \varphi_i RC_{it} + \sum_{k=1}^K \phi_k X_{kit} + \mu_{it}, \quad (1.1)$$

$$\text{with } \mu_{it} = \eta_i + \varepsilon_{it}. \quad (1.2)$$

$F_{it}$  corresponds to the fiscal policy variable of country  $i$  at time  $t$  and  $Y_{it}^*$ , the business cycle.  $X_{kit}$  is a set of controls,  $\eta_i$  is a dummy variable which allows us to isolate characteristics of each country, and  $\varepsilon_{it}$  is the error term. Including a lagged dependent variable allows for the measurement of inertia and provides information on the sustainability of fiscal policy. With such specification, cyclical properties of fiscal policy are seen through the coefficient  $\delta$ . The interpretation of the sign of the coefficient  $\delta$  depends on the variable used to measure fiscal policy. If one considers government public expenditure as the fiscal policy indicator, fiscal policy is considered to be pro-cyclical (counter-cyclical) if  $\delta > 0$  ( $< 0$ ) and statistically significant; otherwise, fiscal policy is a-cyclical or neutral. Our econometric model presents an interaction term,  $RC_{it} * Y_{it}^*$ , and a dummy variable,  $RC_{it}$ , which corresponds to the ERR of country  $i$  at time  $t$ . It takes the value 1 if the given country is under fixed (intermediate) regime and 0 otherwise. The floating regimes constitute our benchmark.

By deriving equation (1.1), we see that:

$$\frac{\partial F_{it}}{\partial Y_{it}^*} = \delta + \gamma_i RC_{it}. \quad (1.3)$$

Here, the cyclical property of fiscal policy is conditional upon the exchange rate regime. Let us assume that  $\theta$  is the cyclical property of fiscal policy under any ER regime, so  $\theta \equiv \delta + \gamma$ ; according to our hypothesis, we expect that  $\theta < \delta$ . This means that  $\gamma < 0$ . A negative sign of coefficient  $\gamma$  implies that a fixed (intermediate) regime reduces the magnitude of the cyclicity

of fiscal policy,  $\delta$ .<sup>9</sup> Recall that the coefficient  $\delta$  corresponds to the cyclical properties of fiscal policy under floating regimes. So, we can compare the effect of two different regimes (fix [intermediate] vs. floating) by just observing the coefficients  $\theta$  and  $\delta$ .

### 1.4.1. The data

Our study is conducted on a panel of 118 countries. According to the International Monetary Fund classification of countries regarding their level of development, we selected 30 emerging market economies and 88 low-income countries.<sup>10</sup> Our sample period extends from 1980 to 2007. The temporal horizon of our sample is limited by the availability of the data. The chapter focuses only on developing countries for two main reasons. First of all, the optimality of fiscal policy matters only in cases where fiscal policy is pro-cyclical. While the literature broadly supports that fiscal policy is pro-cyclical in developing countries, authors strongly show that this is not the case for developed countries. Fiscal policy in these latter countries is considered to be counter-cyclical or neutral (Talvi and Vegh, 2005; Aghion and Marinescu, 2007). Second, we aim to capture the effect of an exchange rate regime on the cyclical behavior of discretionary policy of fiscal authorities. Such considerations lead us to isolate the effects of automatic stabilizers,<sup>11</sup> which strongly influence the implementation of fiscal policy in developed countries. These effects are much less pronounced in developing countries. We define, below, the dependent variables, the variable of interest, and the controls used throughout the chapter.

Our dependent variable is fiscal policy. We rely on the overall fiscal balance as the fiscal policy indicator, as commonly used in the literature. In addition, we use government (current and capital) expenditure variables. These variables allow us to identify a composition effect in the reaction of the fiscal authorities to the business cycle. In order to disaggregate the response of fiscal authorities to the business cycle, we use government public expenditure and total

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<sup>9</sup> This interpretation holds only if the fiscal policy variable is the public expenditure. The effect of alternative regimes manifests differently if one considers the fiscal balance or government revenue as fiscal policy variables. This specification is discussed in deeper details in the ensuing sections.

<sup>10</sup> The list of countries is provided in Appendix A.1.

<sup>11</sup> According to Budnevich (2001), automatic stabilizers are those elements of fiscal policy that tend to mitigate output fluctuations (affecting demand by reducing taxes and increasing government spending during a recession) without any explicit government actions. Progressive income taxes, value added tax, taxes on corporate profits, and unemployment premiums and benefits may play the role of automatic stabilizers.

revenue.<sup>12</sup> All three of these variables are expressed in percent of GDP. To capture the fact that fiscal authorities use discretionary fiscal policy to target short-run fluctuations, it seems more appropriate to extract the short-run component of fiscal policy. Then, we use the first difference to proxy the discretionary response of fiscal authorities to short-run fluctuations.<sup>13</sup> We also use the real changes in government public expenditure as the dependent variable. A logical question can arise here regarding the use of this particular variable. The usage of this variable flows from criticisms found in Kaminsky *et al.* (2004). These authors support that variables such as the fiscal balance or fiscal revenue should be considered as results of fiscal policy rather than instruments, unlike public expenditure or tax rates. If government would like to influence economic activity, it modifies its expenditure program or changes tax rates. Such effects are reflected in tax revenue and fiscal balance. As a consequence, fiscal authorities cannot directly use these latter two variables as policy tools. Moreover, considering the fiscal variable as a proportion of GDP (as is most often the case in the literature) could yield misleading interpretations, in the sense that the cyclical behavior of the fiscal variable may (or may not) be dominated by the cyclical behavior of output.<sup>14</sup> However, to dismiss any suspicion of subjective or irrational choice, we conduct several robustness checks with alternative fiscal variables.

The main explanatory variables here are the interactive variables, which combine the output gap and the ER regimes (*Output gap\*Fixed* and *Output gap\*Intermediate*). We use the *de jure* and *de facto* classifications taken from the IMF as well as the IRR natural *de facto* classification. The choice of the IMF *de facto* classification is justified by the fact that it relies not only on ER movements but also on monetary policy frameworks and authorities' formal or informal policy intentions with data on actual ER and reserves. It is also known as a hybrid classification. RR classification is also particular in the sense that it separates episodes of severe macroeconomic stress and incorporates information on dual/parallel market ER. It distinguishes regimes that are "freely falling"<sup>15</sup> as a separate category and use movements of dual/parallel market ER

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<sup>12</sup> In the best-case scenario, we would use the tax rates, as in Talvi and Vegh (2005), but were constrained by data availability.

<sup>13</sup> By "first differencing" the fiscal variables, we hit two targets with one bullet. In addition in isolating the long-run components, we also avoid the non-stationarity problem. Econometric tests are implemented to confirm this.

<sup>14</sup> See Kaminsky *et al.* (2004) for further details.

<sup>15</sup> This category is excluded from the regressions.

movements to classify the regime. It also uses a five-year horizon to gauge the true flexibility of the longer-term ER regime.

Table 1.1 displays the distribution of ERR throughout. The most frequent regimes in developing countries are the hard- and soft-pegged regimes, i.e., fixed and intermediate regimes; floating regimes cover less than a fourth of the available observations. Considering RR natural classification, the prevalence of pegged regimes persists. However, the floating regime covers almost 15% of the observations.

**Table 1.1: Alternative classifications of exchange rate regimes (IMF and RR)**

|                     | IMF classification |            |                 |            | Reinhart and Rogoff (2004) |            |
|---------------------|--------------------|------------|-----------------|------------|----------------------------|------------|
|                     | <i>De jure</i>     | (%)        | <i>De facto</i> | (%)        | <i>Freq.</i>               | (%)        |
| <b>Fixed</b>        | 1232               | 38.8       | 1522            | 47.6       | 900                        | 33.1       |
| <b>Intermediate</b> | 1337               | 42.1       | 1388            | 43.5       | 1408                       | 51.8       |
| <b>Floating</b>     | 608                | 19.1       | 284             | 8.9        | 410                        | 15.1       |
| <b>Total</b>        | <b>3177</b>        | <b>100</b> | <b>3194</b>     | <b>100</b> | <b>2718</b>                | <b>100</b> |

Source: Author.

As an explanatory variable, the output gap (OG) allows us to measure the business cycle. Using the Hodrick Prescott (HP) filter<sup>16</sup> applied to the real growth rate of GDP, we obtain the GDP trend. The OG is defined as the difference between the real GDP growth rate and its trend. We include a set of control variables,<sup>17</sup> often used in the literature to isolate the effect of ERR on the cyclical features of fiscal policy. The lagged dependent variable ( $FP_{t-1}$ ) captures the inertia in the reaction of fiscal policy, and measures, to some extent, the sustainability of fiscal policy. *Inflation* measures the changes in the consumer price index and allows to isolate any nominal variation in our dependent and interest variables. To limit the effects of hyperinflation episodes,

<sup>16</sup> Given that we use annual data, the smoothing parameter is set to  $\lambda = 100$ . In our robustness checks, the smoothing parameter is set to 6.25, as shown by Ravn and Uhlig (2002). Note that the HP filter is subject to several criticisms, especially due to the arbitrary choice of the smoothing parameter and the fact that it disregards the structural breakdowns. Moreover, the literature points out the instability of the filter due to its symmetric design. Despite these criticisms, this filter is commonly used throughout the literature (Agenor *et al.*, 1999; Stein, 1999; Talvi and Vegh, 2005 and Guillaumont-Jeanneney and Tapsoba, 2011). The alternatives methods (Band-Pass filter implemented by Baxter and King) are not spared from criticism.

<sup>17</sup> Detailed descriptive statistics are given in Appendix A.2.



we compute a modified inflation index.<sup>18</sup> GDP per capita (*GDP pc*) controls for fiscal policy behavior that depends on the level of development. The vulnerability of developing countries to external shocks and the sensitivity of fiscal policy to external conditions are accounted for using an indicator of trade openness (*Open*), computed as the ratio of imports and exports over GDP. Moreover, the recent literature shows that workers' remittances (*Remittances*) influence the path of government public consumption, even though those funds are remitted directly to households. Public authorities may indirectly benefit from these funds through taxation, and considerably reduce the amounts devoted to public services, such as education and health, with the expectation that households will fill the gap.<sup>19</sup> The expected sign of the remittances depends on the fiscal policy variable. It is also important to control for aid flows (*Aid*), owing to our sample composition. The majority of in-sample countries are referred to as aid receivers and these flows strongly impact the authorities' decisions in designing fiscal policy. Additional crucial element in fiscal authorities' decision making is the level of public debt ( $P.debt_{(t)}$ ).<sup>20</sup> Effects of public debt on fiscal policy are not clear-cut, though. We also control for natural resource rents (*Natural\_res*), which can be taken as an alternative source of financing, especially for developing countries. Natural resources can affect the behavior of fiscal authorities in terms of public expenditure and/or tax collection. One could assume that, in the presence of natural resources, governments increase public expenditure and public investment, whereas others contend that the presence of natural resources contributes to the weakening of social stability. In this context, governments prefer to capture the windfall from resource revenue, and reduce public expenditure. Our model also controls for the political environment, through the variable democracy (*Democ*), coded 1 if a given country rules under a democratic system, and 0 otherwise. Political concerns may influence the business cycle and the reaction of fiscal authorities can be guided by political ideology rather than economic rationale. Except for inflation and democracy variables, all other controls are log-transformed. The ensuing sections present our estimation strategies and econometric results.

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<sup>18</sup> The modified index of inflation is taken from Guillaumont-Jeanneney and Tapsoba (2011). It is computed as follows:  $\pi' = \pi / (1 + \pi)$  with  $\pi$  being the inflation rate and  $\pi'$  the modified inflation index.

<sup>19</sup> Ebeke (2012) concluded that authorities of poorly governed countries tend to reduce the level of public spending in social sectors such as education and health.

<sup>20</sup> As in Guillaumont-Jeanneney and Tapsoba (2011), and knowing that current fiscal policy is constrained by the outstanding debt stock, this variable is introduced with one-time lag.

### **1.4.2. Estimation strategies**

Equation (1.1) contrasts the effects of fixed regimes (intermediate regimes) with those of the flexible regime. Using the classical estimator as the ordinary least squares or fixed effects lead undoubtedly to biased coefficients due to the endogeneity problem. In fact, one can argue that the choice of any ERR depends on the macroeconomic performances of the given regimes rather than the reverse, inducing a reverse causality. Countries that have higher inflation tend to have floating regimes due to the need of adjustment of the ER. Consequently, the regime choice is not exogenous. This reverse causality creates an endogeneity bias (Edwards and Savastano, 1998; Mussa *et al.* 2000; Levy-Yeyati *et al.* 2010; and Berdiev *et al.* 2011 ). In addition, as pointed out by Rogoff *et al.* 2004, the harmful effects of a regime can be observed only when it collapses, leading the misattribution of the poor performances to the successor regimes. In this context lagged ERR appears to be a good instrument of the present regime. One could also be doubtful about the exogeneity of the output gap. Since the fiscal stance can influence the business cycle, we shall instrument the ERR variable as well as the output gap.

The appropriate instrumental variable estimator appears to be the generalized method of moments (GMM). We give priority to the GMM-system estimator, but for robustness purposes we present estimates with the GMM-difference estimator.

## **1.5. Empirical findings**

This section discusses the estimation results of the effect of ERR on the pro-cyclicality of fiscal policy. Initially, we present results of the global effect of alternative regimes and further disaggregate the observed effect using the fine classification of ERR.

### **1.5.1. The stabilizing effect of exchange rate regimes**

We contrast the effects of fixed and intermediate regimes with those of flexible regimes. Table 1.2 displays our baseline results. Estimations are made using the IMF *de facto* classification of ERR.<sup>21</sup>

First, we notice that the coefficient of the lagged dependent variable appears statistically significant with a negative sign, meaning the actual fiscal stance is constrained by the lagged fiscal stance. This is consistent with Aghion and Marinescu (2007) and Ben Slimane and Ben Tahar (2010). A one percentage point increase in the lagged fiscal balance leads to a 0.28 to 0.33 percentage point reduction in the actual balance. The significance of the lagged dependent variable validates the inertia of fiscal policy.

**Table 1.2: Effect of exchange rate regime on the cyclicity of fiscal policy**

*Dependent Variable: Overall fiscal balance*

|                          | GMM difference |                | GMM system     |                 |
|--------------------------|----------------|----------------|----------------|-----------------|
|                          | Pegged         | Intermediate   | Pegged         | Intermediate    |
|                          | (1)            | (2)            | (3)            | (4)             |
| OFB <sub>(-1)</sub>      | -0.284***      | -0.333***      | -0.293***      | -0.327***       |
|                          | (5.10)         | (6.81)         | (6.63)         | (6.27)          |
| Output gap (OG)          | <b>-20.28*</b> | <b>5.138*</b>  | <b>-13.32*</b> | <b>3.868*</b>   |
|                          | (1.86)         | (1.74)         | (1.85)         | (1.74)          |
| <b>OG × Pegged</b>       | <b>31.63*</b>  |                | <b>21.75*</b>  |                 |
|                          | (1.80)         |                | (1.86)         |                 |
| <b>OG × Intermediate</b> |                | <b>-20.83*</b> |                | <b>-15.44**</b> |
|                          |                | (1.91)         |                | (2.42)          |
| Controls                 | Yes            | Yes            | Yes            | Yes             |
| Obs. (countries)         | 1518 (95)      | 1518 (95)      | 1615 (97)      | 1615 (97)       |
| AR (1) p-value           | 0.086          | 0.084          | 0.035          | 0.023           |
| AR (2)                   | 0.272          | 0.177          | 0.285          | 0.244           |
| Hansen                   | 0.551          | 0.206          | 0.315          | 0.474           |
| Time dummies             | Yes            | Yes            | Yes            | Yes             |
| Instruments              | 69             | 69             | 82             | 82              |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets. All GMM estimators include temporary dummies. Following Roodman (2006), instruments are limited in order to avoid the over-fitting problem. All control variables are considered as predetermined. Given the fact that GMM estimators are implemented in two steps, we apply the Windmeijer (2005) correction to obtain robust standard errors.

<sup>21</sup> Estimations made with the IMF *de jure* classification display quite different results from those presented here. Following Edwards and Savastano, (1999) and Rogoff *et al.*, (2004), we do not report *de jure*-based estimates. These authors support that *de jure* classification leads to misleading statistical inference and a wrong interpretation of the effects of ERR.

The sign of the output gap coefficient allows us to see whether fiscal policy is pro- or counter-cyclical. The dependent variable—overall fiscal balance—corresponds to the difference between revenue and expenditure. In the whole sample, the average of the dependent variable, i.e., the first difference of overall fiscal balance, displays a positive sign, meaning that countries experience fiscal surplus. In this context, the interpretation of the output gap coefficient changes. A negative sign of the output gap coefficient unusually means that fiscal policy is pro-cyclical. Given that the output gap is log-transformed, the estimated coefficient should be interpreted as semi-elasticity. A 1% increase in the output gap leads to a decrease in the fiscal stance of at least 0.13 pp of GDP. This result can be taken as follows: a positive output gap (a situation where real GDP exceeds potential GDP, identified as economic expansion) worsens the fiscal stance. In other words, in times of expansion, fiscal authorities increase public expenditure and/or reduce taxes and hence revenue. We do not spend time interpreting the coefficients of the intermediate regime that displays the counter-cyclical behavior of fiscal policy.

Our coefficient of interest is the interactive variable. We remind that, according to the econometric specification (i.e., the flexible regime used as reference), the coefficient of the OG describes the behavior of fiscal policy for countries under flexible regimes. Therefore, we can compare the effects of alternative regimes by simply contrasting the OG coefficient (flexible regime) with that of the interactive variable (pegged regimes). This latter coefficient is positive and statistically significant. The positive sign of the coefficient of the interactive variable means that the pro-cyclicity of fiscal policy is mitigated in the context of a fixed regime. This result matches the expected stabilizing effect of pegged regimes and is consistent with Ghosh *et al.* (2010). In fact, there is a stabilizing effect of pegged regimes compared to the flexible ones. Countries under pegged regimes show a pro-cyclicity coefficient of 8.43 (-13.3+21.7), if one considers the system-GMM estimator. This means that the presence of a pegged regime strongly reduces the magnitude of pro-cyclicity and even turns it into counter-cyclicity. This coefficient should be interpreted as follows. Under a pegged regime, a 1% increase in the output gap increases the fiscal stance—surplus—by 0.8 pp of GDP. We discuss further and in greater detail the fiscal response of the government in terms of discretionary policies by increasing fiscal

revenue or reducing expenditure in good times.<sup>22</sup> According to the above discussion on the stabilizing mechanism of the ER regime, countries under a pegged regime restrain their incentive to overspend during booms in order to avoid the rapid growth of money and inflation, which would threaten the peg. This can also be explained by the fact that, under pegged regimes, countries should not have adequate or even any room to monetize the debt. Given that, authorities tend to monitor money growth in order to hold down inflation pressures that represent a major threat to the peg and deal with moderate level of fiscal deficit.

In Table 1.3 below, control variables are introduced separately. Columns (1) to (8) introduce successively control variables. Except for column (6), we see that the coefficient of the interactive variable remains positive and statistically significant. The stabilizing effect of pegged regimes persists regardless of the control variables included in the model.

As seen before, a possible explanation for the stabilizing effect flows from the idea that pegged regimes tie the hands of fiscal authorities, who are committed to support a peg. They, therefore, strongly limit the expansion of public expenditure, especially in an economic boom, to hold down inflation pressures, following the rise of public expenditure. Note that this stabilizing effect makes sense only where fiscal policy is pro-cyclical.

The stabilizing effect persists even when we separate the sample according to income level. It is more pronounced in low-income countries (28.2 pp of GDP) compared to the sample excluding the BRICs<sup>23</sup> (22.1 pp of GDP). This effect persists even when the East and Central Asian countries are excluded from the sample (20.3 pp of GDP).

Another important feature of this chapter is that it goes further than just contrasting the three-way coarse classification (Pegged, Intermediate and Flexible). In what follows, we use the fine classification of ERRs to see which regimes are more stabilizing between the pegs and

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<sup>22</sup> The term “good times” refers to economic expansion or economic boom as used by Kaminsky *et al.* (2004), a situation where the real GDP growth rate is above its median during a five to ten year calculation; otherwise, the economy is considered to be in “bad times.”

<sup>23</sup> Estimations results excluding BRICs (Brazil, Russia, India and China) and the ECA (East and Central Asia) countries are presented in Appendix A.4.

intermediates. We aim to measure the extent to which the different categories of regimes included in the group of hard pegs are constraining.<sup>24</sup>

**Table 1.3: Effect of ERR on the pro-cyclicality: by controls**

| <i>Dependent Variable: OFB (% GDP)</i> |                          |                         |                         |                         |                         |                     |                         |                         |
|--|--------------------------|-------------------------|-------------------------|-------------------------|-------------------------|---------------------|-------------------------|-------------------------|
|  | (1)                      | (2)                     | (3)                     | (4)                     | (5)                     | (6)                 | (7)                     | (8)                     |
| OFB <sub>(-1)</sub>                    | -0.271***<br>(4.51)      | -0.270***<br>(4.03)     | -0.236***<br>(2.62)     | -0.269***<br>(3.92)     | -0.259***<br>(3.33)     | -0.292***<br>(4.38) | -0.248***<br>(4.30)     | -0.258***<br>(3.35)     |
| OG                                     | <b>-9.109*</b><br>(1.72) | -0.453<br>(0.12)        | -7.034<br>(1.39)        | -5.652<br>(1.52)        | -2.436<br>(0.77)        | -3.749<br>(1.01)    | -3.443<br>(1.18)        | -4.405<br>(1.21)        |
| <b>OG xPegged</b>                      | <b>18.65*</b><br>(1.86)  | <b>16.34*</b><br>(1.69) | <b>28.84*</b><br>(1.79) | <b>21.10*</b><br>(1.82) | <b>21.34*</b><br>(1.70) | 15.89<br>(1.58)     | <b>22.22*</b><br>(1.95) | <b>24.22*</b><br>(1.86) |
| GDP pc                                 | -0.0267<br>(0.01)        |                         |                         |                         |                         |                     |                         |                         |
| Inflation                              |                          | 1.835<br>(1.45)         |                         |                         |                         |                     |                         |                         |
| P. debt                                |                          |                         | 2.622<br>(0.26)         |                         |                         |                     |                         |                         |
| Aid                                    |                          |                         |                         | 2.662<br>(0.50)         |                         |                     |                         |                         |
| Openness                               |                          |                         |                         |                         | -26.23<br>(1.14)        |                     |                         |                         |
| Remittances                            |                          |                         |                         |                         |                         | -0.527<br>(0.32)    |                         |                         |
| Natural res.                           |                          |                         |                         |                         |                         |                     | -1.402<br>(0.37)        |                         |
| Democracy                              |                          |                         |                         |                         |                         |                     |                         | -10.18<br>(1.13)        |
| Obs (countries)                        | 2526 (114)               | 2248 (110)              | 2314 (113)              | 2417 (114)              | 2526 (114)              | 2066 (109)          | 2331 (107)              | 2525 (114)              |
| AR1 (p-value)                          | 0.029                    | 0.082                   | 0.099                   | 0.060                   | 0.091                   | 0.091               | 0.085                   | 0.089                   |
| AR2 (p-value)                          | 0.256                    | 0.194                   | 0.84                    | 0.405                   | 0.491                   | 0.509               | 0.405                   | 0.56                    |
| Hansen                                 | 0.188                    | 0.024                   | 0.325                   | 0.028                   | 0.107                   | 0.23                | 0.004                   | 0.052                   |
| Time dummies                           | Yes                      | Yes                     | Yes                     | Yes                     | Yes                     | Yes                 | Yes                     | Yes                     |
| Instruments                            | 61                       | 61                      | 61                      | 61                      | 61                      | 61                  | 61                      | 61                      |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets.

## The case of hard pegs

In addition to the coarse classification, the IMF makes a fine classification of the ER regimes. This latter classification includes different types of regimes. The hard pegs or fixed regimes are grouped according to the following arrangements:

<sup>24</sup> The same exercise is done for intermediate regimes. None of the arrangements comprising the soft peg group display a statistically significant coefficient. We fail to identify any significant relationship between the intermediate regimes and pro-cyclicality. No stabilizing effect exists for this type of regime.

- Countries which adopt another currency as legal tender (AC)
- The currency union (CU)
- Currency boards (CB)
- The economic and monetary unions (EMU)
- Countries with conventional fixed peg (CP)

Previous estimation results showed that fixed or *hard pegged* regimes are stabilizing. Here, we disaggregate the fixed regimes into five different fixed arrangements and compare the effect of each of them within the hard peg group. We use the same specification as the previous estimations and exchange the dummy variable of the coarse classification ER regimes for the fine classification. To test the mechanism in question, we generate five dummy variables for each arrangement included in the hard peg group. As with our previous estimations, we build an interactive variable with output gap and each of the five dummies previously generated. Therefore, the variable *Another currency* is an interaction between the output gap and the dummy variable that takes the value 1 if the country adopts another currency as legal tender and 0 otherwise. The remaining interactive variables (*Currency union*, *Currency board*, *Economic and Monetary union* and *Conventional peg*) are built using the same process. All of these specifications include control variables. The question here is whether there exist any significant differences within the hard peg. Results are presented in Table 1.4.

First, we find that the stabilizing effect does not hold for all types of fixed arrangements. Our estimation results show that the coefficients of *Another currency* and *Conventional pegs* are positive, though only the latter is statistically significant. Thus, the stabilizing effect is effective only for countries under a conventional pegged arrangement.

Another important consideration is that the estimated coefficient of the stabilizing effect is greater than those obtained above with the coarse classification ( $34.5 > 21.7$ ). The fact that only one type of arrangement within the hard pegs displays stabilizing properties is due to the specific features of each type of arrangement per se. Among the hard pegs, the adoption of another currency as legal tender, along with the currency board and currency union, turn out to be the most constraining arrangements in the eyes of decision-makers. Countries under fixed arrangements cannot use the nominal ER to face external shocks. As one might know, under

such arrangements, monetary authorities relinquish independence of monetary policy and import the monetary policy of the issuing countries. The need for authorities to rely more on fiscal policy to deal with internal imbalances or face external shocks might outpace the advantages of fixing the ER, in terms of credibility and stability. Considering the economic and monetary union arrangements, the absence of any significant stabilizing effect can be justified by the behavior of the union member countries. Economic and monetary unions are characterized by important cross-country interactions, qualified as positive or negative externalities. The ongoing economic situation prevailing in the European monetary union clearly describes the detrimental effects that can arise from a poorly-managed union. The compulsory reaction of good performers in assisting bad performers to support the peg leads implicitly to free riding behavior, a moral hazard problem among the union members. Thus, the trade-off shifts in favor of the conventional peg arrangements. Countries benefit from the “signaling effect” of a pegged regime that helps to ensure the credibility of monetary authorities. This latter arrangement is not fully stringent, in the sense that there is no commitment to keep the parity irrevocably. Authorities limit their use of fiscal policy but, instead, adopt a policy mix to better handle the economy vis-à-vis the business cycle.



**Table 1.4: Effect of ERR on the pro-cyclicality: within pegged regimes**

|                        | ACL                    | CB                  | CU                  | EMU                 | CP                       |
|------------------------|------------------------|---------------------|---------------------|---------------------|--------------------------|
|                        | (1)                    | (2)                 | (3)                 | (4)                 | (5)                      |
| OFB <sub>(-1)</sub>    | -0.329***<br>(6.63)    | -0.327***<br>(6.88) | -0.329***<br>(6.66) | -0.327***<br>(6.50) | -0.209***<br>(2.60)      |
| OG                     | 0.27<br>(0.93)         | 0.895<br>(1.04)     | 0.289<br>(1.00)     | 0.773<br>(1.26)     | <b>-5.880*</b><br>(1.75) |
| Another currency (ACL) | <b>0.039</b><br>(0.04) |                     |                     |                     |                          |
| Currency Board (CB)    |                        | -1.555<br>(0.92)    |                     |                     |                          |
| Currency Union (CU)    |                        |                     | -1.607<br>(0.66)    |                     |                          |
| Econ. Mon union (EMU)  |                        |                     |                     | -20.78<br>(0.72)    |                          |
| Conventional peg (CP)  |                        |                     |                     |                     | <b>34.53**</b><br>(2.02) |
| Controls               | Yes                    | Yes                 | Yes                 | Yes                 | Yes                      |
| Obs. (countries)       | 1615 (97)              | 1615 (97)           | 1615 (97)           | 1615 (97)           | 1615 (97)                |
| AR1 (p-value)          | 0.125                  | 0.12                | 0.125               | 0.077               | 0.04                     |
| AR2 (p-value)          | 0.19                   | 0.192               | 0.19                | 0.222               | 0.419                    |
| Hansen                 | 0.008                  | 0.003               | 0.008               | 0.004               | 0.332                    |
| Time dummies           | Yes                    | Yes                 | Yes                 | Yes                 | Yes                      |
| Instruments            | 82                     | 82                  | 82                  | 81                  | 82                       |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets.

## 1.6. Sensitivity analysis

We proceed by implementing a range of sensitivity analyses, in order to gauge how robust our estimation results are. For this purpose, two different approaches are used. First, we modify the fiscal policy indicator. Instead of the overall fiscal balance, we rely on general government consumption expenditure and total government revenue. Second, rather than the IMF *de facto* classification, we make use of the natural *de facto* classification developed by IRR (2010). We test the same hypothesis that the stability of fiscal policy increases with the rigidity of the ERR. GMM estimators are used in order to obtain correct estimations. Results relative to these modifications are presented below.

### 1.6.1. Changing the fiscal policy indicator

Here, we use two novel dependent variables: general government consumption expenditure and the total government revenue. These two variables are considered to be the main components of the fiscal balance. So, disaggregating our former measure of fiscal policy—*fiscal balance*—answers the following question: to what extent do governments use these two policy tools in designing discrete fiscal reactions to short-run fluctuations.

Table 1.5 below describes the results obtained using total government revenue as fiscal policy variable. Except for the lagged dependent variable, none of the remaining variables is statistically significant. We notice that coefficients of the output gap variable, with negative sign, suggest pro-cyclicality of fiscal policy (columns 1 and 3). The positive sign of the coefficients of interactive variables confirm the stabilizing effect of pegged and intermediate regimes. However these coefficients are not statistically significant.

**Table 1.5: Effect of ERR on the pro-cyclicality**

*Dependent Variable: Government Total Revenue (% GDP)*

|                          | GMM difference |               | GMM system    |               |
|--------------------------|----------------|---------------|---------------|---------------|
|                          | (1)            | (2)           | (3)           | (4)           |
| OFB <sub>(-1)</sub>      | -0.0852**      | -0.0836**     | -0.195***     | -0.188***     |
|                          | (2.26)         | (2.25)        | (2.69)        | (2.85)        |
| Output gap (OG)          | <b>-0.213</b>  | <b>0.0518</b> | <b>-0.237</b> | <b>0.0224</b> |
|                          | (0.89)         | (0.32)        | (1.26)        | (0.20)        |
| <b>OG × Pegged</b>       | <b>0.381</b>   |               | <b>0.412</b>  |               |
|                          | (0.99)         |               | (1.48)        |               |
| <b>OG × Intermediate</b> |                | <b>-0.005</b> |               | <b>0.070</b>  |
|                          |                | (0.01)        |               | (0.15)        |
| Controls                 | Yes            | Yes           | Yes           | Yes           |
| Obs. (countries)         | 869 (88)       | 869 (88)      | 961 (92)      | 961 (92)      |
| AR1 (p-value)            | 0.001          | 0.000         | 0.004         | 0.003         |
| AR2 (p-value)            | 0.138          | 0.117         | 0.137         | 0.133         |
| Hansen                   | 0.767          | 0.6           | 0.549         | 0.267         |
| Time dummies             | Yes            | Yes           | Yes           | Yes           |
| Instruments              | 69             | 69            | 82            | 82            |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets.

In Table 1.6, we focus on government public expenditure. We identify three different measures. Columns (1) and (2) refer to government consumption expenditure expressed as a percentage of

GDP as the dependent variable, while columns (3) and (4) use the government expenditure devoted to capital formation as the fiscal policy variable. This variable is a proxy of the amount of public investment. In the remaining columns, [5] and [6], the dependent variable used to gauge fiscal policy refers to the real changes in government consumption expenditure,<sup>25</sup> i.e., the growth rate of public expenditure. This latter variable is log-transformed. The estimation results confirm the inertia of the fiscal policy, with coefficients of lagged dependent variables statistically different from zero. Regarding cyclicity, we see that the output gap coefficient is positive and statistically significant. This means that fiscal policy measured through government expenditure is pro-cyclical. A positive output gap, i.e. an economic expansion, leads to an increase in public expenditure. Pro-cyclicity is not observed for specifications (5) and (6).

**Table 1.6: Effect of ERR on the pro-cyclicity: a composition effect**

*Dependent Variable: Government Expenditure*

|                          | Government consumption (%GDP) |                     | Gross capital formation<br>(% GDP) |                     | Government expenditure<br>(real changes in %) |                        |
|--------------------------|-------------------------------|---------------------|------------------------------------|---------------------|---|------------------------|
|                          | (1)                           | (2)                 | (3)                                | (4)                 | (5)   | (6)                    |
| OFB <sub>(-1)</sub>      | -0.160***<br>(2.92)           | -0.150***<br>(2.94) | -0.166***<br>(3.14)                | -0.176***<br>(3.42) | 0.187***<br>(3.28)                            | 0.188***<br>(3.05)     |
| Output gap (OG)          | <b>0.191**</b><br>(2.08)      | -0.117**<br>(2.43)  | <b>0.521***</b><br>(2.94)          | -0.058<br>(0.54)    | 0.057<br>(1.00)                               | -0.018<br>(1.02)       |
| <b>OG × Pegged</b>       | <b>-0.374***</b><br>(2.69)    |                     | <b>-0.482*</b><br>(1.92)           |                     | <b>-0.076</b><br>(0.98)                       |                        |
| <b>OG × Intermediate</b> |                               | 0.284*<br>(1.91)    |                                    | 0.951***<br>(2.72)  |   | <b>0.097</b><br>(1.00) |
| Controls                 | Yes                           | Yes                 | Yes                                | Yes                 | Yes   | Yes                    |
| Obs. (countries)         | 1725 (98)                     | 1725 (98)           | 1719 (98)                          | 1719 (98)           | 690 (77)                                      | 690 (77)               |
| AR1 (p-value)            | 0.000                         | 0.000               | 0.000                              | 0.000               | 0.000   | 0.000                  |
| AR2 (p-value)            | 0.903                         | 0.898               | 0.633                              | 0.793               | 0.782   | 0.791                  |
| Hansen                   | 0.512                         | 0.341               | 0.179                              | 0.334               | 0.96  | 0.948                  |
| Time dummies             | Yes                           | Yes                 | Yes                                | Yes                 | Yes   | Yes                    |
| Instruments              | 82                            | 82                  | 82                                 | 82                  | 60  | 60                     |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets.

<sup>25</sup> This choice flows from Kaminsky *et al.* (2004). These authors criticize the usage of the fiscal variable expressed over the GDP, in the sense that the evolution of the ration can be influenced by the evolution of the GDP *per se*. Also, Thornton, in his explanation of pro-cyclicity of fiscal policy in African countries, used also the growth rate of public expenditure expressed in logarithm.

Table 1.6 also shows that pegged regimes are stabilizing. The coefficients of the interactive variable are negative and statistically significant. The pro-cyclicality of fiscal policy is mitigated for countries under pegged regimes. If one considers government current expenditure (column (1)), the cyclical coefficient of fiscal policy is -0.18 (0.19-0.34).

Pro-cyclicality of fiscal policy (0.19) is strongly mitigated and even turned into counter-cyclicality (-0.18) for countries under pegged regimes. Regarding investment expenditure (column 3), the cyclical coefficient is 0.04 (0.52-0.48). Pro-cyclicality is also mitigated with the coefficient, which varies from 0.52 to 0.04. However, we note any reversal effect, as is the case for current expenditure.<sup>26</sup> Considering government consumption growth rates (columns (5) and (6)), none of the interactive variables is statistically significant. Thus, there is no stabilizing effect of pegged regimes if the measurement of fiscal policy is based upon the real changes in public expenditure.

### **1.6.2. Alternative exchange rate regime classification: the case of Ilzetzi Reinhart and Rogoff (2010)**

As additional robustness check, we estimate our models using the IRR (2010) natural *de facto* classification of ERRs. We test the hypothesis that the stability of an ERR increases with the rigidity of the peg. In so doing, we estimate the previous model, where the overall fiscal balance is taken as the dependent variable using the GMM estimator. Table 1.7 below presents the detailed results.

As previously shown, the lagged dependent variable remains statistically significant and negatively correlated with the dependent variable, results which confirm the inertia of fiscal policy. However, the remaining results seem quite intriguing.

In fact, Table 1.7 also shows that the output gap coefficients are no longer significant, except for column (1) where the positive sign of the coefficient suggests a counter-cyclical fiscal policy. Moreover, we see through this table that the coefficients of interactive variables do not match the expected positive sign, as in our previous estimations in Tables 1.2 and 1.3. These results seem

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<sup>26</sup> The term “reversal effect” is used to describe a fiscal policy behavior that turns from being pro-cyclical to countercyclical.

quite intriguing for two main reasons. On the one hand, the counter-cyclicality suggested here by the robustness is at odds with the literature on fiscal policy. On the other hand, the negative sign and the non-significant coefficients of the interactive variable reject the hypothesis that the stability of fiscal policy increases with the rigidity of the regime.

**Table 1.7: Effect of ERR on the pro-cyclicality: changing the ERR variable**

*Dependent Variable: Overall fiscal balance*

|                          | Reinhart and Rogoff classification |                 |            |                |
|--------------------------|------------------------------------|-----------------|------------|----------------|
|                          | GMM difference                     |                 | GMM system |                |
|                          | (1)                                | (2)             | (3)        | (4)            |
| OFB <sub>(-1)</sub>      | -0.355***                          | -0.320***       | -0.342***  | -0.295***      |
|                          | (5.12)                             | (6.49)          | (5.21)     | (6.80)         |
| Output gap (OG)          | <b>10.22*</b>                      | 4.962           | 4.95       | 3.599          |
|                          | (1.85)                             | (1.61)          | (1.49)     | (1.44)         |
| <b>OG × Pegged</b>       | <b>-18.73*</b>                     |                 | -9.288     |                |
|                          | (1.91)                             |                 | (1.46)     |                |
| <b>OG × Intermediate</b> |                                    | <b>-19.06**</b> |            | <b>-13.87*</b> |
|                          |                                    | (2.02)          |            | (1.93)         |
| Controls                 | Yes                                | Yes             | Yes        | Yes            |
| N. obs (countries)       | 1367 (89)                          | 1367 (89)       | 1458 (91)  | 1458 (91)      |
| AR 1 p-value             | 0.080                              | 0.064           | 0.056      | 0.027          |
| AR 2                     | 0.125                              | 0.236           | 0.176      | 0.284          |
| Hansen                   | 0.196                              | 0.43            | 0.18       | 0.339          |
| Time dummies             | Yes                                | Yes             | Yes        | Yes            |
| Instruments              | 69                                 | 69              | 82         | 82             |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets.

In summary, the link between the ERR and the cyclical behavior of the fiscal policy seems weak. Table 1.7 shows that the stabilizing effect is sensitive to the fiscal policy variable, as well as to the classification of the ERR.

## 1.7. Conclusion

This chapter tested the hypothesis that the stability of fiscal policy increases with the rigidity of the ERR. The study is conducted within a wide panel of emerging market economies and low-income countries over the period 1980-2008. Our baseline estimations show that pegged regimes influence the cyclical behavior of fiscal policy in the sense that they reduce or even reverse the magnitude of fiscal policy pro-cyclicality. This conclusion seems consistent with Ghosh *et al.*

(2010). Further, we measure the extent to which pegged regimes constrain the discretionary actions of fiscal authorities. We find that the stabilizing effect is not generalizable to all types of pegged regimes. Within the hard pegs, the stabilizing effect is solely observable for countries with a conventional peg arrangement. The rationale of such a stabilizing mechanism is that countries with pegged regime reduce their tendency to overspend during booms in order to avoid the rapid growth of money and inflation pressures that would threaten the peg. This can also be explained by the limited room for debt monetization under fixed regimes. As a consequence, hard pegs tie the hands of policymakers by preventing them from conducting lax fiscal policy. The sensitivity analyses showed that the two main components of the fiscal balance are used differently by the authorities. Government expenditure seems more sensitive to the business cycle than revenue. In reaction to output fluctuations, fiscal authorities tend to reduce expenditure in order to stabilize fiscal policy rather than increasing government revenue.

In light of these results, the following policy implications can be drawn. First, pegging the exchange rate or adopting a fixed regime seems a credible tool for stabilizing fiscal policy. However, such policy measures should be taken carefully. On the one hand, adopting a pegged regime requires the candidate to strike the right balance between surrendering the privilege of monetary actions to the anchor country, and the signaling benefits of fixed regimes. On the other hand, and more fundamentally, the nexus between ERRs and the cyclical behavior of fiscal policy—*the stabilizing effect*—seems weak. Robustness analyses have shown that the stabilizing effect does not persist once the regime classification is changed. Moreover, we fail to identify any influential effect of ERRs when alternative fiscal policy indicators are used. These conclusions cast doubts on the hypothesis that pegged ERRs are stabilizing. The link between an ERR and the cyclical behavior of fiscal policy is not automatic but conditional upon the inter-temporal distribution of the costs of lax fiscal policy among the alternative regimes.

## Appendices A

### Appendix A.1: List of countries

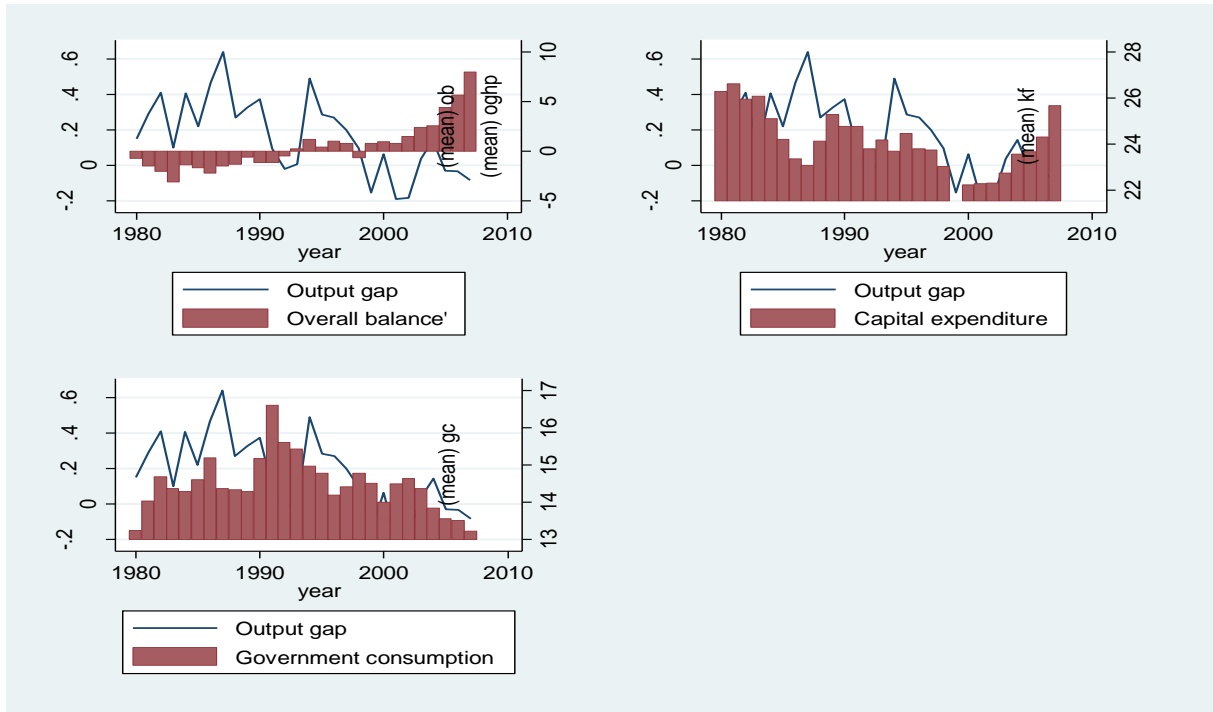
**Emerging Markets:** Albania, Algeria, Argentina, Bolivia, Brazil, Bulgaria, Chili, China, Egypt, Hungary, India, Indonesia, Iran, I.R. of, Kenya, Kuwait, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Tunisia, Turkey, United Arab Emirates, Vietnam.

**Low Income Countries:** Angola, Antigua and Barbuda, Bahamas, The, Bahrain, Bangladesh, Barbados, Belize, Benin, Bhutan, Botswana, Brunei Darussalam, Burkina Faso, Burundi, Cambodia, Cameroon, Cape Verde, Central African R., Chad, Columbia, Comoros, Congo D.R. of, Congo R., Costa Rica, Côte d'Ivoire, Djibouti, Dominica, Dominican R., Ecuador, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, The, Ghana, Grenada, Guatemala, Guinea, Guinea Bissau, Guyana, Haiti, Honduras, Jamaica, Jordan, Lesotho, Liban, Liberia, Madagascar, Malawi, Mali, Malta, Mauritania, Mongolia, Mozambique, Namibia, Nepal, Nicaragua, Niger, Oman, Panama, Papua New Guinea, Paraguay, Peru, Romania, Rwanda, Senegal, Seychelles, Sierra Leone, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent, Sudan, Suriname, Swaziland, Syria, Tanzania, Togo, Tonga, Trinidad and Tobago, Uganda, Uruguay, Vanuatu, Venezuela, R.B. of, Yemen, Zambia, Zimbabwe.

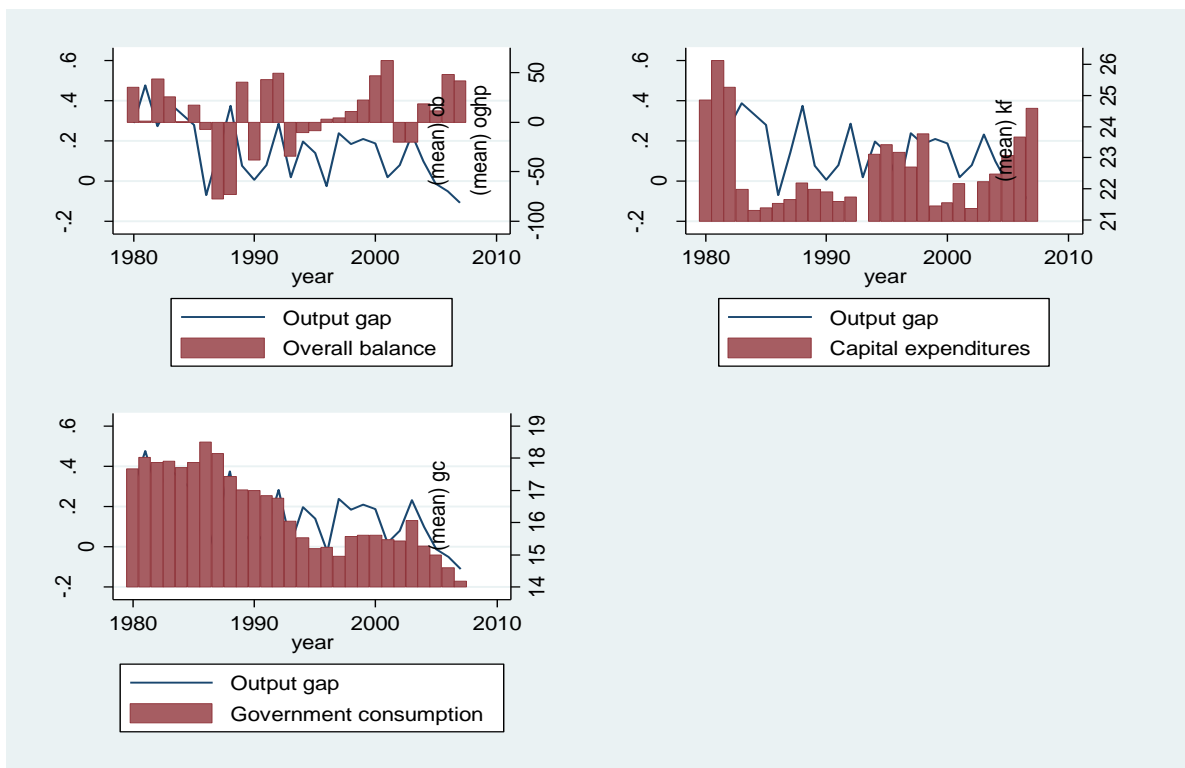
### Appendix A.2: Descriptive statistics

| Variable                          | Obs  | Mean     | Std. Dev. | Min      | Max     |
|-----------------------------------|------|----------|-----------|----------|---------|
| Growth                            | 3304 | 3.427    | 6.209     | -51.031  | 106.28  |
| Democracy                         | 3272 | .398     | .489      | 0        | 1       |
| Output gap                        | 3304 | 4.14e-10 | 4.371     | -46.730  | 79.038  |
| Output gap 1                      | 3304 | 4.08e-09 | 5.130     | -51.276  | 93.942  |
| $\Delta$ (Overall FB)             | 2677 | .478     | 40.522    | -811.378 | 717.515 |
| Log GDP pc                        | 3304 | 7.251    | 1.348     | 3.496    | 10.940  |
| Public deb <sub>(t-1)</sub>       | 2862 | 4.013    | .8072     | -1.145   | 7.646   |
| Log aid                           | 3063 | .889     | 2.054     | -7.564   | 5.122   |
| Log openness                      | 3273 | 4.166    | .584      | 2.167    | 5.898   |
| Log remittances                   | 2409 | .111     | 2.053     | -10.452  | 4.574   |
| Log natural res.                  | 2976 | 1.360    | 1.652     | -6.778   | 4.448   |
| Inflation                         | 2775 | .879     | 3.024     | -26.019  | 146.313 |
| $\Delta$ (Revenue)                | 1652 | .162     | 4.839     | -43.132  | 42.464  |
| Gov. consumption <sub>(t-1)</sub> | 1581 | 1.567    | 1.081     | -4.475   | 4.421   |
| $\Delta$ (Gov. consumption)       | 2959 | -.064    | 3.161     | -63.006  | 63.406  |

### Appendix A.3.1: Evolution of output gap and fiscal policy variables Emerging market economies



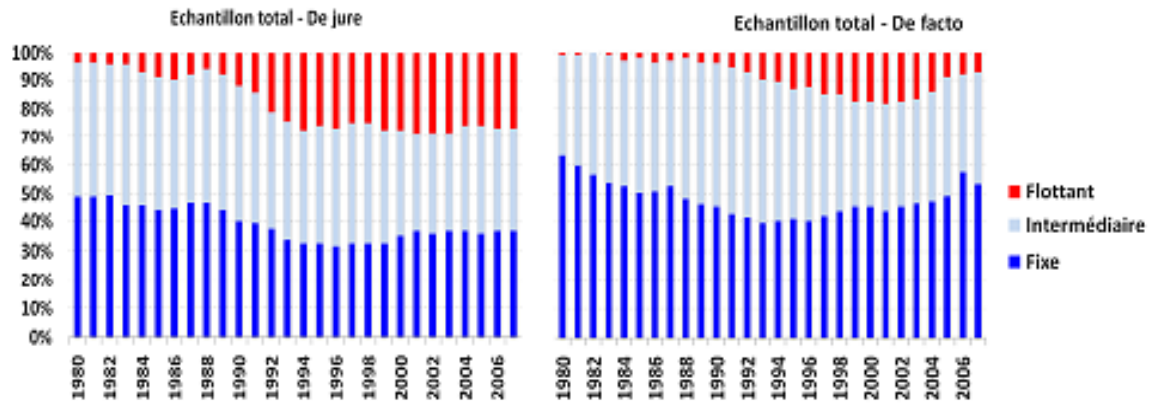
### Low income countries



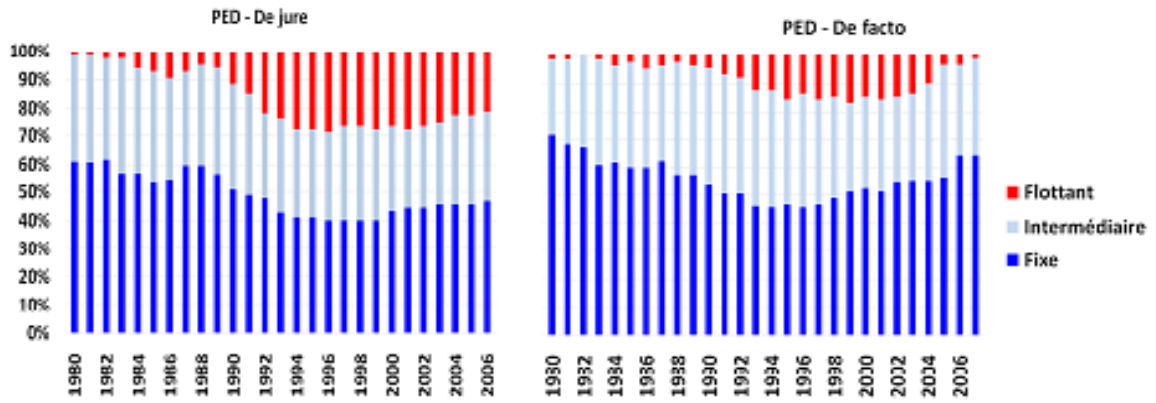


### Appendix A.3.2: Evolution of the exchange rate regimes

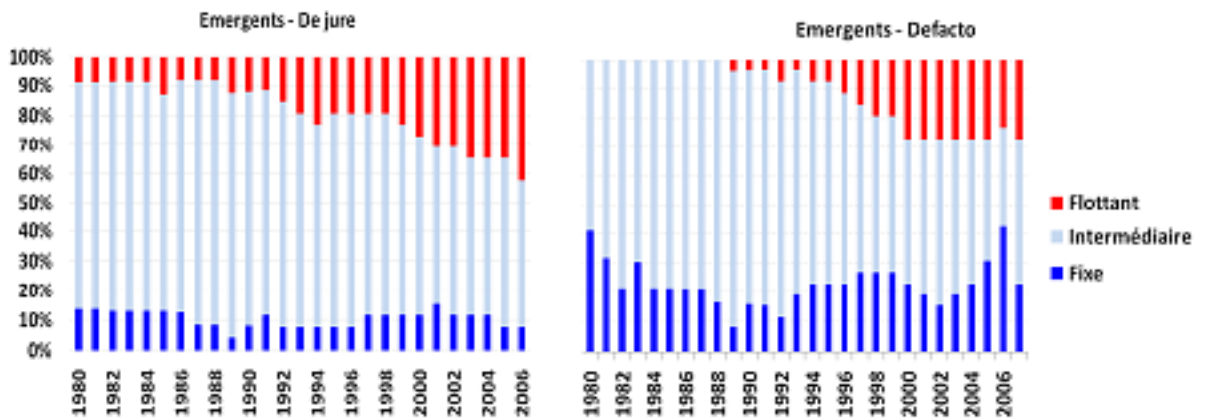
All countries



Low income countries (LIC)



Emerging market economies (EME)



## Appendix A.4: Further robustness checks

**Table A.4:** GMM-system estimates of the effect of ERR on the pro-cyclicality, excluding BRICs and ECA

|                          | LIC <sup>¥</sup>         |                         | Excluding BRIC <sup>§</sup> |                          | Excluding ECA <sup>‡</sup> |                          |
|--------------------------|--------------------------|-------------------------|-----------------------------|--------------------------|----------------------------|--------------------------|
|                          | (1)                      | (2)                     | (3)                         | (4)                      | (5)                        | (6)                      |
| OFB <sub>(-1)</sub>      | -0.297***<br>(6.53)      | -0.336***<br>(6.82)     | -0.292***<br>(6.45)         | -0.331***<br>(6.74)      | -0.297***<br>(7.04)        | -0.333***<br>(6.81)      |
| Output gap (OG)          | <b>-20.63*</b><br>(1.79) | <b>5.780*</b><br>(1.75) | <b>-13.81*</b><br>(1.81)    | <b>4.869*</b><br>(1.68)  | <b>-12.83*</b><br>(1.79)   | <b>5.138*</b><br>(1.74)  |
| <b>OG_Pegged</b>         | <b>28.24*</b><br>(1.77)  |                         | <b>22.14*</b><br>(1.85)     |                          | <b>20.31*</b><br>(1.84)    |                          |
| <b>OG_Intermediate</b>   |                          | -29.06**<br>(2.00)      |                             | <b>-20.60*</b><br>(1.86) |                            | <b>-20.83*</b><br>(1.91) |
| GDP <sub>pc</sub>        | -7.002<br>(0.12)         | -31.25<br>(0.49)        | 12.22<br>(1.05)             | -93.03<br>(1.13)         | 13.97<br>(0.95)            | -64.16<br>(0.93)         |
| Aid                      | 15.45<br>(1.33)          | 18.94<br>(1.39)         | 10.19<br>(1.33)             | 15.34<br>(1.54)          | 9.533<br>(1.32)            | 15.4<br>(1.55)           |
| Openness                 | 44.5<br>(1.22)           | 30.33<br>(0.98)         | 10.13<br>(0.80)             | 36.71<br>(1.35)          | 14.69<br>(1.15)            | 36.88<br>(1.44)          |
| Remittances              | -9.04<br>(1.19)          | -2.234<br>(0.40)        | -3.951<br>(1.24)            | -7.383<br>(1.28)         | -3.55<br>(1.18)            | -6.114<br>(1.18)         |
| Natural res.             | -5.167<br>(0.49)         | -15.83<br>(1.25)        | -5.351<br>(1.02)            | -8.323<br>(0.91)         | -5.139<br>(1.13)           | -9.076<br>(0.98)         |
| P. debt                  | 37.31<br>(1.52)          | 7.278<br>(0.45)         | 10.36<br>(0.93)             | 10.23<br>(0.91)          | 10.73<br>(1.06)            | 10.8<br>(0.99)           |
| Inflation                | 1.019<br>(1.58)          | 0.744*<br>(1.68)        | 1.094<br>(1.57)             | 0.557<br>(1.57)          | 0.98<br>(1.56)             | 0.612<br>(1.64)          |
| Democracy                | -5.466<br>(0.17)         | 12.86<br>(0.47)         | -20.95<br>(1.52)            | -13.8<br>(0.66)          | -16.87<br>(1.48)           | -4.745<br>(0.25)         |
| Observations             | 1071                     | 1071                    | 1555                        | 1462                     | 1528                       | 1518                     |
| Countries                | 68                       | 68                      | 93                          | 91                       | 90                         | 95                       |
| AR 1 ( <i>p-value</i> )  | 0.093                    | 0.074                   | 0.035                       | 0.089                    | 0.028                      | 0.084                    |
| AR 2 ( <i>p-value</i> )  | 0.183                    | 0.24                    | 0.300                       | 0.177                    | 0.27                       | 0.177                    |
| Hansen ( <i>pvalue</i> ) | 0.412                    | 0.536                   | 0.396                       | 0.234                    | 0.44                       | 0.206                    |
| Time dummies             | Yes                      | Yes                     | Yes                         | Yes                      | Yes                        | Yes                      |
| Instruments              | 69                       | 69                      | 82                          | 69                       | 82                         | 69                       |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with t-statistic in brackets.

<sup>¥</sup> Low Income Countries.<sup>§</sup> Brazil, Russia India and China.<sup>‡</sup> East and Central Asia.

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## **CHAPTER 2:**

# **Crises and Exchange Rate Regimes: Time to Break Down the Bipolar View?**

### **Abstract**

We revisit the link between crises and exchange rate regimes. Using a panel of 90 developed and developing countries over the period 1980-2009, we find that the corner regimes—*to peg or to float*—are not less vulnerable to crises (banking, currency and debt) compared to intermediate exchange rate regimes. Consequently, we clearly break down the traditional bipolar view: countries that aim at preventing crisis episodes should focus less on the choice of the exchange rate regimes, and instead, implement sound macro-financial policies.

**Keywords:** exchange rate regimes, economic crises, bipolar view.

## 2.1. Introduction

The choice of an exchange rate regime (ERR) has been so far the foremost battleground between the advocates of the exchange rate stability and those supporting the capacity of the exchange rate policy to handle real shocks. Up until the beginning of the 70s, a traditional view widely conveyed by the Bretton Woods monetary arrangements defended pegged regimes as the most workable exchange arrangement for promoting macroeconomic performance, including a low volatility of the exchange rate. The collapse of the Bretton Woods system and the emergence of several intermediate arrangements revived the issue relative to the choice of the appropriate ERR, all the more that the resurgence of crisis episodes revealed the vulnerability of hard pegs.<sup>27</sup> As pointed out by Fisher (2001), the virulence of East Asia and Latin American crises shifted the balance toward the choice of more flexible exchange rate systems. In addition, the worldwide feature of the recent crisis, irrespective of countries' ERR, tends to mitigate the vision relative to the safety of corner solutions compared to intermediated ERR, regarding the surge of crises. Consequently, one might reasonably ask if the choice of the ERR really matters for the incidence of crises, and moreover which ERR is more or less vulnerable to crises.

Although these questions were tackled already, the existing contributions failed to reach a consensus on the vulnerability of alternative ERR to crises. On the one hand, a major strand of the literature (see below; see also Fisher, 2001, for a survey) argues that extreme (fixed or floating) regimes are disciplinary, while intermediate regimes are crisis-prone, i.e. the well-known *bipolar view*, establishing a formal link between the ERR and the probability of crisis. On the other hand, several influential papers, including Burnside et al., (2001, 2004), support that fixed regimes are, by construction, vulnerable to speculative attacks and particularly sensitive to banking and currency crises.

Building upon this growing and controversial literature, this chapter aims at exploring the choice of the appropriate ERR when it comes to gauging crises. First, we shed a fresh light on the stark controversy that plagues the literature relative to the crisis proneness of alternative

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<sup>27</sup> The crisis episodes in Mexico (1994), Thailand, Indonesia, and Korea (1997), Russia and Brazil (1998), Ecuador (1999), and Turkey (2000), led to the perception that adjustable fixed ERRs are inherently fragile and crisis-prone (see, for example, Fischer 2001; Ghosh *et al.*, 2002). In addition, following the collapse of Argentina's Currency Board, the stability of hard pegs has been equally questioned (see, for example, Fisher, 2001).

ERR; to this end, we begin by contrasting the proponents and the critics of the bipolar view. Second, using a panel of developed and developing countries over the period 1980-2009, we conduct a systematic analysis of the vulnerability of the exchange rate regimes to different types of crises, namely banking, currency and debt crises, by properly accounting for different control variables for each type of crisis.

Our results are the following. First, our baseline estimations show that intermediate ERR are not more vulnerable to banking or currency crises than pegged or floating regimes. Consequently, these findings clearly break down the bipolar view that intermediate regimes are systematically more vulnerable to banking or currency crises. Second, we explore, for the first time to the best of our knowledge, the proneness of alternative ERR to sovereign debt crises. Our findings do not emphasize a significant difference between corner and floating ERR in terms of their vulnerability to debt crises, contradicting, once again, the bipolar view. Third, we show that our results are robust to a wide set of tests, namely (i) when taking into account the contagion effects between crises, (ii) when splitting the sample according to the level of economic development or the time period; (iii) when performing estimations with alternative methods; (iv) when controlling for different variables or (v) when using alternative definitions for the ERR or (vi) alternative databases for the main variables, namely ERR and crises.

The remainder of the chapter is organized as follows. Section 2 reviews the related literature on the link between ERR and crises surge, Section 3 presents the econometric strategy and the data, Section 4 emphasizes and discusses our main results, Section 5 performs a wide robustness analysis, and Section 6 concludes.

## **2.2. Literature review**

The literature on crises experienced a particular development starting the 80's, following several episodes of currency crises in Latin American and Asian economies. The abundant theoretical literature focusing on the determinants of currency crises (see the well-known contributions of Krugman, 1979, Obstfeld, 1986, and Chang and Velasco, 2000, for first, second, and respectively third-generation models of currency crises) fueled a more recent empirical literature illustrating a wider perspective of crises.

If we stick to the relation between the exchange rate regime (ERR) and the likelihood of crises, several authors, including Arteta and Eichengreen (2000), Aghion *et al.* (2001) or

Stiglitz (2002) conclude to the absence of any effect of ERR on crises.<sup>28</sup> Moreover, Esaka (2010a, b) and Asici (2011) do not establish a clear ranking of ERR, but instead assert that the appropriateness of the chosen regime depends on structural characteristics of each country.

**Table 2.1: The literature on crises and ERR**

| Authors                                   | Type of crisis                   | Data features                                 | Results   | Analysis                 |
|---|----------------------------------|---|---|--------------------------|
| <b>The proponents of the bipolar view</b> |                                  |   |   |                          |
| Eichengreen <i>et al.</i> (1994)          | Speculative attacks              | 1967-1992, 22 countries, mostly OECD          | IR are more prone to banking crises   | Empirical                |
| Domac and Peria (2000)                    | Banking crisis with dummy        | 1980-1997, developed and developing countries | Fixed ER diminish the likelihood of crisis  | Empirical                |
| Mendis (2002)                             | Banking crisis with crisis dummy | Developing economies                          | Flexible regimes reduce the likelihood of banking crises  | Theoretical<br>Empirical |
| Bubula and Otker Robe (2003)              | Currency crisis with EMPI        | 1990-2001                                     | IR are more crisis prone  | Empirical                |
| Angkinand and Willet (2006)               | Banking crisis with dummy        | 1990-2003                                     | Soft peg and IR are associated with higher probabilities of financial crises                                  | Empirical                |
| <b>The critics of the bipolar view</b>    |                                  |   |   |                          |
| Corsetti <i>et al.</i> (1998)             | Asian crises using crisis index  |   | Expectations of inflationary financing cause the collapse of the currency                                     | Theoretical<br>Empirical |
| Eichengreen and Hausman (1999)            |                                  |   | Pegged regimes are crisis-prone due to a moral hazard problem   | Theoretical              |
| Chang and Velasco (2000)                  | Banking crisis                   |   | Pegged regimes are more prone to banking crises. Flexible rates eliminate (bank) runs with appropriate policy | Theoretical              |
| Fisher (2001)                             | Currency crises                  | 1991-1999, developed and emerging markets     | Softly-pegged ERR are crisis prone and not sustainable over the long period                                   | Theoretical              |
| Daniel (2001)                             | Currency crises                  |   | Pegged regimes are inevitably crisis-prone due to unsustainable fiscal policy                                 | Theoretical              |
| Mc Kinnon (2002)                          | Currency crisis                  | Emerging market economies                     | Floating regimes increase nations' vulnerability to currency crises through higher ER volatility              | Theoretical              |
| Burnside <i>et al.</i> (2004)             | Banking and Currency crises      |   | Government guarantees of the monetary regimes lead to self-fulfilling banking and currency crises             | Theoretical              |
| Rogoff (2005)                             | Debt crises                      | Developing Countries                          | Rigid ERR or excessive borrowing lead to debt problems under any system                                       | Theoretical              |

Note: ER stands for exchange rate; ERR, exchange rate regimes, and IR stands for intermediate regimes.

Alternatively, an important strand of literature (see the upper part of Table 2.1) argues that corner solutions, which consist of pegging or floating, are less vulnerable to crises compared to intermediate ERR. However, this bipolar view was criticized by several papers, presented

<sup>28</sup> According to these authors, crises have other determinants but the ERR, including, if we refer to banking crises, the rapid domestic credit growth, large bank liabilities relative to reserves and deposit rate decontrol. In addition, Haile and Pozo (2006) discuss the difference between de facto and de jure ERR for the surge of crises.



in the bottom part of Table 2.1. Overall, it seems that the existing literature has not yet provided clear-cut results regarding the eventual vulnerability to crises of alternative exchange rate regimes.

### 2.3. Econometric strategy and data

We first present the econometric specification and then discuss the data used in our study.

#### 2.3.1. Econometric specification and estimation strategies

To estimate the extent to which alternatives exchange rate regimes might be vulnerable to the occurrence of different types of crises, we adopt the following binary choice model

$$Crisis_{it} = \alpha_i + \mu_t + \beta ERR_{it-1} + \gamma X_{it-1} + \varepsilon_{it}, \quad (2.1)$$

where *Crisis* is a dummy variable coded 1 if country *i* experiences a crisis at time *t* and 0 otherwise. The interest variable is the exchange rate regime; since we aim at contrasting intermediate with extreme regimes,  $ERR_{it}$  is defined as a dummy variable that equals 1 if country *i* is under pegged or floating regime at time *t* and 0 otherwise. According to the bipolar view, if intermediate regimes were more prone to crises, we should find a negative and significant effect of ERR. Finally,  $\alpha_i$  and  $\mu_t$  stand for country and time specific effects,  $X_{it}$  is a vector of control variables (see below) and  $\varepsilon_{it}$  is the error term. We rely upon logit models to estimate equation (2.1). To mitigate possible reverse causality problems, we explain the likelihood of crisis in the current period using one subperiod-lagged variables, including the ERR.

#### 2.3.2. Data

Our study is conducted within a panel of 90 countries over the period 1980-2009. The time span is subdivided into ten periods of three years each and variables are three-year-averaged.<sup>29</sup> To capture a crisis event, we built a dummy variable coded one if a given country experiences at least one crisis episode during the three years subperiod, and zero otherwise.

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<sup>29</sup> The empirical literature often drops out the observations following a crisis episode to avoid the reverse causality problem. Since this method is not exempted from criticisms in the sense that dropping out observations can raise an attrition bias and alter conclusions, we refrain from using it in the paper.

The following subsections discuss extensively our main variables, namely the crisis and the ERR, and then present the set of control variables.

### 2.3.3. Definition of crises

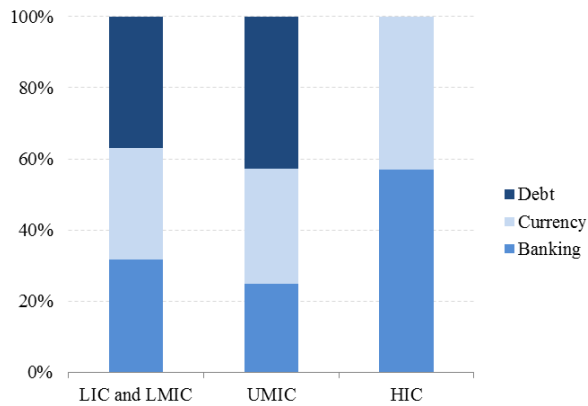
To capture crisis episodes, we use the crisis database developed by Reinhart and Rogoff (2011), combined with that of Laeven and Valencia (2012). According to these datasets, crisis episodes are defined as follows. First, *banking crisis* occur in two cases, namely when bank-runs lead to closure, merging or takeover by public sector of one or more financial institutions, and when, although there are no runs, the closure, merging, takeover or large-scale government assistance of an important financial institution marks the start of a string of similar outcome for other financial institutions. Second, a *currency crisis* refers to a situation where the depreciation (devaluation) of the local currency of a given country regarding the US dollar equals or exceeds 15%. Finally, we distinguish among external and domestic *debt crisis*. Regarding the former, a sovereign default is defined as the failure to meet principal or interest payments on the due date (or within the grace period), and also as episodes where rescheduling of debt is ultimately extinguished in less favorable terms than the original obligation. Regarding the definition of domestic debt crisis, Reinhart and Rogoff (2011) use roughly the same criteria, except that the debt holders are domestic; in addition, domestic debt crises involved the freezing of bank deposits and/or forcible conversions of such deposits from the US dollar to the local currency.<sup>30</sup>

We illustrate in Figure 2.1 the distribution of different types of crises among different groups of countries. For generality, we use the World Bank's country income level-based classification and distinguish among high income, including OECD, countries (HIC), upper middle income countries (UMIC) and low and lower middle income countries (LIC and LMIC respectively).<sup>31</sup> LIC, LMIC and UMIC experienced all types of crisis, with debt crisis being the most common. In addition, HIC suffered of currency and banking crisis, with no debt crises during the considered period 1980-2009.

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<sup>30</sup> Financial crises or bank collapses refer to banking crises; analogously, currency crashes correspond to currency crises; finally, debt crises and sovereign debt default are used interchangeably.

<sup>31</sup> The list of countries, the definition of variables and the sources of data, and some descriptive statistics are detailed in appendices B.1 and B.2.

**Figure 2.1. Income level comparison of crises occurrence**

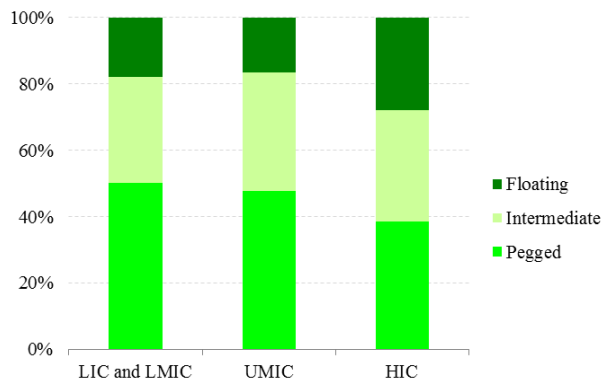
### 2.3.4. Definition of exchange rate regimes

We measure ERR using the *de facto* classification of the IMF (Appendix B.3).<sup>32</sup> Figure 2 illustrates the distribution of ERR using the income level-based classification of the World Bank. Pegged regimes, including exchange arrangements with no separate legal tender, currency boards, dollarization and currency unions, are the most popular monetary arrangements among LIC, LMIC and UMIC countries (roughly, 50% of them), while the remaining countries are divided between intermediate regimes (with crawling pegs, crawling bands and managed float, about 30%) and floaters (freely floating regimes with the exchange rate fully determined by the exchange market, about 20% of countries). In addition, the situation of HIC seems slightly different, with a more proportional distribution of the three core regimes mainly due to a higher proportion of floaters, while a consistent part of the pegged regimes are EMU countries, classified as fixed ERR.<sup>33</sup>

Table 2.2 displays the likelihood of different types of crises among the three core ERR, defined using the IMF *de facto* classification (the upper part) and the Ilzetski, Reinhart and Rogoff (IRR, 2010) classification (the bottom part).

<sup>32</sup> Since the use of *de jure* classification was found to engender misleading statistical inference in the assessment of the link between crises and ERR (Edwards and Sevestano, 1999, and Rogoff et al., 2004), we refrain from using it. In addition, we draw upon the *natural de facto* classification of Ilzetski, Reinhart and Rogoff (2010) in our robustness analysis.

<sup>33</sup> Since according to the European Commission (Directorate-General for Trade) the trade volume is stronger within the EMU compared to other non-EMU partners, it is plausible to consider EMU countries as being under a pegged rather than a floating regime.

**Figure 2.2. The distribution of exchange rate regimes (ERR)**

Based on the IMF classification, 160 (namely 17.8%) out of the 894 available observations are associated to banking crises, and out of the total of these crises episodes almost half (namely 73) concern countries with pegged ERR. Pegged arrangements are also the most affected by currency and debt crises (more than 50%), which occurred in 1 out of 4 and 9 periods respectively, according to the IMF classification. Although the use of the IRR classification reduces the number of available observations, the distribution among the different types of crises is comparable for debt crises, with 4 percentage points more (less) for banking (currency) crises. However, one significant difference is that most of crises occur in intermediate ERR when using the IRR classification.

**Table 2.2: Crises occurrence among ERR**

| IMF classification  | Banking crises |     |             | Currency crises |     |             | Debt crises |     |             |
|---------------------|----------------|-----|-------------|-----------------|-----|-------------|-------------|-----|-------------|
|                     | No             | Yes | Freq. (%)   | No              | Yes | Freq. (%)   | No          | Yes | Freq. (%)   |
| <i>Pegged</i>       | 343            | 73  | <b>45.6</b> | 303             | 113 | <b>50.2</b> | 355         | 61  | <b>57.5</b> |
| <i>Intermediate</i> | 243            | 53  | 33.1        | 221             | 75  | 33.3        | 266         | 30  | 28.3        |
| <i>Floating</i>     | 148            | 34  | 21.3        | 145             | 37  | 16.4        | 167         | 15  | 14.2        |
| <b>Total</b>        | 734            | 160 | 17.8        | 669             | 225 | 25.2        | 788         | 106 | 11.9        |
| IRR classification  |                |     |             |                 |     |             |             |     |             |
| <i>Pegged</i>       | 246            | 46  | 33.6        | 233             | 59  | 33.5        | 257         | 35  | 42.7        |
| <i>Intermediate</i> | 352            | 75  | <b>54.7</b> | 324             | 103 | <b>58.5</b> | 386         | 41  | <b>50</b>   |
| <i>Floating</i>     | 42             | 16  | 11.7        | 44              | 14  | 8           | 52          | 6   | 7.3         |
| <b>Total</b>        | 640            | 137 | 21.4        | 601             | 176 | 29.3        | 695         | 82  | 11.8        |

Note: The number of three-year periods is 894 (IMF) and 777 (IRR), divided for each crisis between crisis and non-crisis observations, with a total of 491 (IMF) and 395 (IRR) crisis observations. Bolded values represent, for each type of crisis, the ERR most frequently affected by crises.

### 2.3.5. Control variables

Our analysis distinguishes among three types of crises, namely banking, debt and currency crises; consequently, when selecting control variables, we focused on the most appropriate variables for each type of crisis.

Regarding *banking crisis*, the first control variable is the domestic credit to the private sector in percentage of GDP.<sup>34</sup> Following Demirgüç-Kunt and Detragiache (1997) and Arteta and Eichengreen (2000), the dynamic of credit is a salient feature in the occurrence of crises, as highlighted by the recent financial crisis. A rapid development of domestic credit reflects either a credit market with sufficiently safe borrowers or a situation of risk misassessment. This latter case can be very damaging for the stability of the financial system, since it favors the growing up of financial bubbles arising from rapid credit growth with lenders seeking permanently for more profits. Such a situation is unsustainable, and the collapse of the bubble weakens the financial system and can trigger bank runs. Therefore, we expect a positive effect of the domestic credit on the probability of banking crises. The second control variable is the volatility of the domestic credit, measured by the standard deviation of domestic credits. High credit volatility can have damaging effects by leading to credit misallocation and by blurring private agents' foresights. Consequently, we expect credit volatility to increase the odds of banking crisis. The third control variable is the sum between the claims on the domestic real nonfinancial sector by the Central Bank and the private credit by deposit money banks and other financial institutions, as share of GDP. It allows capturing differences in the size of the financial sector. On the one hand, a sizeable financial sector with complex financial products and multiple market players can be thought as detrimental because of greater exposure to financial imbalances. On the other hand, a large size of the financial sector can increase the risk-sharing opportunity. Therefore, the expected impact of the size of the financial sector on the probability of banking crises is ambiguous. Fourth, a variable of intermediation, built as the ratio between private credit supply and private deposits, proxies the ability of transforming deposits into credits, i.e. the intermediation capacity of the banking sector. The expected sign is positive. Finally, in addition to these four fundamental determinants of banking crises, we consider a variable that may affect banking crises' probability, namely the regulation of the credit market. Intuitively, we expect a negative

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<sup>34</sup> We define it as financial resources provided to the private sector, such as loans, purchases of non-equity securities, trade credits, and other accounts that establish a claim for repayment.

influence since authorities' regulation of the credit market tends to lower the risk taken by bankers and therefore reduces the likelihood of crises.

Let us now turn our attention to currency crises fundamentals. First, the variable reserves money growth measures seigniorage revenue. Based on Buitier (2007), we define seigniorage as resources appropriated by monetary authorities through their capacity to issue zero interest fiat money, and measure it as the variation in the monetary base in percentage of GDP. This variable is particularly relevant in first-generation crises models, concluding that the main cause of currency crashes is the financing of fiscal deficits using seigniorage. Second, to reveal the fiscal stance of the government, and more widely the design of the fiscal policy, we consider the primary fiscal balance (FB), defined as the difference between fiscal revenue and expenditure. Large fiscal deficits may be an indirect source of financial imbalances, by generating inconsistency between fiscal and exchange rate policies (see first-generation crises models) and therefore leading to currency and/or banking crises, as equally defended by the FTC hypothesis. Finally, in addition to these fundamentals, we consider subsequent variables that could affect the probability of currency crisis, namely the domestic credit to the private sector, broad money and the current account (Esaka, 2010a, b).

To evaluate the likelihood of *debt crises*, we consider first public debt, as a GDP ratio. Given that public debt is a prominent variable to predict sovereign debt defaults, its expected effect is positive. In addition, according to a recent literature emphasizing non-linear effects (see, for example, Ardagna *et al.* 2006), we equally account for the square of the debt to GDP ratio. Second, inflation may be a salient feature in predicting the occurrence of debt crises. While inflation may reduce the odds of domestic debt default, it also may increase the burden of the foreign currency-denominated debt when it leads to a nominal depreciation. Therefore the expected sign is ambiguous. Third, political institutions could also predict the likelihood of debt crises. We account for it by controlling whether there exist any constraints on the executive; if so, the odds of debt crises are expected to decrease, as the room for the incumbent government to overspend is somewhat reduced. Finally, some external conditions, as the aid flows, could influence the occurrence of debt crisis. Since these flows can be used to face the debt burden (in terms of interests and capital repayment) and therefore mitigate the probability of debt default, we expect a negative sign on the likelihood of debt default.

The set of controls also includes variables that are common to all type of crises. On the one hand, output growth is assumed to negatively influence the occurrence of banking, currency

or debt crisis. The output growth may help avoid banking disturbances by providing additional resources for the private sector and strengthening its capacity to meet credit reimbursement commitments. Regarding currency crises, the output growth leads to an increase in foreign exchange reserves and allows authorities supporting the fixity of the exchange rate or at least postponing the collapse of the peg. The same rationale prevails for debt crises, as in times of growth the increase of the resources of the government enhances its capacity to meet its commitments. On the other hand, as suggested by Glick and Hutchison, (2005) and Glick *et al.* (2006), the capital account openness captures the influence of the restrictions (or liberalization) of the capital account on the probability of banking, currency and debt crises.

#### 2.4. Estimation results: the likelihood of crises

Table 2.3 illustrates our baseline estimations of the likelihood of *banking crises*. To directly test the bipolar view, we focus on the variable *Peg or float*, which is a dummy coded one if a country is under pegged or floating regime and zero if the regime is qualified as intermediate.

Starting from regression (1), we explore the sensitivity of the effect of ERR on the probability of banking crises by progressively adding relevant control variables. Notice that a percentage point increase in the level of domestic credit or in its volatility increases the incidence of banking crises by roughly 1 and 5-6 percentage points respectively, a result consistent with Demirgüç-Kunt and Detragiache (1997). Instead, as shown by columns (5)-(8), better credit market (CM) regulation, higher growth and a lower intermediation ratio reduce the probability of banking crises. Irrespective of the control variables used, the coefficient of the variable *Peg or float* is statistically not significant in regressions (1)-(8). These results clearly fail to support the bipolar view, since intermediate regimes are not more prone to *banking* crises than corner, namely pegged or floating, regimes.<sup>35</sup>

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<sup>35</sup> Our findings are unchanged when performing regressions (1)-(8) by holding the number of observations constant (results are provided in the Supplementary Material section at the end of the manuscript).

**Table 2.3: Likelihood of banking crises***Dependent variable: probability of banking crisis*

|                            | (1)           | (2)           | (3)          | (4)           | (5)           | (6)           | (7)           | (8)           |
|----------------------------|---------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|
| <b>Peg or float</b>        | <b>-0.049</b> | <b>-0.097</b> | <b>-0.13</b> | <b>-0.055</b> | <b>-0.075</b> | <b>-0.067</b> | <b>-0.132</b> | <b>-0.279</b> |
|                            | (0.835)       | (0.689)       | (0.587)      | (0.833)       | (0.773)       | (0.798)       | (0.622)       | (0.323)       |
| Domestic credit            |               | 0.013***      | 0.009**      | 0.011**       | 0.013**       | 0.013**       | 0.013**       | 0.015**       |
|                            |               | (0.001)       | (0.018)      | (0.041)       | (0.021)       | (0.028)       | (0.029)       | (0.015)       |
| Volatility of DC           |               |               | 0.062***     | 0.060***      | 0.055***      | 0.056***      | 0.051***      | 0.047**       |
|                            |               |               | (0.000)      | (0.002)       | (0.005)       | (0.004)       | (0.010)       | (0.019)       |
| Size of the FS             |               |               |              | -0.129        | -0.364        | -0.188        | -0.231        | -0.509        |
|                            |               |               |              | (0.835)       | (0.568)       | (0.779)       | (0.735)       | (0.491)       |
| Intermediation             |               |               |              |               | 0.001**       | 0.001*        | 0.001*        | 0.001*        |
|                            |               |               |              |               | (0.035)       | (0.068)       | (0.091)       | (0.090)       |
| CM regulation              |               |               |              |               |               | -0.163**      | -0.139*       | -0.168*       |
|                            |               |               |              |               |               | (0.035)       | (0.081)       | (0.057)       |
| Growth                     |               |               |              |               |               |               | -0.082**      | -0.083**      |
|                            |               |               |              |               |               |               | (0.034)       | (0.044)       |
| KA open                    |               |               |              |               |               |               |               | -0.057        |
|                            |               |               |              |               |               |               |               | (0.652)       |
| Obs. (countries)           | 893 (90)      | 893           | 892 (90)     | 840 (88)      | 839 (88)      | 759 (83)      | 759 (83)      | 691 (76)      |
| Pseudo-R <sup>2</sup>      | 0.03          | 0.04          | 0.04         | 0.05          | 0.05          | 0.04          | 0.04          | 0.04          |
| Wald-stat ( <i>Chi</i> -2) | 36.21         | 44.52         | 51.87        | 47.53         | 49.44         | 48.71         | 51.45         | 48.52         |
| Wald ( <i>p</i> -value)    | 0.00          | 0.00          | 0.00         | 0.00          | 0.00          | 0.00          | 0.00          | 0.00          |
| Log likelihood             | -381.4        | -374.6        | -367.2       | -339.3        | -336.9        | -319.8        | -317.4        | -283.7        |
| % Obs. correctly called    | 78            | 76.2          | 77.8         | 78.2          | 78.5          | 76.4          | 76.1          | 78.2          |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Coefficients displayed are marginal effects. Hausman specification test suggested random effects with the Logit estimator. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Let us now discuss the results for currency crises, depicted in Table 2.4. As shown by columns (5)-(8), the seigniorage increases the odds of currency crises, confirming the fiscal theory of currency crises. We also notice that the capital account openness decreases the probability of currency crises (column 8), as it offers more flexibility in the implementation of the monetary policy for countries under fixed regimes (Esaka, 2010a, b). Finally, the fiscal balance (FB) does not matter in the prediction of currency crises: what matters is not whether governments generate fiscal deficits, but rather the way they finance such deficits.

The non-significance of the variable *Peg or float*, whatever the control variables considered, breaks down the bipolar view, as there is no evidence that intermediate regimes are more prone to currency crises than pegs or floats.



**Table 2.4: Likelihood of currency crises***Dependent variable: probability of currency crisis*

|                            | (1)          | (2)          | (3)         | (4)          | (5)          | (6)          | (7)          | (8)          |
|----------------------------|--------------|--------------|-------------|--------------|--------------|--------------|--------------|--------------|
| <b>Peg or float</b>        | <b>0.073</b> | <b>0.166</b> | <b>0.36</b> | <b>0.349</b> | <b>0.339</b> | <b>0.333</b> | <b>0.277</b> | <b>0.418</b> |
|                            | (0.764)      | (0.51)       | (0.277)     | (0.296)      | (0.363)      | (0.378)      | (0.468)      | (0.297)      |
| Seigniorage                |              | 0.002        | 0.006       | 0.006        | 0.009*       | 0.009*       | 0.008*       | 0.010*       |
|                            |              | (0.348)      | (0.159)     | (0.15)       | (0.072)      | (0.073)      | (0.084)      | (0.052)      |
| FB                         |              |              | -0.021      | -0.02        | -0.014       | -0.014       | -0.007       | -0.01        |
|                            |              |              | (0.501)     | (0.51)       | (0.684)      | (0.683)      | (0.831)      | (0.777)      |
| Domestic credit            |              |              |             | 0.004        | 0.007        | 0.007        | 0.007        | 0.018**      |
|                            |              |              |             | (0.53)       | (0.339)      | (0.34)       | (0.344)      | (0.022)      |
| Broad money                |              |              |             |              | -0.038       | -0.038       | -0.038       | -0.037       |
|                            |              |              |             |              | (0.251)      | (0.25)       | (0.247)      | (0.263)      |
| Growth                     |              |              |             |              |              | -0.005       | -0.029       | 0.02         |
|                            |              |              |             |              |              | (0.924)      | (0.607)      | (0.742)      |
| Current account            |              |              |             |              |              |              | -0.046       | -0.013       |
|                            |              |              |             |              |              |              | (0.13)       | (0.689)      |
| KA open                    |              |              |             |              |              |              |              | -0.789***    |
|                            |              |              |             |              |              |              |              | (0.000)      |
| Obs. (countries)           | 893 (90)     | 820 (83)     | 552 (73)    | 552 (73)     | 491 (66)     | 491 (66)     | 491 (66)     | 485 (65)     |
| Pseudo-R <sup>2</sup>      | 0.13         | 0.14         | 0.14        | 0.13         | 0.14         | 0.14         | 0.15         | 0.15         |
| Wald-stat ( <i>Chi</i> -2) | 58.79        | 56.92        | 36.61       | 36.44        | 26.59        | 26.58        | 28.14        | 38.78        |
| Wald ( <i>p</i> -value)    | 0.00         | 0.00         | 0.00        | 0.00         | 0.02         | 0.03         | 0.03         | 0.00         |
| Log likelihood             | -417.2       | -386.2       | -261        | -260.8       | -213.7       | -213.7       | -212.5       | -198.5       |
| % Obs. correctly called    | 67.7         | 68.9         | 69          | 68.3         | 67.4         | 68.3         | 69.2         | 71.8         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. Once we introduce the variable Seigniorage in our models (from specification [3]), we drop Cameroon, Republic of Congo, Cote d'Ivoire, Gabon, Senegal, Sudan, Suriname, Syria and Zimbabwe from the sample due to outliers. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Finally, the Table 2.5 focuses on debt crises. Unlike the two previous crises (banking and currency), empirical evidence on the determinants of debt crises is remarkably scarce.

Among the most important fundamentals, macroeconomic imbalances in terms of unsustainable public debt affect the occurrence of debt crises. The positive sign of the squared term suggests that a large share of public debt to GDP increases the odds of debt default, with some non-linearity. On the contrary, output growth reduces significantly the incidence of default.<sup>36</sup> Finally, results in column (7) support the use of aid flows as a hedge against sovereign debt default, since higher aid significantly decreases the odds of debt crises. Coming back to our main analysis, we follow the strategy emphasized earlier and contrast

<sup>36</sup> Manasse and Roubini (2009) provide an interesting discussion regarding the economic growth mechanism as a necessary but not sufficient condition to avoid debt default.

intermediate regimes with corner regimes. As emphasized by columns (1)-(8), there is no support that intermediate regimes matter for *debt* crisis compared to fixed or peg exchange rate regimes.<sup>37</sup> In short, we clearly break down the bipolar view, as the occurrence of banking, currency or debt crises was not found to be related to the presence of a particular exchange rate regime.

**Table 2.5: Likelihood of debt crises**

| <i>Dependent variable: probability of debt crisis</i> |              |              |              |              |              |              |              |              |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|   | (1)          | (2)          | (3)          | (4)          | (5)          | (6)          | (7)          | (8)          |
| <b>Peg or float</b>                                   | <b>0.597</b> | <b>0.545</b> | <b>0.546</b> | <b>0.567</b> | <b>0.337</b> | <b>0.399</b> | <b>0.354</b> | <b>0.222</b> |
|   | (0.106)      | (0.142)      | (0.147)      | (0.144)      | (0.396)      | (0.343)      | (0.396)      | (0.644)      |
| Public debt   |              | 0.005        | -0.004       | 0.001        | -0.003       | -0.006       | -0.003       | 0.006        |
|   |              | (0.105)      | (0.577)      | (0.889)      | (0.745)      | (0.593)      | (0.757)      | (0.634)      |
| Public debt squared                                   |              |              | 0.662**      | 0.496        | 0.637*       | 0.760**      | 0.753**      | 0.468        |
|   |              |              | (0.023)      | (0.178)      | (0.077)      | (0.043)      | (0.034)      | (0.216)      |
| Inflation   |              |              |              | 0.067        | 0.06         | 0.058        | 0.046        | 0.041        |
|   |              |              |              | (0.396)      | (0.430)      | (0.439)      | (0.530)      | (0.617)      |
| Growth  |              |              |              |              | -0.183***    | -0.200***    | -0.214***    | -0.211***    |
|   |              |              |              |              | (0.000)      | (0.000)      | (0.000)      | (0.001)      |
| Executive constraint                                  |              |              |              |              |              | -0.111       | 0.047        | -0.014       |
|   |              |              |              |              |              | (0.285)      | (0.650)      | (0.907)      |
| Aid   |              |              |              |              |              |              | -0.111**     | -0.146**     |
|   |              |              |              |              |              |              | (0.024)      | (0.022)      |
| KA open   |              |              |              |              |              |              |              | -0.377       |
|   |              |              |              |              |              |              |              | (0.107)      |
| Obs. (countries)                                      | 893 (90)     | 875 (90)     | 875 (90)     | 855 (90)     | 855 (90)     | 798 (86)     | 597 (66)     | 517 (58)     |
| Pseudo-R <sup>2</sup>                                 | 0.23         | 0.23         | 0.23         | 0.24         | 0.24         | 0.24         | 0.18         | 0.21         |
| Wald-stat ( <i>Chi</i> -2)                            | 40.45        | 42.34        | 44.9         | 44.56        | 50.21        | 50.11        | 49.5         | 42.83        |
| Wald ( <i>p</i> -value)                               | 0.00         | 0.00         | 0.00         | 0.00         | 0.00         | 0.00         | 0.00         | 0.00         |
| Log likelihood  | -236.8       | -234.4       | -230.6       | -223.2       | -216.7       | -200.7       | -183.7       | -153.9       |
| % Obs. correctly called                               | 88.1         | 87.7         | 87.7         | 87.8         | 87.6         | 87           | 82.7         | 82.7         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

<sup>37</sup> The inclusion of the variable aid in regressions (7)-(8) decreases the sample size, mainly since high income countries do not receive aid flows and are therefore excluded. Despite that, our main results remain unchanged.

## **2.5. Sensitivity analysis**

The goal of this section is to explore the robustness of our results. For each type of crises, we consider the widest specification, namely column (8) from Tables 2.3, 2.4 and 2.5 above. In addition, to better focus our analysis and keep the chapter short, we present all along this sensitivity section only interest coefficients.

### **2.5.1. Accounting for contagion effects**

A strand of influential papers, including Kaminsky and Reinhart (1999) or Reinhart and Rogoff (2011), emphasized the importance of contagion effects between different types of crises in a given country. We present in Table 2.6 results for the influence of the ERR on the likelihood of crises, when controlling for such contagion effects.

The burst of other types of crises increases the probability of having a banking, currency or debt crisis (except for the effect that transits from banking to currency crises, which is found not significant). However, even when accounting for the presence of such important contagion effects, we find yet again no support for an influence of ERR on the probability of experiencing a banking, currency or debt crisis.

**Table 2.6: Likelihood of crises and contagion effects**

| Banking crises             |               |               | Currency crises            |              |              | Debt crises                |              |              |
|----------------------------|---------------|---------------|----------------------------|--------------|--------------|----------------------------|--------------|--------------|
| <b>Peg or float</b>        | <b>-0.260</b> | <b>-0.331</b> | <b>Peg or float</b>        | <b>0.439</b> | <b>0.395</b> | <b>Peg or float</b>        | <b>0.255</b> | <b>0.282</b> |
|                            | (0.337)       | (0.232)       |                            | (0.270)      | (0.328)      |                            | (0.593)      | (0.564)      |
| Currency crises            | 0.701**       |               | Banking crises             | 0.523        |              | Banking crises             | 1.231***     |              |
|                            | (0.016)       |               |                            | (0.175)      |              |                            | (0.004)      |              |
| Debt crises                |               | 1.015***      | Debt crises                |              | 2.449***     | Currency crises            |              | 2.017***     |
|                            |               | (0.004)       |                            |              | (0.000)      |                            |              | (0.000)      |
| Domestic credit            | 0.014**       | 0.015**       | Seigniorage                | 0.010**      | 0.012**      | Public debt                | 0.007        | 0.005        |
|                            | (0.025)       | (0.014)       |                            | (0.045)      | (0.020)      |                            | (0.561)      | (0.656)      |
| Volatility of DC           | 0.046**       | 0.046**       | FB                         | -0.006       | -0.013       | Public debt squared        | 0.545        | 0.442        |
|                            | (0.018)       | (0.020)       |                            | (0.879)      | (0.712)      |                            | (0.151)      | (0.238)      |
| Size of the FS             | -0.424        | -0.440        | Domestic credit            | 0.016**      | 0.016**      | Inflation                  | 0.051        | 0.046        |
|                            | (0.543)       | (0.538)       |                            | (0.047)      | (0.032)      |                            | (0.544)      | (0.568)      |
| Intermediation             | 0.001         | 0.001         | Broad money                | -0.035       | -0.044       | Growth                     | -0.194***    | -0.202***    |
|                            | (0.173)       | (0.186)       |                            | (0.276)      | (0.200)      |                            | (0.003)      | (0.002)      |
| CM regulation              | -0.141*       | -0.151*       | Growth                     | 0.025        | 0.047        | Executive constraint       | 0.027        | -0.046       |
|                            | (0.095)       | (0.079)       |                            | (0.674)      | (0.437)      |                            | (0.823)      | (0.705)      |
| Growth                     | -0.077*       | -0.066        | Current account            | -0.009       | -0.007       | Aid                        | -0.161**     | -0.135**     |
|                            | (0.056)       | (0.107)       |                            | (0.771)      | (0.826)      |                            | (0.012)      | (0.027)      |
| KA open                    | -0.018        | -0.048        | KA open                    | -0.788***    | -0.691***    | KA open                    | -0.363       | -0.201       |
|                            | (0.882)       | (0.699)       |                            | (0.000)      | (0.000)      |                            | (0.117)      | (0.394)      |
| Obs. (countries)           | 691 (76)      | 691 (76)      | Obs. (countries)           | 485 (65)     | 485 (65)     | Obs. (countries)           | 517 (58)     | 517 (58)     |
| Pseudo-R <sup>2</sup>      | 0.02          | 0.02          | Pseudo-R <sup>2</sup>      | 0.12         | 0.11         | Pseudo-R <sup>2</sup>      | 0.20         | 0.16         |
| Wald-stat ( <i>Chi</i> -2) | 55.28         | 56.10         | Wald-stat ( <i>Chi</i> -2) | 40.05        | 49.26        | Wald-stat ( <i>Chi</i> -2) | 47.02        | 50.09        |
| Wald ( <i>p</i> -value)    | 0.00          | 0.00          | Wald ( <i>p</i> -value)    | 0.00         | 0.00         | Wald ( <i>p</i> -value)    | 0.00         | 0.00         |
| Log likelihood             | -281.0        | -279.9        | Log likelihood             | -197.6       | -187.8       | Log likelihood             | -149.7       | -144.3       |
| % Obs. corr. called        | 77.8          | 77.7          | % Obs. corr. called        | 70.8         | 76.1         | % Obs. corr. called        | 83.9         | 85.1         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. Hausman specification test suggested random effects with the Logit estimator. All specifications include time dummies. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

### 2.5.2. Is the proneness of the regimes influenced by the level of development or the time period?

An important criticism of our analysis may be related to the possible heterogeneities in the effect of the ERR on the likelihood of crises, depending on the level of economic development. For example, one should account for the absence of debt crises for high income countries during the period we consider. One alternative to tackle this shortcoming is to include the GDP per capita, capturing the level of economic development, as an additional explanatory variable.<sup>38</sup> However, a better solution is to perform individual regressions for each group of countries, according to their level of development (Table 2.7). For generality, we draw upon the World Bank's country income level classification and distinguish among

<sup>38</sup> We report that the coefficients of the variable Peg or float (together with their p-values) for the regressions (8) from Tables 3.1, 3.2 and 3.3 augmented with the variable GDP per capita are respectively 0.13 (0.62), 0.061 (0.87) and 0.24 (0.53).

high income, including OECD, countries (HIC), upper middle income countries (UMIC) and low and lower middle income countries (LIC and LMIC respectively).

Irrespective of the considered crisis, extreme ERR do not exert a statistically different effect on the probability of experiencing a crisis, compared to intermediate ERR. Thus, our analysis performed on groups of countries located at different stages of economic development concludes, yet again, against the bipolar view, in line with our main findings.

In addition to this analysis, our results might be biased by time heterogeneity. Therefore, we check the stability of our findings by performing estimations on two sub-periods, namely before and after 1990. This splitting was chosen to reflect the worldwide major institutional changes related to the end of the Cold War. Whatever the crisis considered, the variable of interest is never significant (Table 2.8). Therefore, our results show that the rejection of the bipolar view is not specific to a period.

**Table 2.7: Likelihood of crises: income level comparisons**

|                            | Banking crises |                |                | Currency crises            |                |                | Debt crises    |                            |                |                |
|----------------------------|----------------|----------------|----------------|----------------------------|----------------|----------------|----------------|----------------------------|----------------|----------------|
|                            | LIC & LMIC     | UMIC           | HIC            | LIC & LMIC                 | UMIC           | HIC            | LIC & LMIC     | UMIC                       |                |                |
| <b>Peg or float</b>        | <b>-0.144</b>  | <b>-1.797*</b> | <b>0.684</b>   | <b>Peg or float</b>        | <b>0.694</b>   | <b>0.930</b>   | <b>0.498</b>   | <b>Peg or float</b>        | <b>0.525</b>   | <b>-0.818</b>  |
|                            | <b>(0.688)</b> | <b>(0.063)</b> | <b>(0.380)</b> |                            | <b>(0.178)</b> | <b>(0.472)</b> | <b>(0.728)</b> |                            | <b>(0.367)</b> | <b>(0.482)</b> |
| Domestic credit            | 0.031**        | 0.081*         | 0.011          | Seigniorage                | 0.002          | 0.029*         | 0.042**        | Public debt                | 0.006          | 0.050          |
|                            | (0.023)        | (0.088)        | (0.380)        |                            | (0.788)        | (0.057)        | (0.017)        |                            | (0.627)        | (0.526)        |
| Volatility of DC           | 0.054          | 0.116*         | 0.012          | FB                         | 0.069          | -0.230*        | -0.106         | Public debt squared        | 0.122          | 0.527          |
|                            | (0.175)        | (0.087)        | (0.732)        |                            | (0.194)        | (0.071)        | (0.221)        |                            | (0.791)        | (0.806)        |
| Size of the FS             | 0.756          | -9.585*        | 0.215          | Domestic credit            | 0.031**        | -0.003         | -0.015         | Inflation                  | -0.012         | 0.316          |
|                            | (0.535)        | (0.098)        | (0.875)        |                            | (0.037)        | (0.898)        | (0.391)        |                            | (0.928)        | (0.601)        |
| Intermediation             | 0.001          | -2.058         | 0.275          | Broad money                | 0.080          | -0.392**       | 0.041          | Growth                     | -0.287***      | -0.118         |
|                            | (0.221)        | (0.243)        | (0.764)        |                            | (0.310)        | (0.042)        | (0.848)        |                            | (0.001)        | (0.504)        |
| CM regulation              | -0.077         | -0.041         | -0.204         | Growth                     | -0.060         | -0.316**       | 0.031          | Executive constraint       | -0.066         | -0.123         |
|                            | (0.473)        | (0.898)        | (0.380)        |                            | (0.278)        | (0.045)        | (0.451)        |                            | (0.662)        | (0.730)        |
| Growth                     | -0.061         | -0.096         | -0.274***      | Current account            | 0.051          | -0.143         | -0.200*        | Aid                        | -0.133**       | -1.037*        |
|                            | (0.277)        | (0.452)        | (0.002)        |                            | (0.322)        | (0.105)        | (0.070)        |                            | (0.046)        | (0.061)        |
| KA open                    | 0.100          | 0.510          | -0.478         | KA open                    | -0.511*        | -0.581         | -1.116***      | KA open                    | -0.036         | -0.804*        |
|                            | (0.605)        | (0.153)        | (0.168)        |                            | (0.090)        | (0.164)        | (0.009)        |                            | (0.916)        | (0.100)        |
| Obs. (countries)           | 328 (38)       | 132 (14)       | 231 (24)       | Obs. (countries)           | 236 (33)       | 111 (13)       | 138 (19)       | Obs. (countries)           | 361 (41)       | 135 (14)       |
| Pseudo-R <sup>2</sup>      | 0.01           | 0.06           | 0.01           | Pseudo-R <sup>2</sup>      | 0.076          | 0.134          | 0.000          | Pseudo-R <sup>2</sup>      | 0.230          | 0.121          |
| Wald-stat ( <i>Chi-2</i> ) | 28.86          | 9.666          | 26.29          | Wald-stat ( <i>Chi-2</i> ) | 22.70          | 14.33          | 20.38          | Wald-stat ( <i>Chi-2</i> ) | 24.13          | 12.49          |
| Wald ( <i>p-value</i> )    | 0.036          | 0.92           | 0.069          | Wald ( <i>p-value</i> )    | 0.159          | 0.644          | 0.255          | Wald ( <i>p-value</i> )    | 0.116          | 0.769          |
| Log likelihood             | -134.8         | -46.56         | -69.14         | Log likelihood             | -96.20         | -36.23         | -29.30         | Log likelihood             | -100.4         | -32.50         |
| % Obs. corr. called        | 54.7           | 67.7           | 70.4           | % Obs. corr. called        | 61.9           | 60.6           | 53.1           | % Obs. corr. called        | 82.2           | 80.2           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. No debt crises for HIC during the period of our analysis. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

**Table 2.8: Likelihood of crises: period comparisons**

|                            | Banking crises                  |                                 | Currency crises            |                                | Debt crises                     |                            |                                 |                                |
|----------------------------|---------------------------------|---------------------------------|----------------------------|--------------------------------|---------------------------------|----------------------------|---------------------------------|--------------------------------|
|                            | Before 1990                     | After 1990                      | Before 1990                | After 1990                     | Before 1990                     | After 1990                 |                                 |                                |
| <b>Peg or float</b>        | <b>-0.325</b><br><b>(0.448)</b> | <b>-0.410</b><br><b>(0.320)</b> | <b>Peg or float</b>        | <b>0.443</b><br><b>(0.403)</b> | <b>-0.561</b><br><b>(0.495)</b> | <b>Peg or float</b>        | <b>-1.088</b><br><b>(0.220)</b> | <b>0.693</b><br><b>(0.303)</b> |
| Domestic credit            | 0.012<br>(0.423)                | 0.021**<br>(0.013)              | Seigniorage                | 0.010<br>(0.129)               | 0.009<br>(0.381)                | Public debt                | -0.010<br>(0.744)               | 0.033*<br>(0.092)              |
| Volatility of DC           | 0.124**<br>(0.011)              | 0.033<br>(0.219)                | FB                         | -0.020<br>(0.650)              | -0.018<br>(0.832)               | Public debt squared        | 1.172<br>(0.313)                | -0.200<br>(0.679)              |
| Size of the FS             | -2.653*<br>(0.079)              | -0.179<br>(0.855)               | Domestic credit            | 0.011<br>(0.194)               | 0.022<br>(0.385)                | Inflation                  | -0.012<br>(0.944)               | 1.475<br>(0.380)               |
| Intermediation             | -0.009<br>(0.893)               | 0.001*<br>(0.064)               | Brod money                 | -0.017<br>(0.631)              | -0.176*<br>(0.098)              | Growth                     | -0.420***<br>(0.004)            | -0.107<br>(0.220)              |
| CM regulation              | -0.112<br>(0.334)               | -0.285*<br>(0.070)              | Growth                     | -0.031<br>(0.714)              | 0.095<br>(0.432)                | Executive constraint       | -0.267<br>(0.345)               | 0.129<br>(0.388)               |
| Growth                     | -0.013<br>(0.814)               | -0.094<br>(0.180)               | Current account            | -0.021<br>(0.629)              | 0.022<br>(0.737)                | Aid                        | -0.159<br>(0.180)               | -0.236**<br>(0.012)            |
| KA open                    | -0.151<br>(0.434)               | -0.056<br>(0.766)               | KA open                    | -0.448**<br>(0.044)            | -1.838***<br>(0.001)            | KA open                    | -0.110<br>(0.778)               | -0.639*<br>(0.076)             |
| Obs. (countries)           | 254 (69)                        | 437 (76)                        | Obs. (countries)           | 294 (65)                       | 191 (60)                        | Obs. (countries)           | 320 (58)                        | 197 (53)                       |
| Pseudo-R <sup>2</sup>      | 0.01                            | 0.05                            | Pseudo-R <sup>2</sup>      | 0.09                           | 0.16                            | Pseudo-R <sup>2</sup>      | 0.31                            | 0.11                           |
| Wald-stat ( <i>Chi-2</i> ) | 14.06                           | 37.94                           | Wald-stat ( <i>Chi-2</i> ) | 14.09                          | 17.81                           | Wald-stat ( <i>Chi-2</i> ) | 15.43                           | 12.43                          |
| Wald ( <i>p-value</i> )    | 0.230                           | 0.000                           | Wald ( <i>p-value</i> )    | 0.37                           | 0.09                            | Wald ( <i>p-value</i> )    | 0.28                            | 0.33                           |
| Log likelihood             | -117.5                          | -156.7                          | Log likelihood             | -116.3                         | -81.67                          | Log likelihood             | -62.18                          | -84.55                         |
| % Obs. corr. called        | 78.0                            | 79.1                            | % Obs. corr. called        | 64.3                           | 72.0                            | % Obs. corr. called        | 70.4                            | 83.1                           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

### 2.5.3. Are the results robust to the estimation method?

In the following, we allow for alternative methods of estimation of the effect of the ERR on the likelihood of crises.

**Table 2.9: Likelihood of crises: alternative binary estimation methods**

|                            | Banking crises                  |                                 | Currency crises            |                                | Debt crises                    |                            |                                |                                |
|----------------------------|---------------------------------|---------------------------------|----------------------------|--------------------------------|--------------------------------|----------------------------|--------------------------------|--------------------------------|
|                            | Logit FE                        | Probit                          | Logit FE                   | Probit                         | Logit FE                       | Probit                     |                                |                                |
| <b>Peg or float</b>        | <b>-0.115</b><br><b>(0.733)</b> | <b>-0.166</b><br><b>(0.295)</b> | <b>Peg or float</b>        | <b>0.710</b><br><b>(0.128)</b> | <b>0.232</b><br><b>(0.311)</b> | <b>Peg or float</b>        | <b>0.598</b><br><b>(0.308)</b> | <b>0.117</b><br><b>(0.658)</b> |
| Domestic credit            | 0.030***<br>(0.002)             | 0.009**<br>(0.018)              | Seigniorage                | 0.013**<br>(0.018)             | 0.006**<br>(0.047)             | Public debt                | 0.020<br>(0.272)               | 0.003<br>(0.654)               |
| Volatility of DC           | 0.040<br>(0.177)                | 0.028**<br>(0.019)              | FB                         | -0.028<br>(0.565)              | -0.005<br>(0.802)              | Public debt squared        | 0.083<br>(0.871)               | 0.247<br>(0.240)               |
| Size of the FS             | 0.225<br>(0.845)                | -0.307<br>(0.466)               | Domestic credit            | 0.052***<br>(0.000)            | 0.010**<br>(0.020)             | Inflation                  | 0.361<br>(0.359)               | 0.023<br>(0.637)               |
| Intermediation             | 0.002<br>(0.319)                | 0.000*<br>(0.092)               | Brod money                 | -0.051<br>(0.325)              | -0.020<br>(0.276)              | Growth                     | -0.187**<br>(0.013)            | -0.116***<br>(0.001)           |
| CM regulation              | -0.115<br>(0.380)               | -0.102**<br>(0.041)             | Growth                     | 0.065<br>(0.335)               | 0.011<br>(0.754)               | Executive constraint       | 0.025<br>(0.853)               | -0.015<br>(0.818)              |
| Growth                     | -0.113**<br>(0.018)             | -0.049**<br>(0.039)             | Current account            | 0.013<br>(0.743)               | -0.008<br>(0.671)              | Aid                        | -0.129<br>(0.142)              | -0.082**<br>(0.020)            |
| KA open                    | 0.234<br>(0.204)                | -0.019<br>(0.793)               | KA open                    | -0.541**<br>(0.026)            | -0.447***<br>(0.000)           | KA open                    | -0.481<br>(0.120)              | -0.209<br>(0.109)              |
| Obs. (countries)           | 516 (54)                        | 691 (76)                        | Obs. (countries)           | 339 (44)                       | 485 (65)                       | Obs. (countries)           | 262 (27)                       | 517 (58)                       |
| Pseudo-R <sup>2</sup>      | 0.20                            | 0.04                            | Pseudo-R <sup>2</sup>      | 0.36                           | 0.15                           | Pseudo-R <sup>2</sup>      | 0.34                           | 0.22                           |
| Wald-stat ( <i>Chi</i> -2) | 76.10                           | 52.76                           | Wald-stat ( <i>Chi</i> -2) | 92.61                          | 43.16                          | Wald-stat ( <i>Chi</i> -2) | 68.66                          | 46.55                          |
| Wald ( <i>p</i> -value)    | 0.00                            | 0.00                            | Wald ( <i>p</i> -value)    | 0.00                           | 0.00                           | Wald ( <i>p</i> -value)    | 0.00                           | 0.00                           |
| Log likelihood             | -154.5                          | -283.2                          | Log likelihood             | -81.54                         | -198.3                         | Log likelihood             | -65.49                         | -153.5                         |
| % Obs. corr. called        | 35.8                            | 76.9                            | % Obs. corr. called        | 36.5                           | 70.1                           | % Obs. corr. called        | 43.3                           | 81.6                           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Coefficients displayed are marginal effects. The Probit models are estimated with random effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

According to Table 2.9, the use of fixed, instead of random, effects logit or of probit estimators has no qualitative effects on the coefficients of our interest variable *Peg or float*, which remain statistically not significant. In addition, the significance of these coefficients is not improved when considering OLS, instead of binary, estimators in Table 2.10. Consequently, our previous findings of non-systematic vulnerability of intermediate ERR to banking, currency and sovereign debt crises are robust to alternative estimation methods, contradicting yet again the bipolar view.



**Table 2.10: Likelihood of crises: OLS estimations**

|                     | Banking crises |                |                | Currency crises     |                |                | Debt crises    |                      |                |                |                |
|---------------------|----------------|----------------|----------------|---------------------|----------------|----------------|----------------|----------------------|----------------|----------------|----------------|
|                     | Pooled         | FE             | RE             | Pooled              | FE             | RE             | Pooled         | FE                   | RE             |                |                |
| <b>Peg or float</b> | <b>-0.047</b>  | <b>-0.008</b>  | <b>-0.036</b>  | <b>Peg or float</b> | <b>0.008</b>   | <b>0.035</b>   | <b>0.021</b>   | <b>Peg or float</b>  | <b>0.009</b>   | <b>0.018</b>   | <b>0.014</b>   |
|                     | <b>(0.137)</b> | <b>(0.837)</b> | <b>(0.276)</b> |                     | <b>(0.849)</b> | <b>(0.463)</b> | <b>(0.629)</b> |                      | <b>(0.782)</b> | <b>(0.627)</b> | <b>(0.668)</b> |
| Domestic credit     | 0.001**        | 0.003***       | 0.002**        | Seigniorage         | 0.001          | 0.001**        | 0.001*         | Public debt          | 0.000          | 0.001          | 0.000          |
|                     | (0.046)        | (0.000)        | (0.018)        |                     | (0.146)        | (0.045)        | (0.051)        |                      | (0.753)        | (0.409)        | (0.608)        |
| Volatility of DC    | 0.008***       | 0.005*         | 0.007***       | FB                  | -0.002         | -0.000         | -0.001         | Public debt squared  | 0.038          | 0.026          | 0.035          |
|                     | (0.003)        | (0.061)        | (0.005)        |                     | (0.569)        | (0.909)        | (0.797)        |                      | (0.135)        | (0.405)        | (0.187)        |
| Size of the FS      | -0.031         | -0.024         | -0.059         | Domestic credit     | 0.001          | 0.004***       | 0.002***       | Inflation            | -0.001         | 0.002          | 0.001          |
|                     | (0.687)        | (0.855)        | (0.493)        |                     | (0.199)        | (0.000)        | (0.006)        |                      | (0.941)        | (0.731)        | (0.831)        |
| Intermediation      | 0.000**        | 0.000          | 0.000**        | Brod money          | -0.003         | -0.002         | -0.003         | Growth               | -0.021***      | -0.013***      | -0.015***      |
|                     | (0.016)        | (0.159)        | (0.029)        |                     | (0.266)        | (0.531)        | (0.325)        |                      | (0.000)        | (0.009)        | (0.001)        |
| CM regulation       | -0.022**       | -0.005         | -0.021**       | Growth              | -0.002         | 0.004          | 0.001          | Executive constraint | 0.008          | -0.011         | -0.002         |
|                     | (0.021)        | (0.748)        | (0.046)        |                     | (0.744)        | (0.567)        | (0.879)        |                      | (0.309)        | (0.256)        | (0.852)        |
| Growth              | -0.007         | -0.011**       | -0.008*        | Current account     | 0.002          | -0.001         | -0.001         | Aid                  | -0.009***      | -0.006         | -0.008***      |
|                     | (0.158)        | (0.035)        | (0.087)        |                     | (0.545)        | (0.884)        | (0.737)        |                      | (0.001)        | (0.139)        | (0.010)        |
| KA open             | -0.013         | 0.003          | -0.012         | KA open             | -0.080***      | -0.072***      | -0.087***      | KA open              | -0.021         | -0.044**       | -0.033**       |
|                     | (0.289)        | (0.854)        | (0.367)        |                     | (0.000)        | (0.001)        | (0.000)        |                      | (0.112)        | (0.013)        | (0.023)        |
| Obs. (countries)    | 691            | 691 (76)       | 691 (76)       | Obs. (countries)    | 485            | 485 (65)       | 485 (65)       | Obs. (countries)     | 517            | 517 (58)       | 517 (58)       |
| R-squared           | 0.10           | 0.11           | 0.10           | R-squared           | 0.14           | 0.19           | 0.13           | R-squared            | 0.13           | 0.15           | 0.12           |
| Fischer-stat        | 4.45           | 4.47           |                | Fischer-stat        | 4.61           | 5.46           |                | Fischer-stat         | 4.29           | 4.50           |                |
| ( <i>p-value</i> )  | (0.00)         | (0.00)         |                | ( <i>p-value</i> )  | (0.00)         | (0.00)         |                | ( <i>p-value</i> )   | (0.00)         | (0.00)         |                |
| Wald-stat           |                |                | 75.66          | Wald-stat           |                |                | 89.93          | Wald-stat            |                |                | 78.31          |
| ( <i>p-value</i> )  |                |                | (0.000)        | ( <i>p-value</i> )  |                |                | (0.000)        | ( <i>p-value</i> )   |                |                | (0.00)         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Coefficients displayed are marginal effects. The full table is reported as supplementary material at the end of the manuscript.

#### **2.5.4. Alternative definitions of the ERR variable**

In our main regressions, we differentiated among corner ERR, namely peg or float ERR, and intermediate regimes. In the following, we refine this classification by specifically differentiating among peg and float ERR, while still keeping the intermediated regimes as reference (Appendix B.3).

According to column (1) in Table 2.11, peg regimes are not found to significantly increase the probability of experiencing a banking crisis, compared to intermediate regimes. The same holds when comparing floating regimes with intermediate regimes, as emphasized by column (2). These findings are supported by the results illustrated in column (3), where we simultaneously account for the effect of peg and floating ERR on the likelihood of banking crises. Moreover, the high p-values of the equality tests between the coefficients of peg and float variables confirm that the effect of alternative corner ERR, namely peg or floating, on the likelihood of banking crises is statistically identical, supporting our strategy of considering them jointly in our main analysis. While the results are more mitigated for currency crises (columns 4-6), the evidence for debt crises (columns 7-9) confirms once again the absence of significant differences between the effects of corner and intermediate ERR on the likelihood of crises.

**Table 2.11: Pair comparison of the likelihood of crises**

|                          | Banking crises |                |                | Currency crises          |                |                | Debt crises  |                          |                |          |           |
|--------------------------|----------------|----------------|----------------|--------------------------|----------------|----------------|--------------|--------------------------|----------------|----------|-----------|
|                          | [1]            | [2]            | [3]            | [4]                      | [5]            | [6]            | [7]          | [8]                      | [9]            |          |           |
| <b>Peg</b>               | <b>-0.143</b>  |                | <b>-0.068</b>  | <b>Peg</b>               | <b>-0.298</b>  | <b>-0.340</b>  | <b>Peg</b>   | <b>-0.150</b>            | <b>0.174</b>   |          |           |
|                          | <b>(0.686)</b> |                | <b>(0.847)</b> |                          | <b>(0.584)</b> | <b>(0.497)</b> |              | <b>(0.791)</b>           | <b>(0.763)</b> |          |           |
| <b>Float</b>             |                | <b>-0.399</b>  | <b>-0.487</b>  | <b>Float</b>             |                | <b>0.721</b>   | <b>Float</b> |                          | <b>0.183</b>   |          |           |
|                          |                | <b>(0.274)</b> | <b>(0.167)</b> |                          |                | <b>(0.173)</b> |              |                          | <b>(0.815)</b> |          |           |
| Domestic credit          | 0.013          | 0.016**        | 0.016**        | Seigniorage              | 0.009          | 0.009          | 0.010**      | Public debt              | 0.015          | -0.013   | 0.006     |
|                          | (0.103)        | (0.021)        | (0.014)        |                          | (0.148)        | (0.140)        | (0.045)      |                          | (0.330)        | (0.464)  | (0.630)   |
| Volatility of DC         | 0.047*         | 0.041*         | 0.048**        | FB                       | -0.023         | -0.022         | -0.010       | Public debt squared      | 0.184          | 1.556**  | 0.470     |
|                          | (0.051)        | (0.063)        | (0.018)        |                          | (0.597)        | (0.625)        | (0.790)      |                          | (0.685)        | (0.021)  | (0.215)   |
| Size of the FS           | -1.002         | -0.662         | -0.430         | Domestic credit          | 0.018          | 0.016*         | 0.015*       | Inflation                | 0.030          | 4.132*   | 0.041     |
|                          | (0.288)        | (0.420)        | (0.568)        |                          | (0.175)        | (0.079)        | (0.062)      |                          | (0.747)        | (0.074)  | (0.618)   |
| Intermediation           | 0.001          | 0.000          | 0.001*         | Brod money               | -0.062         | -0.047         | -0.036       | Growth                   | -0.196***      | -0.270** | -0.213*** |
|                          | (0.222)        | (0.432)        | (0.094)        |                          | (0.254)        | (0.267)        | (0.275)      |                          | (0.005)        | (0.014)  | (0.001)   |
| CM regulation            | -0.065         | -0.147         | -0.163*        | Growth                   | -0.021         | 0.003          | 0.019        | Executive constraint     | 0.091          | -0.055   | -0.013    |
|                          | (0.494)        | (0.151)        | (0.068)        |                          | (0.764)        | (0.972)        | (0.754)      |                          | (0.465)        | (0.727)  | (0.910)   |
| Growth                   | -0.090**       | -0.073         | -0.083**       | Current account          | -0.004         | -0.046         | -0.013       | Aid                      | -0.114*        | -0.109   | -0.146**  |
|                          | (0.041)        | (0.141)        | (0.044)        |                          | (0.920)        | (0.277)        | (0.699)      |                          | (0.091)        | (0.174)  | (0.022)   |
| KA open                  | -0.137         | -0.112         | -0.054         | KA open                  | -0.935***      | -0.919***      | -0.826***    | KA open                  | -0.339         | -0.135   | -0.373    |
|                          | (0.341)        | (0.446)        | (0.672)        |                          | (0.001)        | (0.000)        | (0.000)      |                          | (0.181)        | (0.677)  | (0.111)   |
| Obs. (countries)         | 491 (70)       | 505 (63)       | 691 (76)       | Obs. (countries)         | 347 (59)       | 357 (55)       | 485 (65)     | Obs. (countries)         | 402 (57)       | 334 (46) | 517 (58)  |
| Pseudo R <sup>2</sup>    | 0.020          | 0.041          | 0.039          | Pseudo R <sup>2</sup>    | 0.122          | 0.154          | 0.137        | Pseudo R <sup>2</sup>    | 0.196          | 0.180    | 0.213     |
| Wald ( <i>stat</i> )     | 28.69          | 37.75          | 48.43          | Wald ( <i>stat</i> )     | 33.39          | 29.93          | 40.64        | Wald ( <i>stat</i> )     | 29.63          | 23.38    | 42.95     |
| Wald ( <i>p-value</i> )  | 0.037          | 0.002          | 0.000          | Wald ( <i>p-value</i> )  | 0.010          | 0.026          | 0.001        | Wald ( <i>p-value</i> )  | 0.029          | 0.137    | 0.000     |
| Log likelihood           | -219.5         | -215.0         | -283.2         | Log likelihood           | -143.6         | -146.0         | -195.9       | Log likelihood           | -131.9         | -96.01   | -153.9    |
| Test 1 [Peg]=[Float]     |                |                | 0.99           | Test 1 [Peg]=[Float]     |                |                | 5.21         | Test 1 [Peg]=[Float]     |                |          | 0.01      |
| Chi-2 ( <i>p-value</i> ) |                |                | 0.319          | Chi-2 ( <i>p-value</i> ) |                |                | 0.022        | Chi-2 ( <i>p-value</i> ) |                |          | 0.936     |
| Test 2 [Peg]=[Float]=0   |                |                | 1.96           | Test 2 [Peg]=[Float]=0   |                |                | 5.90         | Test 2 [Peg]=[Float]=0   |                |          | 0.10      |
| Chi-2 ( <i>p-value</i> ) |                |                | 0.376          | Chi-2 ( <i>p-value</i> ) |                |                | 0.052        | Chi-2 ( <i>p-value</i> ) |                |          | 0.950     |
| % Obs. corr. called      | 73.3           | 73.6           | 78.0           | % Obs. corr. called      | 71.2           | 65.5           | 72.0         | % Obs. corr. called      | 81.8           | 83.8     | 82.3      |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

In the following, we go one step further, by additionally decomposing our corner ERR variable. As emphasized by Table 2.12 based on IMF's classification, the variable Peg or float is the one used in our main analysis. Starting from this benchmark, we restrict the definition of corner ERR regimes by progressively dropping conventional peg and managed float ERR (Peg or Float1), currency union and EMU regimes (Peg or Float2) and currency boards (Peg or Float3). Notice that following this logic, the variable Peg or Float3 corresponds to the most narrow definition of corner ERR regimes, since it includes only extreme forms of pegs (another currency as legal tender, for example dollarization) and extreme forms of floating (floating regimes, namely freely floating). The rationale is that the more extreme the ERR, the bigger the room for finding a significant effect on the likelihood of crises for these extreme ERR compared to intermediate ERR.

**Table 2.12: Alternative definitions of corner EER based on IMF's classification**

| Fine                | Coarse       | Peg or float | Peg or float1 | Peg or float2 | Peg or float3 |
|---------------------|--------------|--------------|---------------|---------------|---------------|
| another currency    |              | 1            | 1             | 1             | 1             |
| currency board      | Peg          | 1            | 1             | 1             | excluded      |
| currency union/emu  |              | 1            | 1             | excluded      | excluded      |
| conventional peg    |              | 1            | excluded      | excluded      | excluded      |
| conventional basket |              | 0            | 0             | 0             | 0             |
| band peg            |              | 0            | 0             | 0             | 0             |
| forward cp          |              | 0            | 0             | 0             | 0             |
| forward cb          | Intermediate | 0            | 0             | 0             | 0             |
| backward cp         |              | 0            | 0             | 0             | 0             |
| backward cb         |              | 0            | 0             | 0             | 0             |
| other managed       |              | 0            | 0             | 0             | 0             |
| managed float       | Floating     | 1            | excluded      | excluded      | excluded      |
| floating            |              | 1            | 1             | 1             | 1             |

Note: Fine classifications are fully detailed in Appendix B.3.

According to the first column of Table 2.13, the use of an alternative definition for corner ERR does not change our previous findings: more restrictive ERR, namely with conventional peg and managed float excluded, are not found to be more prone to banking crises compared to intermediate regimes. Moreover, as emphasized by columns (2)-(3), the use of a more narrow definition for our interest variable, by additionally excluding currency unions and then currency boards, still refutes the bipolar view. In addition, we disentangle the variable Peg of float1 according to the level of income, using the same classification from section 5.2 above. As reported by the last three regressions, accounting for the level of economic development does not allow capturing a significantly different effect of ERR on the likelihood of banking crises, compared to intermediate ERR.

**Table 2.13: Alternative definitions of the ERR variable: banking crises**

|                         | [1]                      | [2]                      | [3]                      | LIC & LMIC               | UMIC                     | HIC                      |
|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>Peg or float1</b>    | <b>-0.308</b><br>(0.395) |                          |                          | <b>-0.517</b><br>(0.268) | <b>-1.949</b><br>(0.100) | <b>1.422*</b><br>(0.097) |
| <b>Peg or float2</b>    |                          | <b>-0.162</b><br>(0.705) |                          |                          |                          |                          |
| <b>Peg or float3</b>    |                          |                          | <b>-0.175</b><br>(0.693) |                          |                          |                          |
| Domestic credit         | 0.010<br>(0.133)         | 0.011<br>(0.129)         | 0.011<br>(0.104)         | 0.033**<br>(0.041)       | 0.024<br>(0.529)         | 0.013<br>(0.308)         |
| Volatility of DC        | 0.037*<br>(0.092)        | 0.031<br>(0.160)         | 0.036<br>(0.115)         | 0.042<br>(0.325)         | 0.201<br>(0.110)         | 0.004<br>(0.897)         |
| Size of the FS          | -0.267<br>(0.721)        | -0.623<br>(0.436)        | -0.597<br>(0.461)        | 1.096<br>(0.408)         | -8.172*<br>(0.098)       | -0.313<br>(0.828)        |
| Intermediation          | -0.000<br>(0.852)        | -0.000<br>(0.841)        | -0.000<br>(0.802)        | -0.000<br>(0.702)        | -2.009<br>(0.203)        | 0.031<br>(0.975)         |
| CM regulation           | -0.063<br>(0.522)        | -0.036<br>(0.734)        | -0.061<br>(0.567)        | 0.086<br>(0.550)         | 0.295<br>(0.348)         | -0.199<br>(0.419)        |
| Growth                  | -0.078*<br>(0.082)       | -0.088*<br>(0.072)       | -0.090*<br>(0.069)       | -0.065<br>(0.360)        | -0.217*<br>(0.099)       | -0.271***<br>(0.004)     |
| KA open                 | 0.008<br>(0.956)         | -0.048<br>(0.743)        | -0.069<br>(0.641)        | 0.287<br>(0.164)         | 0.655*<br>(0.078)        | -0.409<br>(0.265)        |
| Obs. (countries)        | 528 (74)                 | 439 (65)                 | 435 (65)                 | 221 (36)                 | 102 (14)                 | 205 (24)                 |
| Pseudo-R <sup>2</sup>   | 0.02                     | 0.03                     | 0.03                     | 0.00                     | 0.05                     | 0.014                    |
| Wald ( <i>stat</i> )    | 32.43                    | 28.24                    | 29.22                    | 22.80                    | 8.921                    | 24.53                    |
| Wald ( <i>p-value</i> ) | 0.01                     | 0.04                     | 0.03                     | 0.16                     | 0.94                     | 0.11                     |
| Log likelihood          | -228.1                   | -200.2                   | -195.7                   | -88.09                   | -36.99                   | -64.64                   |
| % Obs. correctly called | 72.3                     | 70.6                     | 70.8                     | 50.9                     | 68.5                     | 69.3                     |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

Finally, for robustness issues, we perform the same analysis for currency crises (Table 2.14) and debt crises (Table 2.15); yet again, we fail to observe significant differences between corner and intermediate ERR.<sup>39</sup> To summarize, this analysis confirms the robustness of our main results when considering alternative ERR classifications.<sup>40</sup>

<sup>39</sup> Besides, accounting for the level of income for each of the two remaining corner ERR variables, namely Peg or float2 and Peg or float3, and for each of the three types of crises, still supports our main findings (these estimations are fully reported as supplementary material).

<sup>40</sup> All our findings are established by holding the group of intermediate ERR identical (see Table 2.13). For robustness issues, we performed estimations in which the group of intermediate ERR is extended with the ERR excluded from the definition of Peg or float variables. These results, equally refute the bipolar view.

**Table 2.14: Alternative definitions of the ERR variable: *currency crises***

|                         | [1]                             | [2]                            | [3]                            | LIC & LMIC                     | UMIC                            | HIC                            |
|-------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------------------|--------------------------------|
| <b>Peg or float1</b>    | <b>-0.066</b><br><b>(0.918)</b> |                                |                                | <b>0.504</b><br><b>(0.571)</b> | <b>-2.451</b><br><b>(0.701)</b> | <b>1.134</b><br><b>(0.442)</b> |
| <b>Peg or float2</b>    |                                 | <b>0.165</b><br><b>(0.823)</b> |                                |                                |                                 |                                |
| <b>Peg or float3</b>    |                                 |                                | <b>0.265</b><br><b>(0.736)</b> |                                |                                 |                                |
| Seigniorage             | 0.016**<br>(0.017)              | 0.014*<br>(0.058)              | 0.015*<br>(0.058)              | 0.010<br>(0.292)               | 0.039<br>(0.419)                | 0.047**<br>(0.036)             |
| FB                      | -0.050<br>(0.276)               | -0.059<br>(0.237)              | -0.046<br>(0.356)              | 0.029<br>(0.661)               | -0.819<br>(0.109)               | -0.112<br>(0.198)              |
| Domestic credit         | 0.015<br>(0.112)                | 0.014<br>(0.184)               | 0.014<br>(0.195)               | 0.033<br>(0.147)               | 0.291<br>(0.106)                | -0.015<br>(0.357)              |
| Brod money              | -0.020<br>(0.600)               | -0.017<br>(0.685)              | -0.015<br>(0.725)              | -0.054<br>(0.497)              | -0.571<br>(0.421)               | 0.034<br>(0.405)               |
| Growth                  | -0.036<br>(0.652)               | -0.046<br>(0.608)              | -0.005<br>(0.960)              | 0.021<br>(0.857)               | -2.522**<br>(0.048)             | 0.038<br>(0.860)               |
| Current account         | -0.007<br>(0.846)               | -0.033<br>(0.437)              | -0.028<br>(0.523)              | 0.092<br>(0.164)               | -1.040<br>(0.150)               | -0.195*<br>(0.076)             |
| KA open                 | -0.683***<br>(0.004)            | -0.793***<br>(0.002)           | -0.843***<br>(0.002)           | -0.303<br>(0.463)              | -1.817<br>(0.365)               | -1.125***<br>(0.009)           |
| Obs. (countries)        | 360 (62)                        | 324 (57)                       | 320 (57)                       | 157 (31)                       | 75 (11)                         | 120 (18)                       |
| Pseudo-R <sup>2</sup>   | 0.15                            | 0.16                           | 0.17                           | 0.05                           | 0.15                            | 0.00                           |
| Wald ( <i>stat</i> )    | 27.84                           |                                | 27.05                          | 12.00                          | 14.85                           | 17.97                          |
| Wald ( <i>p-value</i> ) | 0.05                            |                                | 0.06                           | 0.80                           | 0.61                            | 0.39                           |
| Log likelihood          | -142.8                          | -128.4                         | -124.3                         | -60.96                         | -18.79                          | -28.33                         |
| % Obs. correctly called | 72.8                            | 71.6                           | 73.1                           | 58.1                           | 55.9                            | 62.8                           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

**Table 2.15: Alternative definitions of the ERR variable: debt crises**

|                         | [1]                      | [2]                      | [3]                      | LIC & LMIC               | UMIC                     |
|-------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <b>Peg or float1</b>    | <b>-0.457</b><br>(0.527) |                          |                          | <b>-0.036</b><br>(0.972) | <b>-1.074</b><br>(0.379) |
| <b>Peg or float2</b>    |                          | <b>-0.678</b><br>(0.452) |                          |                          |                          |
| <b>Peg or float3</b>    |                          |                          | <b>-0.774</b><br>(0.413) |                          |                          |
| Public debt             | 0.013<br>(0.470)         | 0.011<br>(0.598)         | 0.007<br>(0.719)         | 0.025<br>(0.295)         | 0.060<br>(0.504)         |
| Public debt squared     | 0.360<br>(0.497)         | 0.693<br>(0.275)         | 0.707<br>(0.253)         | -0.328<br>(0.692)        | 0.013<br>(0.995)         |
| Inflation               | 0.025<br>(0.823)         | -0.616<br>(0.488)        | 3.427*<br>(0.090)        | -0.029<br>(0.894)        | 0.151<br>(0.772)         |
| Growth                  | -0.161**<br>(0.036)      | -0.163*<br>(0.078)       | -0.157*<br>(0.097)       | -0.232*<br>(0.062)       | -0.127<br>(0.472)        |
| Executive constraint    | 0.079<br>(0.573)         | 0.100<br>(0.521)         | 0.061<br>(0.693)         | 0.147<br>(0.454)         | -0.188<br>(0.590)        |
| Aid                     | -0.126*<br>(0.083)       | -0.100<br>(0.232)        | -0.100<br>(0.222)        | -0.130<br>(0.155)        | -0.678<br>(0.132)        |
| KA open                 | -0.205<br>(0.434)        | -0.199<br>(0.515)        | -0.100<br>(0.737)        | 0.134<br>(0.771)         | -0.623*<br>(0.094)       |
| Obs. (countries)        | 373 (56)                 | 303 (48)                 | 299 (48)                 | 245 (39)                 | 108 (14)                 |
| Pseudo-R <sup>2</sup>   | 0.12                     | 0.16                     | 0.14                     | 0.12                     | 0.01                     |
| Wald ( <i>stat</i> )    | 29.59                    | 26.61                    | 26.07                    | 13.68                    | 9.09                     |
| Wald ( <i>p-value</i> ) | 0.03                     | 0.06                     | 0.07                     | 0.69                     | 0.94                     |
| Log likelihood          | -114.5                   | -96.39                   | -93.56                   | -66.05                   | -27.82                   |
| % Obs. correctly called | 84.7                     | 82.8                     | 83.6                     | 83.6                     | 78.5                     |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. No debt crises for HIC during the period of our analysis. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

### 2.5.5. Alternative databases for the main variables: crises and exchange rate regimes

One criticism for our main results may arise from combining data from Reinhart and Rogoff (2011) with data from Laeven and Valencia (2012) to define crises episodes. To tackle this point, we present in the following results based on the use of crises episodes from Reinhart and Rogoff's database alone. Due to gaps in their database, the number of countries in our sample falls from 90 to 59 countries.<sup>41</sup>

<sup>41</sup> The countries dropped are: Benin, Botswana, Burkina Faso, Burundi, Cameroon, Congo Republic, Dominica, Dominican Republic, Ethiopia, Gabon, Gambia, Israel, Jamaica, Jordan, Kuwait, Lesotho, Madagascar, Malawi, Mali, Nepal, Niger, Pakistan, Papua New Guinea, Senegal, Sierra Leone, Sudan, Suriname, Swaziland, Syrian Arab Republic, Togo and Uganda.

The first four columns of Table 2.16 report estimations based on the IMF's classification of ERR. For robustness issues, we disentangle the interest variable in several alternative variables measuring corner ERR, following the definitions used previously. As emphasized by columns (1)-(4) of Table 2.16, the coefficient of our interest variable is statistically not significant, supporting our previous findings that corner exchange rate regimes are not more prone to banking crises compared to intermediate regimes.



**Table 2.16: Alternative databases for crises and ERR: banking crises**

|                         | IMF classification |                |                |                | IRR classification      |                |                |                |
|-------------------------|--------------------|----------------|----------------|----------------|-------------------------|----------------|----------------|----------------|
|                         | [1]                | [2]            | [3]            | [4]            | [5]                     | [6]            | [7]            | [8]            |
| <b>Peg or float</b>     | <b>0.125</b>       |                |                |                | <b>Peg_or_float</b>     | <b>0.030</b>   |                |                |
|                         | <b>(0.620)</b>     |                |                |                |                         | <b>(0.899)</b> |                |                |
| <b>Peg or float1</b>    |                    | <b>0.326</b>   |                |                | <b>Peg_or_float1</b>    |                | <b>-0.018</b>  |                |
|                         |                    | <b>(0.381)</b> |                |                |                         |                | <b>(0.944)</b> |                |
| <b>Peg or float2</b>    |                    |                | <b>0.298</b>   |                | <b>Peg_or_float2</b>    |                |                | <b>-0.072</b>  |
|                         |                    |                | <b>(0.447)</b> |                |                         |                |                | <b>(0.796)</b> |
| <b>Peg or float3</b>    |                    |                |                | <b>0.344</b>   | <b>Peg_or_float3</b>    |                |                | <b>0.262</b>   |
|                         |                    |                |                | <b>(0.407)</b> |                         |                |                | <b>(0.439)</b> |
| Domestic credit         | 0.010**            | 0.006          | 0.006          | 0.007          | Domestic credit         | 0.010*         | 0.010*         | 0.010*         |
|                         | (0.038)            | (0.267)        | (0.293)        | (0.246)        |                         | (0.055)        | (0.086)        | (0.080)        |
| Volatility of DC        | 0.045**            | 0.041*         | 0.037*         | 0.043*         | Volatility of DC        | 0.053**        | 0.052**        | 0.051**        |
|                         | (0.017)            | (0.057)        | (0.086)        | (0.055)        |                         | (0.012)        | (0.021)        | (0.022)        |
| Size of the FS          | -0.665             | -0.709         | -0.782         | -0.817         | Size of the FS          | -0.601         | -0.590         | -0.607         |
|                         | (0.236)            | (0.250)        | (0.241)        | (0.234)        |                         | (0.283)        | (0.360)        | (0.347)        |
| Intermediation          | 0.000              | -0.000         | -0.000         | -0.001         | Intermediation          | 0.000          | 0.000          | 0.000          |
|                         | (0.308)            | (0.374)        | (0.412)        | (0.379)        |                         | (0.714)        | (0.333)        | (0.317)        |
| CM regulation           | -0.180**           | -0.083         | -0.056         | -0.085         | CM regulation           | -0.176**       | -0.200**       | -0.202**       |
|                         | (0.020)            | (0.402)        | (0.599)        | (0.433)        |                         | (0.021)        | (0.037)        | (0.036)        |
| Growth                  | -0.078*            | -0.105*        | -0.102*        | -0.108*        | Growth                  | -0.074*        | -0.109**       | -0.110**       |
|                         | (0.085)            | (0.067)        | (0.093)        | (0.086)        |                         | (0.098)        | (0.036)        | (0.034)        |
| KA open                 | -0.079             | -0.039         | -0.047         | -0.060         | KA open                 | -0.081         | -0.019         | -0.017         |
|                         | (0.412)            | (0.738)        | (0.702)        | (0.638)        |                         | (0.393)        | (0.858)        | (0.874)        |
| Obs. (countries)        | 496 (53)           | 377 (53)       | 351 (52)       | 347 (52)       | Obs. (countries)        | 491 (53)       | 453 (53)       | 453 (53)       |
| Pseudo R                | 0.00               | 0.00           | 0.00           | 0.00           | Pseudo R                | 0.00           | 0.00           | 0.00           |
| Wald ( <i>stat</i> )    | 44.82              | 33.11          | 29.77          | 31.16          | Wald ( <i>stat</i> )    | 42.72          | 38.91          | 38.98          |
| Wald ( <i>p-value</i> ) | 0.00               | 0.01           | 0.03           | 0.02           | Wald ( <i>p-value</i> ) | 0.00           | 0.00           | 0.00           |
| Log likelihood          | -267.8             | -202.3         | -191.9         | -187.3         | Log likelihood          | -262.9         | -237.8         | -237.8         |
| % Obs. corr. called     | 59.4               | 57.2           | 57.2           | 58.2           | % Obs. corr. called     | 59.4           | 61.5           | 61.1           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The IMF and IRR classifications of ERR lead to different definitions of corner ERR variables. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

In the following, we investigate the robustness of our results to the use of an alternative classification for our main variable, namely ERR. To do so, we draw upon the Ilzetski, Reinhart and Rogoff's (2010) natural de facto classification of ERR, and define the following dummies. *Peg\_or\_float* is the widest measure of corner ERR, since it includes all forms of peg (namely hard pegs and de facto pegs) and all forms of floating (namely managed and freely floating), as reported by Table 2.17 and Appendix B.4. By so doing, the variable *Peg\_or\_float* aims at matching, to the extent to which this is possible given the use of two different databases, the variable Peg or float based on the IMF database.

**Table 2.17: Alternative definitions of corner EER based on IRR's classification**

| Fine                | Coarse       | Peg or float | Peg or float1 | Peg or float2 | Peg or float3 |
|---------------------|--------------|--------------|---------------|---------------|---------------|
| no separate         | Hard peg     | 1            | 1             | 1             | 1             |
| currency board      |              | 1            | 1             | 1             | 1             |
| defacto peg         | Peg          | 1            | 1             | excluded      | excluded      |
| crawling peg        | Intermediate | 0            | 0             | 0             | 0             |
| crawling band       |              | 0            | 0             | 0             | 0             |
| defacto cp          |              | 0            | 0             | 0             | 0             |
| defacto cb          |              | 0            | 0             | 0             | 0             |
| wider cb            |              | 0            | 0             | 0             | 0             |
| defacto cb narrower |              | 0            | 0             | 0             | 0             |
| moving band         | Floating     | 0            | 0             | 0             | 0             |
| managed float       |              | 1            | 1             | 1             | excluded      |
| freely floating     |              | 1            | 1             | 1             | 1             |
| freely falling      |              | 0            | excluded      | excluded      | excluded      |

Note: Fine classifications are fully detailed in Appendix B.4.

Using the variable Peg or float as benchmark, we refine it as follows. Peg or float1 includes the same corner regimes, but we exclude freely falling observations from intermediate regimes. According to IRR, freely falling observations refer to countries that present inflation rates above 40%, irrespective of their ERR. Next, we restrict the definition of corner ERR by progressively dropping de facto pegs (Peg or float2) and managed float regimes (Peg or float3). As previously, the rationale is that restricting at most the definition of corner ERR might unveil a significant effect compared to intermediate ERR.

The results based on the use of the IRR database for the ERR are illustrated in columns (5)-(8) in Table 2.16. Despite alternative measures of extreme ERR, we fail to reveal a significantly different effect of such regimes on the likelihood of banking crises, compared to intermediate regimes. In addition, excluding observations for countries with inflation rates above 40% does not alter our findings, thus confirming previous evidence based on the IMF's classification of ERR.

Finally, Tables 2.18 and 2.19 perform the same analysis for currency and debt crises respectively.<sup>42</sup> Irrespective of the database used to classify ERR, namely IMF or Ilzetski, Reinhart and Rogoff, or of the way corner ERR are defined, we still fail to find a significantly different effect of extreme ERR on the occurrence of currency and debt crises, compared to intermediate ERR. Consequently, our former findings of no bipolar view persist, and are equally robust to the sample selection bias analyzed in this subsection.

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<sup>42</sup> As previously, we performed for robustness issues estimations in which the group of intermediate ERR is extended with the ERR excluded from the definition of *Peg\_or\_float* variables, without however identifying qualitative changes in the effect of corner ERR on the likelihood of crises.

**Table 2.18: Alternative databases for crises and ERR: currency crises**

|                         | IMF classification             |                                |                                |                                | IRR classification      |                                 |                                |                                 |                      |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------|---------------------------------|--------------------------------|---------------------------------|----------------------|
|                         | [1]                            | [2]                            | [3]                            | [4]                            | [5]                     | [6]                             | [7]                            | [8]                             |                      |
| <b>Peg or float</b>     | <b>0.477</b><br><b>(0.200)</b> |                                |                                |                                | <b>Peg_or_float</b>     | <b>-0.151</b><br><b>(0.686)</b> |                                |                                 |                      |
| <b>Peg or float1</b>    |                                | <b>0.413</b><br><b>(0.493)</b> |                                |                                | <b>Peg_or_float1</b>    |                                 | <b>0.104</b><br><b>(0.774)</b> |                                 |                      |
| <b>Peg or float2</b>    |                                |                                | <b>0.428</b><br><b>(0.476)</b> |                                | <b>Peg_or_float2</b>    |                                 | <b>0.178</b><br><b>(0.649)</b> |                                 |                      |
| <b>Peg or float3</b>    |                                |                                |                                | <b>0.542</b><br><b>(0.398)</b> | <b>Peg_or_float3</b>    |                                 |                                | <b>-0.087</b><br><b>(0.870)</b> |                      |
| Seigniorage             | 0.012**<br>(0.029)             | 0.013*<br>(0.059)              | 0.013*<br>(0.059)              | 0.013*<br>(0.055)              | Seigniorage             | 0.010*<br>(0.063)               | 0.006<br>(0.321)               | 0.006<br>(0.323)                | 0.006<br>(0.314)     |
| FB                      | -0.033<br>(0.338)              | -0.030<br>(0.473)              | -0.030<br>(0.472)              | -0.021<br>(0.620)              | FB                      | -0.031<br>(0.379)               | -0.002<br>(0.953)              | -0.002<br>(0.963)               | -0.004<br>(0.918)    |
| Domestic credit         | 0.005<br>(0.403)               | 0.007<br>(0.387)               | 0.007<br>(0.391)               | 0.007<br>(0.387)               | Domestic credit         | 0.006<br>(0.332)                | 0.002<br>(0.677)               | 0.002<br>(0.693)                | 0.003<br>(0.617)     |
| Brod money              | 0.002<br>(0.891)               | 0.015<br>(0.566)               | 0.015<br>(0.574)               | 0.017<br>(0.523)               | Brod money              | 0.009<br>(0.674)                | 0.016<br>(0.445)               | 0.015<br>(0.461)                | 0.017<br>(0.437)     |
| Growth                  | -0.049<br>(0.446)              | -0.065<br>(0.439)              | -0.061<br>(0.465)              | -0.024<br>(0.785)              | Growth                  | -0.077<br>(0.224)               | -0.100<br>(0.138)              | -0.097<br>(0.152)               | -0.101<br>(0.136)    |
| Current account         | 0.011<br>(0.752)               | 0.067<br>(0.153)               | 0.068<br>(0.148)               | 0.073<br>(0.137)               | Current account         | 0.011<br>(0.757)                | -0.000<br>(0.994)              | 0.000<br>(0.993)                | -0.001<br>(0.977)    |
| KA open                 | -0.740***<br>(0.000)           | -0.854***<br>(0.000)           | -0.850***<br>(0.000)           | -0.906***<br>(0.000)           | KA open                 | -0.752***<br>(0.000)            | -0.658***<br>(0.000)           | -0.655***<br>(0.000)            | -0.658***<br>(0.000) |
| Obs. (countries)        | 353 (48)                       | 266 (46)                       | 263 (46)                       | 259 (46)                       | Obs. (countries)        | 350 (48)                        | 310 (48)                       | 310 (48)                        | 310 (48)             |
| Pseudo R                | 0.04                           | 0.06                           | 0.05                           | 0.06                           | Pseudo R                | 0.05                            | 0.02                           | 0.02                            | 0.02                 |
| Wald ( <i>stat</i> )    | 49.50                          | 37.38                          | 36.60                          | 35.73                          | Wald ( <i>stat</i> )    | 49.01                           | 38.68                          | 39.02                           | 38.30                |
| Wald ( <i>p-value</i> ) | 0.000                          | 0.002                          | 0.003                          | 0.004                          | Wald ( <i>p-value</i> ) | 0.00                            | 0.00                           | 0.00                            | 0.00                 |
| Log likelihood          | -178.1                         | -130.0                         | -129.9                         | -126.0                         | Log likelihood          | -175.3                          | -158.4                         | -158.4                          | -158.5               |
| % Obs corr. called      | 65.7                           | 65.7                           | 65.0                           | 66.0                           | % Obs corr. called      | 66.8                            | 64.8                           | 64.8                            | 65.8                 |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The IMF and IRR classifications of ERR lead to different definitions of corner ERR variables. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

**Table 2.19: Alternative databases for crises and ERR: debt crises**

|                         | IMF classification             |                                 |                                 |                                 | IRR classification      |                                 |                                 |                                 |                      |
|-------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|-------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------|
|                         | [1]                            | [2]                             | [3]                             | [4]                             | [5]                     | [6]                             | [7]                             | [8]                             |                      |
| <b>Peg or float</b>     | <b>0.115</b><br><b>(0.807)</b> |                                 |                                 |                                 | <b>Peg_or_float</b>     | <b>-0.345</b><br><b>(0.485)</b> |                                 |                                 |                      |
| <b>Peg or float1</b>    |                                | <b>-1.371</b><br><b>(0.123)</b> |                                 |                                 | <b>Peg_or_float1</b>    |                                 | <b>-0.430</b><br><b>(0.465)</b> |                                 |                      |
| <b>Peg or float2</b>    |                                |                                 | <b>-1.371</b><br><b>(0.123)</b> |                                 | <b>Peg_or_float2</b>    |                                 |                                 | <b>-0.755</b><br><b>(0.240)</b> |                      |
| <b>Peg or float3</b>    |                                |                                 |                                 | <b>-1.441</b><br><b>(0.121)</b> | <b>Peg_or_float3</b>    |                                 |                                 | <b>-0.889</b><br><b>(0.237)</b> |                      |
| Public debt             | -0.000<br>(0.982)              | 0.006<br>(0.808)                | 0.006<br>(0.808)                | 0.006<br>(0.807)                | Public debt             | -0.002<br>(0.920)               | 0.014<br>(0.561)                | 0.015<br>(0.564)                | 0.016<br>(0.512)     |
| Public debt squared     | 0.953**<br>(0.043)             | 1.314<br>(0.116)                | 1.314<br>(0.116)                | 1.237<br>(0.131)                | Public debt squared     | 1.021**<br>(0.038)              | 0.837<br>(0.271)                | 0.857<br>(0.269)                | 0.756<br>(0.318)     |
| Inflation               | 0.155<br>(0.784)               | -1.204<br>(0.332)               | -1.204<br>(0.332)               | -0.123<br>(0.961)               | Inflation               | 0.096<br>(0.858)                | -0.004<br>(0.994)               | -0.065<br>(0.902)               | -0.047<br>(0.926)    |
| Growth                  | -0.336***<br>(0.000)           | -0.257**<br>(0.032)             | -0.257**<br>(0.032)             | -0.248**<br>(0.037)             | Growth                  | -0.306***<br>(0.000)            | -0.288***<br>(0.006)            | -0.307***<br>(0.005)            | -0.296***<br>(0.005) |
| Executive constraint    | -0.052<br>(0.659)              | -0.053<br>(0.752)               | -0.053<br>(0.752)               | -0.052<br>(0.748)               | Executive constraint    | -0.022<br>(0.854)               | -0.137<br>(0.338)               | -0.150<br>(0.306)               | -0.127<br>(0.375)    |
| Aid                     | -0.003<br>(0.961)              | 0.000<br>(0.996)                | 0.000<br>(0.996)                | 0.002<br>(0.986)                | Aid                     | -0.006<br>(0.929)               | 0.085<br>(0.341)                | 0.088<br>(0.339)                | 0.086<br>(0.347)     |
| KA open                 | 0.019<br>(0.927)               | 0.133<br>(0.640)                | 0.133<br>(0.640)                | 0.174<br>(0.535)                | KA open                 | 0.028<br>(0.895)                | -0.012<br>(0.956)               | -0.024<br>(0.917)               | 0.047<br>(0.838)     |
| Obs. (countries)        | 313 (34)                       | 211 (34)                        | 211 (34)                        | 207 (34)                        | Obs. (countries)        | 310 (34)                        | 262 (34)                        | 262 (34)                        | 262 (34)             |
| Pseudo R                | 0.10                           | 0.10                            | 0.10                            | 0.09                            | Pseudo R                | 0.11                            | 0.10                            | 0.09                            | 0.09                 |
| Wald ( <i>stat</i> )    | 51.56                          | 32.26                           | 32.26                           | 31.22                           | Wald ( <i>stat</i> )    | 50.97                           | 38.76                           | 38.67                           | 39.09                |
| Wald ( <i>p-value</i> ) | 0.000                          | 0.014                           | 0.014                           | 0.018                           | Wald ( <i>p-value</i> ) | 0.00                            | 0.00                            | 0.00                            | 0.00                 |
| Log likelihood          | -133.8                         | -91.04                          | -91.04                          | -90.13                          | Log likelihood          | -131.6                          | -105.2                          | -104.7                          | -104.7               |
| % Obs. corr. called     | 72.5                           | 73.9                            | 73.9                            | 72.4                            | % Obs. corr. called     | 71.9                            | 74.8                            | 73.6                            | 73.2                 |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The IMF and IRR classifications of ERR lead to different definitions of corner ERR variables. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b). The full table is reported as supplementary material at the end of the manuscript.

## **2.6. Conclusion**

This chapter offers an overview on the link between crises and exchange rate regimes. Based on a panel of developing and developed countries over the period 1980-2009, we show that the type of exchange rate regime is unimportant when it comes to explaining the likelihood of crises. This result holds to a wide set of robustness specifications. First, our findings do not characterize a specific type of crisis, but they are common to banking, currency and debt crises, and also when controlling for appropriate determinants of each type of crisis. Second, accounting for contagion effects between the three types of crises or controlling for the level of economic development leaves our results unchanged. Third, our results are robust to the use of alternative definitions of corner ERR. Finally, conducting the analysis on alternative databases for our main variables, namely ERR and crises, has no impact on our findings. Consequently, our results vigorously contradict the view that intermediate exchange rate regimes are more prone to crises than hard pegs and independently floating regimes. In other words, although the likelihood of crises might depend of fiscal, financial and monetary variables, it is not related to the exchange rate regime in place. Thus, we clearly break down the bipolar view.

The policy implications of this chapter appear straightforward. Our main findings show that crises and ERR are not systematically interrelated. Therefore, countries aiming at preventing economic crises should not focus on the choice of an appropriate exchange rate regime alone, and instead proceed to structural reforms by implementing sound macroeconomic and financial policies to safeguard against crises-conducting behaviors, such as reckless credit expansion, unsustainable fiscal policy or exploding debt paths policies.

## Appendices B

### Appendix B.1: The list of countries by income level

**Low and Lower Middle Income Countries (LIC and LMIC):** Benin, Bolivia, Burkina Faso, Burundi, Cameroon, Congo, Rep., Cote d'Ivoire, Egypt, El Salvador, Ethiopia, Gambia, Ghana, Guatemala, Honduras, India, Indonesia, Kenya, Lesotho, Madagascar, Malawi, Mali, Morocco, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Paraguay, Philippines, Senegal, Sierra Leone, Sri Lanka, Sudan, Swaziland, Syrian Arab Republic, Togo, Uganda, Zambia, Zimbabwe.

**Upper Middle Income Countries (UMIC):** Argentina, Botswana, Brazil, Chile, China, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, Gabon, Jamaica, Jordan, Malaysia, Mauritius, Mexico, Panama, Peru, South Africa, Suriname, Thailand, Tunisia, Turkey, Uruguay, Venezuela.

**High Income Countries (HIC):** Australia, Canada, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea Rep., Kuwait, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom, United States.

### Appendix B.2: Descriptive statistics

| Variable                                   | Obs. | Mean   | Std. Dev. | Min   | Max     | Source   |
|--|------|--------|-----------|-------|---------|--|
| Domestic credit                            | 900  | 43.7   | 39.2      | 0     | 244.0   | World Bank, World Development Indicators (WDI) 2011              |
| Volatility of DC                           | 898  | 3.6    | 6.1       | 0     | 77.5    |  |
| Inflation                                  | 880  | 0.8    | 1.7       | -8.1  | 49.3    |  |
| Seigniorage                                | 897  | 38.3   | 336.7     | -54.7 | 8039.0  |  |
| GDP per capita                             | 900  | 8984.9 | 12611.3   | 36.7  | 65670.0 |  |
| ODA (Aid)                                  | 670  | 6.1    | 7.4       | -0.2  | 50.19   |  |
| Output growth                              | 900  | 3.3    | 3.4       | -17.3 | 19.62   |  |
| Broad money                                | 838  | 43.9   | 396.0     | 0.0   | 5784.2  |  |
| Current account balance                    | 897  | -2.8   | 7.7       | -60.5 | 43.5    |  |
| Public debt                                | 881  | 67.0   | 53.7      | 2.7   | 967.8   | Ali Abbas <i>et al.</i> , (2010) Historical Public Debt database |
| Primary fiscal balance                     | 595  | -3.1   | 5.6       | -25.6 | 37.2    | IMF, IFS 2011  |
| Credit market regulation                   | 820  | 6.7    | 2.116     | 0     | 10      | Economic Freedom Network dataset, 2011                           |
| Size of the financial sector               | 845  | 0.5    | 0.3       | 0.03  | 2.4     | Beck and Demirgüç-Kunt, Financial Structure dataset, 2010        |
| Bank credits/bank deposit (Intermediation) | 877  | 7.5    | 70.1      | 0.1   | 942.3   |  |
| Executive constraint                       | 837  | 4.7    | 2.2       | 1     | 7       | Polity IV project database, 2010                                 |
| Capital account openness                   | 804  | 0.1    | 1.5       | -1.8  | 2.5     | Chinn and Ito database, 2008                                     |

**Appendix B.3: IMF classification of exchange rate regimes (ERR)**

| Codes | IMF fine classification   | Coarse classification |
|-------|---|-----------------------|
| 1     | Another currency as legal tender                                  | <b>Peg</b>            |
| 2     | Currency board  |                       |
| 3     | Currency union  |                       |
| 4     | Economic union/Monetary coordination agreement                    |                       |
| 5     | Conventional fixed peg to a single currency                       |                       |
| 6     | Conventional fixed peg to a basket                                | <b>Intermediate</b>   |
| 7     | Pegged within horizontal bands                                    |                       |
| 8     | Forward-looking crawling peg                                      |                       |
| 9     | Forward-looking crawling band                                     |                       |
| 10    | Backward-looking crawling peg                                     |                       |
| 11    | Backward-looking crawling band                                    |                       |
| 12    | Other tightly managed floating                                    | <b>Floating</b>       |
| 13    | Managed floating with no predetermined path for the exchange rate |                       |
| 14    | Independently floating  |                       |

Note: No observation in category 4 in our sample.

**Appendix B.4: Ilzetki, Reinhart and Rogoff (2010) classification of ERR**

| Codes | Fine classifications  | Coarse classification |
|-------|---|-----------------------|
| 1     | No separate legal tender  | <b>Pegged</b>         |
| 2     | Pre announced peg or currency board arrangement   |                       |
| 3     | Pre announced horizontal band that is narrower than or equal to +/-2%   |                       |
| 4     | De facto peg  |                       |
| 5     | Pre announced crawling peg  | <b>Intermediate</b>   |
| 6     | Pre announced crawling band that is narrower than or equal to +/-2%   |                       |
| 7     | De facto crawling peg   |                       |
| 8     | De facto crawling band that is narrower than or equal to +/-2%  |                       |
| 9     | Pre announced crawling band that is wider than or equal to +/-2%  |                       |
| 10    | De facto crawling band that is narrower than or equal to +/-5%  |                       |
| 11    | Moving band that is narrower than or equal to +/-2% (i.e. it allows for both appreciation and depreciation over time) | <b>Floating</b>       |
| 12    | Managed floating  |                       |
| 13    | Freely floating   |                       |
| 14    | Freely falling  | <b>Other</b>          |
| 15    | Dual market in which parallel market data is missing  |                       |

Note: No observation in category 3 in our sample. Due to controversies around their definition, we exclude from our sample observations from category 15.



**Appendix B.5: Supplementary Material:**

Table 3.1.1: Likelihood of banking crises, with a constant number of observations

|                            | (1)             | (2)             | (3)             | (4)             | (5)             | (6)             | (7)             | (8)             |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Peg or float</b>        | <b>-0.055</b>   | <b>-0.100</b>   | <b>-0.139</b>   | <b>-0.142</b>   | <b>-0.172</b>   | <b>-0.218</b>   | <b>-0.290</b>   | <b>-0.279</b>   |
|                            | (0.837)         | (0.720)         | (0.617)         | (0.611)         | (0.534)         | (0.432)         | (0.304)         | (0.323)         |
| Domestic credit            |                 | 0.013***        | 0.008*          | 0.009           | 0.011*          | 0.014**         | 0.015**         | 0.015**         |
|                            |                 | (0.004)         | (0.060)         | (0.147)         | (0.063)         | (0.019)         | (0.017)         | (0.015)         |
| Volatility of DC           |                 |                 | 0.059***        | 0.058***        | 0.053***        | 0.053***        | 0.047**         | 0.047**         |
|                            |                 |                 | (0.002)         | (0.003)         | (0.007)         | (0.007)         | (0.018)         | (0.019)         |
| Size of the FS             |                 |                 |                 | -0.089          | -0.450          | -0.419          | -0.505          | -0.509          |
|                            |                 |                 |                 | (0.903)         | (0.546)         | (0.565)         | (0.497)         | (0.491)         |
| Intermediation             |                 |                 |                 |                 | 0.001**         | 0.001*          | 0.001*          | 0.001*          |
|                            |                 |                 |                 |                 | (0.037)         | (0.063)         | (0.080)         | (0.090)         |
| CM regulation              |                 |                 |                 |                 |                 | -0.211***       | -0.181**        | -0.168*         |
|                            |                 |                 |                 |                 |                 | (0.010)         | (0.030)         | (0.057)         |
| Growth                     |                 |                 |                 |                 |                 |                 | -0.084**        | -0.083**        |
|                            |                 |                 |                 |                 |                 |                 | (0.041)         | (0.044)         |
| KA open                    |                 |                 |                 |                 |                 |                 |                 | -0.057          |
|                            |                 |                 |                 |                 |                 |                 |                 | (0.652)         |
| <b>Obs. (countries)</b>    | <b>691 (76)</b> | <b>691 (76)</b> | <b>691 (76)</b> | <b>691 (76)</b> | <b>691 (76)</b> | <b>691 (76)</b> | <b>691 (76)</b> | <b>691 (76)</b> |
| Pseudo-R <sup>2</sup>      | 0.04            | 0.04            | 0.04            | 0.04            | 0.04            | 0.04            | 0.04            | 0.04            |
| Wald-stat ( <i>Chi-2</i> ) | 27.68           | 33.49           | 39.18           | 39.14           | 41.04           | 45.51           | 48.29           | 48.52           |
| Wald ( <i>p-value</i> )    | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            |
| Log likelihood             | -301.2          | -296.3          | -291.6          | -291.6          | -289.3          | -285.9          | -283.8          | -283.7          |
| % Obs. correctly called    | 78.0            | 76.7            | 78.1            | 77.9            | 78.4            | 77.3            | 76.9            | 78.4            |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values in brackets. All specifications include time dummies. Coefficients displayed are marginal effects. Hausman specification test suggested random effects with the Logit estimator. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Table 3.2.1: Likelihood of currency crises, with a constant number of observations

|                            | [1]                            | [2]                            | [3]                            | [4]                            | [5]                            | [6]                            | [7]                            | [8]                            |
|----------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| <b>Peg or float</b>        | <b>0.202</b><br><b>(0.581)</b> | <b>0.262</b><br><b>(0.483)</b> | <b>0.260</b><br><b>(0.486)</b> | <b>0.246</b><br><b>(0.517)</b> | <b>0.310</b><br><b>(0.417)</b> | <b>0.310</b><br><b>(0.422)</b> | <b>0.258</b><br><b>(0.508)</b> | <b>0.418</b><br><b>(0.297)</b> |
| Seigniorage                |                                | 0.009*<br>(0.053)              | 0.009*<br>(0.051)              | 0.010**<br>(0.049)             | 0.010**<br>(0.049)             | 0.010**<br>(0.049)             | 0.009*<br>(0.057)              | 0.010*<br>(0.052)              |
| FB                         |                                |                                | -0.011<br>(0.735)              | -0.012<br>(0.726)              | -0.015<br>(0.664)              | -0.015<br>(0.664)              | -0.010<br>(0.787)              | -0.010<br>(0.777)              |
| Domestic credit            |                                |                                |                                | 0.005<br>(0.425)               | 0.009<br>(0.238)               | 0.009<br>(0.238)               | 0.009<br>(0.249)               | 0.018**<br>(0.022)             |
| Broad money                |                                |                                |                                |                                | -0.043<br>(0.204)              | -0.043<br>(0.206)              | -0.044<br>(0.202)              | -0.037<br>(0.263)              |
| Growth                     |                                |                                |                                |                                |                                | 0.000<br>(0.993)               | -0.022<br>(0.708)              | 0.020<br>(0.742)               |
| Current account            |                                |                                |                                |                                |                                |                                | -0.042<br>(0.184)              | -0.013<br>(0.689)              |
| KA open                    |                                |                                |                                |                                |                                |                                |                                | -0.789***<br>(0.000)           |
| <b>Obs. (countries)</b>    | <b>485 (65)</b>                | <b>485 (65)</b>                | <b>485 (65)</b>                | <b>485 (65)</b>                | <b>485 (65)</b>                | <b>485 (65)</b>                | <b>485 (65)</b>                | <b>485 (65)</b>                |
| Pseudo-R <sup>2</sup>      | 0.16                           | 0.16                           | 0.16                           | 0.15                           | 0.15                           | 0.15                           | 0.15                           | 0.15                           |
| Wald-stat ( <i>Chi-2</i> ) | 24.66                          | 26.77                          | 26.88                          | 26.69                          | 27.72                          | 27.72                          | 28.99                          | 38.78                          |
| Wald ( <i>p-value</i> )    | 0.01                           | 0.00                           | 0.01                           | 0.01                           | 0.01                           | 0.02                           | 0.02                           | 0.00                           |
| Log likelihood             | -212.3                         | -210.5                         | -210.4                         | -210.1                         | -209.2                         | -209.2                         | -208.3                         | -198.5                         |
| % Obs. correctly called    | 68.6                           | 67.3                           | 69.5                           | 67.3                           | 68.3                           | 68.3                           | 68.7                           | 71.8                           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. Once we introduce the variable Seigniorage in our models (from specification [3]), we drop Cameroon, Republic of Congo, Cote d'Ivoire, Gabon, Senegal, Sudan, Suriname, Syria and Zimbabwe from the sample due to outliers. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Table 3.3.1: Likelihood of debt crises, with a constant number of observations

|                            | (1)             | (2)             | (3)             | (4)             | (5)             | (6)             | (7)             | (8)             |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Peg or float</b>        | <b>0.513</b>    | <b>0.446</b>    | <b>0.497</b>    | <b>0.504</b>    | <b>0.141</b>    | <b>0.135</b>    | <b>0.184</b>    | <b>0.222</b>    |
|                            | <b>(0.243)</b>  | <b>(0.320)</b>  | <b>(0.271)</b>  | <b>(0.267)</b>  | <b>(0.764)</b>  | <b>(0.773)</b>  | <b>(0.697)</b>  | <b>(0.644)</b>  |
| Public debt                |                 | 0.013**         | 0.002           | 0.002           | -0.003          | -0.003          | 0.005           | 0.006           |
|                            |                 | (0.022)         | (0.850)         | (0.862)         | (0.799)         | (0.799)         | (0.693)         | (0.634)         |
| Public debt squared        |                 |                 | 0.432           | 0.434           | 0.607           | 0.607           | 0.550           | 0.468           |
|                            |                 |                 | (0.269)         | (0.268)         | (0.110)         | (0.111)         | (0.136)         | (0.216)         |
| Inflation                  |                 |                 |                 | 0.062           | 0.051           | 0.050           | 0.049           | 0.041           |
|                            |                 |                 |                 | (0.450)         | (0.505)         | (0.506)         | (0.522)         | (0.617)         |
| Growth                     |                 |                 |                 |                 | -0.223***       | -0.223***       | -0.224***       | -0.211***       |
|                            |                 |                 |                 |                 | (0.000)         | (0.000)         | (0.000)         | (0.001)         |
| Executive constraint       |                 |                 |                 |                 |                 | -0.019          | -0.018          | -0.014          |
|                            |                 |                 |                 |                 |                 | (0.874)         | (0.878)         | (0.907)         |
| Aid                        |                 |                 |                 |                 |                 |                 | -0.138**        | -0.146**        |
|                            |                 |                 |                 |                 |                 |                 | (0.027)         | (0.022)         |
| KA open                    |                 |                 |                 |                 |                 |                 |                 | -0.377          |
|                            |                 |                 |                 |                 |                 |                 |                 | (0.107)         |
| <b>Obs. (countries)</b>    | <b>517 (58)</b> | <b>517 (58)</b> | <b>517 (58)</b> | <b>517 (58)</b> | <b>517 (58)</b> | <b>517 (58)</b> | <b>517 (58)</b> | <b>517 (58)</b> |
| Pseudo-R <sup>2</sup>      | 0.23            | 0.23            | 0.23            | 0.23            | 0.22            | 0.22            | 0.21            | 0.21            |
| Wald-stat ( <i>Chi-2</i> ) | 33.77           | 35.40           | 35.65           | 35.65           | 40.93           | 41.01           | 42.37           | 42.83           |
| Wald ( <i>p-value</i> )    | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            |
| Log likelihood             | -168.0          | -165.3          | -164.7          | -164.5          | -158.0          | -158.0          | -155.2          | -153.9          |
| % Obs. correctly called    | 88.1            | 86.8            | 86.2            | 86.6            | 85.4            | 85.8            | 82.7            | 82.7            |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Table 9.1.1: Alternative definitions of the ERR variable and the level of economic development: banking crises (completes Table 9.1)

|                            | LIC & LMIC                      |                   |                   | UMIC                             |                    |                    | HIC                             |                      |                      |
|----------------------------|---------------------------------|-------------------|-------------------|----------------------------------|--------------------|--------------------|---------------------------------|----------------------|----------------------|
| <b>Peg or float1</b>       | <b>-0.517</b><br><b>(0.268)</b> |                   |                   | <b>-1.949*</b><br><b>(0.100)</b> |                    |                    | <b>1.422*</b><br><b>(0.097)</b> |                      |                      |
| <b>Peg or float2</b>       | <b>-0.201</b><br><b>(0.777)</b> |                   |                   | <b>-0.904</b><br><b>(0.450)</b>  |                    |                    | <b>1.356</b><br><b>(0.146)</b>  |                      |                      |
| <b>Peg or float3</b>       | <b>-0.201</b><br><b>(0.777)</b> |                   |                   | <b>-0.571</b><br><b>(0.673)</b>  |                    |                    | <b>1.356</b><br><b>(0.146)</b>  |                      |                      |
| Domestic credit            | 0.033**<br>(0.041)              | 0.031*<br>(0.079) | 0.031*<br>(0.079) | 0.024<br>(0.529)                 | 0.013<br>(0.725)   | -0.017<br>(0.714)  | 0.013<br>(0.308)                | 0.017<br>(0.228)     | 0.017<br>(0.228)     |
| Volatility of DC           | 0.042<br>(0.325)                | 0.033<br>(0.447)  | 0.033<br>(0.447)  | 0.201<br>(0.110)                 | 0.200<br>(0.114)   | 0.436*<br>(0.068)  | 0.004<br>(0.897)                | -0.009<br>(0.804)    | -0.009<br>(0.804)    |
| Size of the FS             | 1.096<br>(0.408)                | 0.685<br>(0.629)  | 0.685<br>(0.629)  | -8.172*<br>(0.098)               | -6.968<br>(0.135)  | -4.925<br>(0.326)  | -0.313<br>(0.828)               | -0.444<br>(0.763)    | -0.444<br>(0.763)    |
| Intermediation             | -0.000<br>(0.702)               | -0.000<br>(0.832) | -0.000<br>(0.832) | -2.009<br>(0.203)                | -1.994<br>(0.204)  | -1.000<br>(0.550)  | 0.031<br>(0.975)                | 0.422<br>(0.674)     | 0.422<br>(0.674)     |
| CM regulation              | 0.086<br>(0.550)                | 0.156<br>(0.317)  | 0.156<br>(0.317)  | 0.295<br>(0.348)                 | 0.049<br>(0.874)   | -0.151<br>(0.645)  | -0.199<br>(0.419)               | -0.167<br>(0.523)    | -0.167<br>(0.523)    |
| Growth                     | -0.065<br>(0.360)               | -0.062<br>(0.441) | -0.062<br>(0.441) | -0.217*<br>(0.099)               | -0.215*<br>(0.083) | -0.246*<br>(0.086) | -0.271***<br>(0.004)            | -0.305***<br>(0.003) | -0.305***<br>(0.003) |
| KA open                    | 0.287<br>(0.164)                | 0.261<br>(0.218)  | 0.261<br>(0.218)  | 0.655*<br>(0.078)                | 0.574<br>(0.106)   | 0.383<br>(0.281)   | -0.409<br>(0.265)               | -0.485<br>(0.236)    | -0.485<br>(0.236)    |
| Obs. (countries)           | 221 (36)                        | 168 (29)          | 168 (29)          | 102 (14)                         | 92 (13)            | 88 (13)            | 205 (24)                        | 179 (23)             | 179 (23)             |
| Pseudo-R <sup>2</sup>      | 0.00                            | 0.00              | 0.00              | 0.05                             | 0.01               | 0.01               | 0.01                            | 0.01                 | 0.01                 |
| Wald-stat ( <i>Chi</i> -2) | 22.80                           | 18.61             | 18.61             | 8.921                            | 9.185              | 9.769              | 24.53                           | 22.35                | 22.35                |
| Wald ( <i>p</i> -value)    | 0.16                            | 0.35              | 0.35              | 0.94                             | 0.93               | 0.91               | 0.11                            | 0.17                 | 0.17                 |
| Log likelihood             | -88.09                          | -73.88            | -73.88            | -36.99                           | -35.26             | -30.37             | -64.64                          | -56.70               | -56.70               |
| % Obs. correctly called    | 50.9                            | 46.0              | 45.9              | 68.5                             | 63.4               | 65.2               | 69.3                            | 72.8                 | 73.3                 |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Table 9.2.1: Alternative definitions of the ERR variable and the level of economic development: currency crises (completes Table 9.2)

|                            | LIC & LMIC     |          |          | UMIC           |          |         | HIC            |           |           |
|----------------------------|----------------|----------|----------|----------------|----------|---------|----------------|-----------|-----------|
| <b>Peg or float1</b>       | <b>0.504</b>   |          |          | <b>-2.451</b>  |          |         | <b>1.134</b>   |           |           |
|                            | <b>(0.571)</b> |          |          | <b>(0.701)</b> |          |         | <b>(0.442)</b> |           |           |
| <b>Peg or float2</b>       | <b>1.871</b>   |          |          | <b>-2.451</b>  |          |         | <b>1.134</b>   |           |           |
|                            | <b>(0.158)</b> |          |          | <b>(0.701)</b> |          |         | <b>(0.442)</b> |           |           |
| <b>Peg or float3</b>       | <b>1.871</b>   |          |          | <b>-1.751</b>  |          |         | <b>1.134</b>   |           |           |
|                            | <b>(0.158)</b> |          |          | <b>(0.717)</b> |          |         | <b>(0.442)</b> |           |           |
| Seigniorage                | 0.010          | 0.006    | 0.006    | 0.039          | 0.039    | 0.049   | 0.047**        | 0.047**   | 0.047**   |
|                            | (0.292)        | (0.611)  | (0.611)  | (0.419)        | (0.419)  | (0.343) | (0.036)        | (0.036)   | (0.036)   |
| FB                         | 0.029          | 0.030    | 0.030    | -0.819         | -0.819   | -0.370  | -0.112         | -0.112    | -0.112    |
|                            | (0.661)        | (0.693)  | (0.693)  | (0.109)        | (0.109)  | (0.285) | (0.198)        | (0.198)   | (0.198)   |
| Domestic credit            | 0.033          | 0.034    | 0.034    | 0.291          | 0.291    | 0.167   | -0.015         | -0.015    | -0.015    |
|                            | (0.147)        | (0.256)  | (0.256)  | (0.106)        | (0.106)  | (0.249) | (0.357)        | (0.357)   | (0.357)   |
| Broad money                | -0.054         | -0.131   | -0.131   | -0.571         | -0.571   | -0.591  | 0.034          | 0.034     | 0.034     |
|                            | (0.497)        | (0.358)  | (0.358)  | (0.421)        | (0.421)  | (0.219) | (0.405)        | (0.405)   | (0.405)   |
| Growth                     | 0.021          | 0.063    | 0.063    | -2.522**       | -2.522** | -1.502  | 0.038          | 0.038     | 0.038     |
|                            | (0.857)        | (0.666)  | (0.666)  | (0.048)        | (0.048)  | (0.136) | (0.860)        | (0.860)   | (0.860)   |
| Current account            | 0.092          | 0.034    | 0.034    | -1.040         | -1.040   | -0.822* | -0.195*        | -0.195*   | -0.195*   |
|                            | (0.164)        | (0.653)  | (0.653)  | (0.150)        | (0.150)  | (0.082) | (0.076)        | (0.076)   | (0.076)   |
| KA open                    | -0.303         | -0.721   | -0.721   | -1.817         | -1.817   | -0.016  | -1.125***      | -1.125*** | -1.125*** |
|                            | (0.463)        | (0.192)  | (0.192)  | (0.365)        | (0.365)  | (0.994) | (0.009)        | (0.009)   | (0.009)   |
| Obs. (countries)           | 157 (31)       | 124 (26) | 124 (26) | 75 (11)        | 75 (11)  | 71 (11) | 120 (18)       | 117 (18)  | 117 (18)  |
| Pseudo-R <sup>2</sup>      | 0.05           | 0.07     | 0.07     | 0.15           | 0.15     | 0.22    | 0.00           | 0.00      | 0.00      |
| Wald-stat ( <i>Chi-2</i> ) | 12.00          | 9.940    | 9.940    | 14.85          | 14.85    | .       | 17.97          | 17.97     | 17.97     |
| Wald ( <i>p-value</i> )    | 0.80           | 0.91     | 0.91     | 0.61           | 0.61     | .       | 0.39           | 0.39      | 0.39      |
| Log likelihood             | -60.96         | -48.62   | -48.62   | -18.79         | -18.79   | -16.24  | -28.33         | -28.33    | -28.33    |
| % Obs. correctly called    | 51.8           | 61.8     | 62.0     | 55.9           | 55.0     | 54.6    | 62.8           | 66.1      | 66.6      |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

Table 9.3.1: Alternative definitions of the ERR variable and the level of economic development: debt crises (completes Table 9.3)

|                            | LIC & LMIC     |                |                | UMIC           |                |                |
|----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Peg or float1</b>       | <b>-0.036</b>  |                |                | <b>-1.074</b>  |                |                |
|                            | <b>(0.972)</b> |                |                | <b>(0.379)</b> |                |                |
| <b>Peg or float2</b>       |                | <b>-0.097</b>  |                |                | <b>-1.923</b>  |                |
|                            |                | <b>(0.940)</b> |                |                | <b>(0.293)</b> |                |
| <b>Peg or float3</b>       |                |                | <b>-0.097</b>  |                |                | <b>-4.092</b>  |
|                            |                |                | <b>(0.940)</b> |                |                | <b>(0.122)</b> |
| Public debt                | 0.025          | 0.015          | 0.015          | 0.060          | 0.129          | 0.341          |
|                            | (0.295)        | (0.565)        | (0.565)        | (0.504)        | (0.375)        | (0.273)        |
| Public debt squared        | -0.328         | 0.247          | 0.247          | 0.013          | -0.002         | -2.207         |
|                            | (0.692)        | (0.789)        | (0.789)        | (0.995)        | (0.999)        | (0.727)        |
| Inflation                  | -0.029         | 2.698          | 2.698          | 0.151          | -0.785         | 38.579**       |
|                            | (0.894)        | (0.376)        | (0.376)        | (0.772)        | (0.480)        | (0.021)        |
| Growth                     | -0.232*        | -0.178         | -0.178         | -0.127         | -0.241         | -0.624*        |
|                            | (0.062)        | (0.234)        | (0.234)        | (0.472)        | (0.323)        | (0.078)        |
| Executive constraint       | 0.147          | 0.175          | 0.175          | -0.188         | 0.161          | -0.863         |
|                            | (0.454)        | (0.436)        | (0.436)        | (0.590)        | (0.776)        | (0.257)        |
| Aid                        | -0.130         | -0.113         | -0.113         | -0.678         | -1.324         | -1.357         |
|                            | (0.155)        | (0.255)        | (0.255)        | (0.132)        | (0.105)        | (0.190)        |
| KA open                    | 0.134          | 0.094          | 0.094          | -0.623*        | -0.988*        | 0.430          |
|                            | (0.771)        | (0.854)        | (0.854)        | (0.094)        | (0.087)        | (0.441)        |
| Obs. (countries)           | 245 (39)       | 185 (32)       | 185 (32)       | 108 (14)       | 98 (13)        | 94 (13)        |
| Pseudo-R <sup>2</sup>      | 0.12           | 0.15           | 0.15           | 0.01           | 0.04           | 0.00           |
| Wald-stat ( <i>Chi-2</i> ) | 13.68          | 10.19          | 10.19          | 9.09           | 6.49           | 9.04           |
| Wald ( <i>p-value</i> )    | 0.69           | 0.89           | 0.89           | 0.94           | 0.99           | 0.94           |
| Log likelihood             | -66.05         | -54.73         | -54.73         | -27.82         | -22.77         | -10.24         |
| % Obs. correctly called    | 83.6           | 83.1           | 83.6           | 78.5           | 79.2           | 81.9           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. P-values are given in brackets. All specifications include time dummies. Hausman specification test suggested random effects with the Logit estimator. Coefficients displayed are marginal effects. No debt crises for HIC during the period of our analysis. The predictive power is calculated using a cutoff point of 25% as in Esaka (2010b).

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## **CHAPTER 3:**

**Does the Exchange Rate  
Regime Influence the Tax  
Policy?**



### Abstract

This chapter addresses the link between exchange rate regimes and tax policy and tests the hypothesis that countries with pegged exchange rate regimes have greater reliance on domestic taxation—such as the VAT—to compensate the loss of revenue and ensure competitiveness following the liberalization reform. Within a panel of developed and developing countries, we first evidence that developing countries with pegged regimes increase their VAT-to-GDP ratio through a substitution effect (*seigniorage vs. VAT*). Second, our findings support that the VAT-to-tax revenue ratio increases significantly for peggers. This result is interpreted as a competitiveness effect (*trade taxes vs. VAT*): countries with pegged regimes apply less border taxation to promote cross-country trade. Finally, estimations from a duration model reveal that pegging the exchange rate, with significant heterogeneities, accelerates the adoption of VAT.

**Keywords:** Exchange rate regimes, tax policy, duration analysis, panel data.

### 3.1. Introduction

Trade liberalization has outpaced protectionism, which made its own way during the sixties and seventies with Prebisch's ideas supporting the industrialization by import substitution. Trade liberalization mechanism has led to the globalization phenomenon characterized by greater trade integration, thanks to a freer trade- barriers world. However, this phenomenon does not come without damages.

In the aftermath of trade liberalization, fiscal authorities strived to recover the resource losses stemming from the reform<sup>43</sup> and undertook a tax transition process. As defined by Berg and Krueger (2003), tax transition mechanism (TT, in short) is defined as the process through which governments switch from international trade taxes to internal (domestic) taxation to reduce their dependency on foreign trade taxes. Proponents of the liberalization reform believe that taxes on international trade have distorting effects and may negatively impact trade flows (Ebrill *et al.*, 1999).<sup>44</sup> TT mechanism, in many countries, was characterized by the adoption of the value added tax (VAT) viewed as less distorting since it is fully supported by the final consumers (Keen and Lockwood, 2007). However its adoption was not exempt from criticisms.<sup>45</sup>

The literature analyzing the macroeconomic impacts of trade liberalization reforms contains various controversies. While a non-negligible trend flaunts the merits of trade liberalization, more skeptical authors stay away from any conclusions recognizing the benefits of greater (trade) liberalization. Discussing the impact of trade liberalization goes beyond the scope of

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<sup>43</sup> Baunsgaard and Keen (2005) investigated whether countries recovered from their resource losses following trade liberalization reform.

<sup>44</sup> Escolano (1995), Farhadian-Lorie and Katz (1988), Helpman and Krugman (1989), Krueger (1995), and Subramanian *et al.* (1993) argue that trade liberalization promotes economic efficiency, international competitiveness, and expands trade, perhaps especially in imperfectly competitive markets.

<sup>45</sup> In comparison to the tax on retail sales, Ebrill *et al.* (2001) find that the Sub-Saharan African countries that have adopted the VAT register an income increase of 1.10% of GDP. This finding is strengthened by Keen and Lockwood (2007), who show that the adoption of VAT can increase the ratio of tax revenue by 1.7 percentage points in the short term and 4.5 percentage points in the long term. Among the critics, Emran and Stiglitz (2005) show that tax reforms consisting of an increase in VAT may reduce welfare and fiscal revenue, due to the existence of an informal economy in developing countries. VAT likely creates inter-sectoral distortions between formal and informal sectors.

this chapter.<sup>46</sup> Despite the centrality of the question, there is little work, even theoretical, that pays attention to the link between exchange rate and tax policies. Exchange rate policies may play a role in this context, in the sense that the exchange rate arrangement implemented by a country directly affects its (trade/financial) partner countries, and indirectly affects the rest of the world. Besides, the exchange rate regimes (ERR) might be influential in the decision to operate TT. To fill this gap, this chapter addresses the pace that countries make up for the shortfall in tax revenue. This chapter aims at tackling the nexus between the tax policy (tax recovering strategies) and the exchange rate policy, namely the influence of the ERR on the TT process.

ERR is a crucial element when it comes to operate structural reforms, such as trade liberalization. Since countries that implement such reform give up a non-negligible part of their tax revenue (those from international trade), governments should consider an off-setting mechanism aimed at recovering the loss. Note that the heavier a country's reliance on border taxation, the greater the resource loss after trade liberalization.

Several off-setting possibilities can be foreseen. Assume that a government can use seigniorage or undertakes tax policy reform. Seigniorage revenue are closely linked with the ERR in place. Under hard pegs, seigniorage revenue are heavily constrained by the fixity of the peg. This constraint is tighter for countries using a foreign currency in that they lose all seigniorage revenue (Fisher, 1981).<sup>47</sup> On the other hand, a government can undertake a TT mechanism. Knowing that countries under fixed regimes have very limited room to use seigniorage or inflation taxes, they seem more likely to operate a TT. The hypothesis we test here is that the probability of a TT is greater for countries under a fixed ERR. A second rationale is related to the effort needed to improve competitiveness. Countries with pegged regimes rely less on external taxation by adopting a less distortive tax structure in order to promote cross-border trade.

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<sup>46</sup> Arguments in favor of trade liberalization: anti-statism, poor economic performance, information, World Bank pressure, and evidence of success (Dornbush, 1992). Winters (2004) surveyed this literature and stated that the most plausible conclusion is that trade liberalization generally induces a temporary (but possibly sustained) increase in growth through an increase in productivity. On the other hand, Santos-Paulino and Thirlwall (2004) found that trade liberalization has worsened the balance of payments of countries, since imports grow faster than exports.

<sup>47</sup> It is also possible that trade liberalization is accompanied or supported by currency devaluation (Agbeyegbe *et al.*, 2006). However, such an option is not systematically possible in most developing countries.

Since an important characteristic of the tax transition mechanism is the adoption of the VAT,<sup>48</sup> and due to the difficulty to build a tax transition index, our analysis is based on the evolution of the level of VAT revenue collected. Our interest variable, the ERR dummy, is taken from the Ilzetki, Reinhart, and Rogoff, (2010) ERR dataset.

Using a panel of developed and developing economies, over the period 1990-2010, with appropriate estimation techniques, we find robust evidence that ERR affects the level of VAT revenue, which proxies the tax transition path. Further, by disentangling within the pegged regimes, we find that more constrained fixed regime is (in the implementation of discretionary monetary policy) have greater reliance on domestic taxation such as the VAT. These findings are strengthened by a battery of sensitivity checks consisting of (i) changing the dependent variable and (ii) adding relevant controls in the baseline specifications to mitigate the omitted variable bias. More fundamentally, our robustness tests address the endogeneity issue by (iii) using the two-stage least squares and GMM instrumental variable methods. Finally, we (iv) estimate a duration model of VAT adoption, where our *left-hand-side* variable is whether the country adopts the VAT or not.

Section 2 of this chapter presents stylized facts on the tax revenue structure and the nexus between tax policy and ERR, while section 3 sets out our empirical modeling. It then details our estimation strategies and the data used throughout. Section 4 depicts our estimation results. Section 5 offers sensitivity analyses before drawing policy lessons. Section 6 concludes.

### 3.2. Tax transition and exchange rate regimes: stylized facts

Despite the centrality of the question, to the best of our knowledge, it remains tricky to find studies, even theoretical assessing the link between ERR and TT. Among the rare papers that analyze the nexus between revenue performance and the ERR, Adam *et al.* (2001) argue that the poor cumulative relative revenue performance of the Franc zone countries is mainly attributable to differences in environmental and structural factors and to their different responses to change in the real equilibrium exchange rate. Agbeyegbe *et al.* (2006) addressed the issue and focused on the effects of currency movements and inflation on tax revenue.

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<sup>48</sup> Aizenman and Jinjark (2009) state that globalization shifts a country's tax revenue from "easy to collect" taxes (tariffs and seigniorage) to "hard to collect" taxes (value added and income taxes).

They found that currency appreciations and higher inflation show some linkage to lower tax revenue or its components.

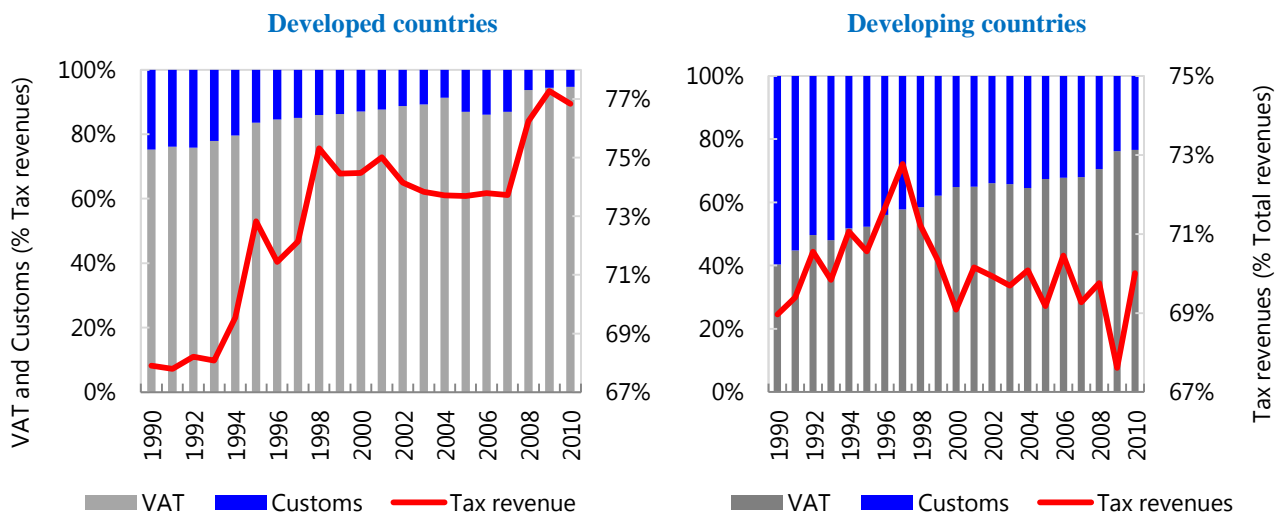
### 3.2.1. Tax composition and tax revenue collection

We present stylized facts relative to the evolution of tax revenue and to the tax structure of developed and developing countries. We also present the evolution of the VAT and tax revenue in relationship to the ERR.

Histogram charts in figures 3.1 and 3.2 display the share of VAT and custom revenue as percent of tax revenue (left scale), whereas the line charts present the evolution of tax revenue in percentage of total revenue (right scale).

For developed countries, we notice an increasing trend of tax revenue collected throughout the period. These countries also experience a sharp increase in the mid-2000s, thanks to an increasing share of consumption and a widened tax base. The surge of the crisis slightly reversed the trend evolution of the ratio in 2009.

Figures 3.1 and 3.2. Tax composition and tax revenue evolution



Considering the developing countries, we notice that they experienced a more volatile trend evolution of tax revenue as a share of total revenue, with more frequent ups and downs during the time span. In contrast to the former group, the mid-90s peak is followed by a sharp decrease of 5 percentage points of tax revenue collected (right scale), a period that corresponds to the early stage of (trade) liberalization. The average level of tax revenue collected is roughly 70 percent of total revenue during the time span. Despite a period of

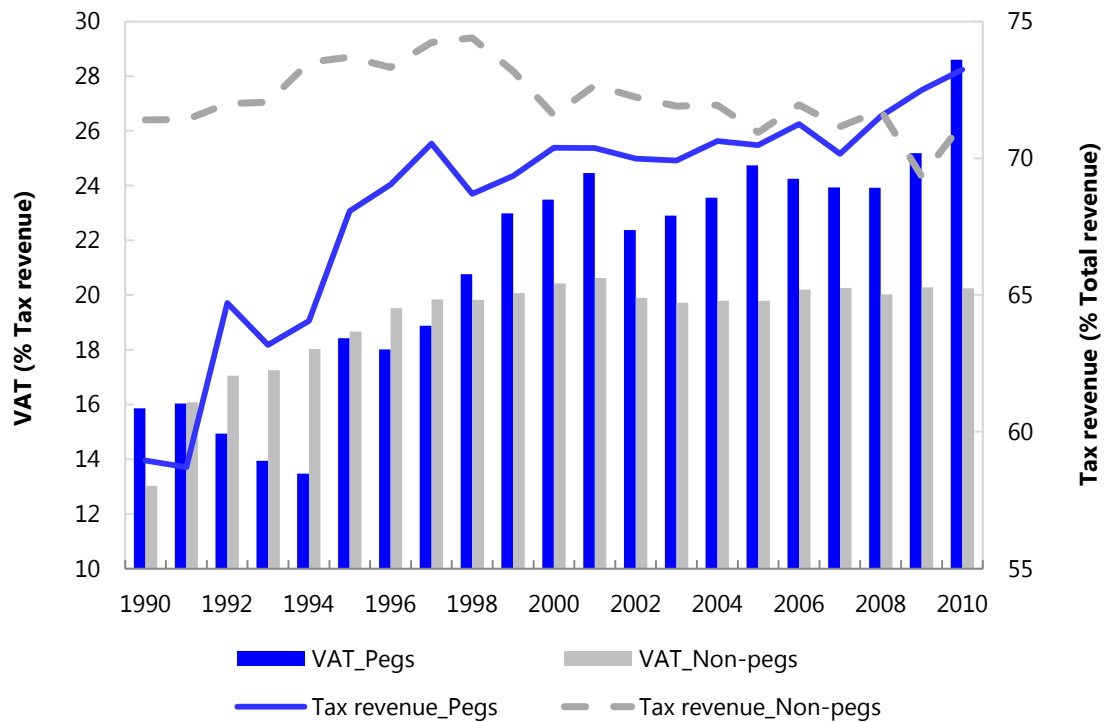
relatively stability, the late-2000s is characterized by a sharp decrease in tax revenue, which reached the lower bound of 68 percent in 2009. This decrease might be attributable to the recent financial crisis that resulted in a global recession and slower trade movement worldwide. Afterwards, developing countries seemed to recover from the downturn with the tax revenue ratio moving back to its mean value.

We find a noteworthy difference in the level of tax revenue collected between developed and developing countries, with the former group outperforming the latter. Tax revenue collection seems closely related with a country's income level. Despite the substantial difference observed, the two groups share a common feature of a remarkably decreasing trend of the trade taxes such as custom receipts. This decreasing trend of revenue from trade taxation contrasts sharply with the relatively stable (or slightly increasing) share of the other components of revenue, especially those from internal taxation (VAT for example). The following section analyzes the relationship between ERR and the tax structure.

### **3.2.2. Tax revenue, VAT and Exchange rate regime**

Figure 3.3 plots the evolution of VAT and tax revenue with regard to the ERR. The histogram chart corresponds to the VAT revenue in terms of the tax revenue of pegged and non-pegged regimes (left scale). We notice that the level of VAT revenue is constantly increasing for pegged regimes (dark blue), despite a slight decrease in the early-90s. On the contrary, countries with non-pegged regimes experience a decreasing trend (grey). The slight increase in the 90s is followed by a stable (non-increasing) evolution of VAT revenue. It is noteworthy that the level of VAT revenue collected by peggers far exceeds that of non-peggers, except in the years 1992-94, where the latter group outperformed the former. Besides, the evolution of the total tax revenue (in percent of total revenue, right scale) displays essentially the same trend. While the peggers experienced a remarkable increase, with a sudden jump in the mid-90s (blue line chart), the non-peggers displayed a relatively volatile evolution of tax revenue (dotted green line), with a decreasing trend. It is also worth noting that the (wide) tax revenue gap observed in the early 90s between the peg and non-peg categories went increasingly shrinking, ending up in a reversal, with the peg category outperforming the non-peg. This result should be taken cautiously. It represents an average of VAT revenue collected by countries with pegged regimes and non-pegged regimes.

Figure 3.3. Tax revenue, composition and Exchange Rate Regimes



Figures 3.1 and 3.2 lead to the belief that countries removed—even progressively—trade barriers by significantly decreasing cross-border taxation, which translates into a sharp decline in trade taxation revenue, regardless of the country's income level. In addition, figure 3.3 shows that the ERR in place influences the composition and evolution of tax revenue. In an attempt to offset their loss of revenue, an increase of internal taxation as a share of total revenue collected is noted, thanks to tax policy reforms such as the introduction of VAT. This assertion is supported by the empirical evidence discussed below.

### 3.3. Empirical modeling and estimation strategies

We first present the econometric approach used to test the underlying hypothesis. Then, we detail the estimation strategies and broadly discuss the variables used.

#### 3.3.1. The econometric model

As a reminder, we probe the following question: does the ERR influence the process of tax transition? The main hypothesis we test here is that, in adopting a pegged ERR, governments give up the resources that could flow from seigniorage (Fisher, 1981). This loss of seigniorage revenue is combined with the loss of tax revenue following the liberalization. As

a result, authorities are willing to offset their losses, for instance, by operating TT. To lend credibility to such a hypothesis, we specify the following model:

$$Y_{it} = \alpha + \delta ERR_{it} + \sum_{k=1}^K \lambda_k X_{k,it} + \eta_i + \varepsilon_{it} \quad (3.1)$$

where  $Y_{it}$  is the variable of tax transition, in other words, the VAT-to-GDP ratio. Our variable of interest,  $ERR_{it}$ , corresponds to the exchange rate regime in place for country  $i$  at time  $t$ .  $ERR_{it}$  is a dummy coded 1 if the country operates under a fixed regime and 0 if the prevailing regime is either intermediate or flexible. This specification allows to broadly contrast peggers and non-peggers. Furthermore, we adopt a detailed classification of the ERR to better contrast the alternative ERR, namely fixed against intermediate, and fixed against floating.

Besides the effect of the ERR per se, we control for time-varying country-specific characteristics reflected in the matrix  $X_{k,it}$  and those that are individual to each country,  $\eta_i$ , essential to explain the different performances in collecting tax revenue in different countries.  $\varepsilon_{it}$  is the unobserved error term.

We test the hypothesis that  $\delta > 0$ . We rely on fixed effect (FE) techniques to estimate equation (3.1). FE techniques address the potential concerns that peggers and non-peggers are simply different type of countries and that this fundamental difference drives the results.<sup>49</sup>

### 3.3.2. The data

We use a dataset encompassing data for 101 developing and developed countries. The panel consists of countries that have the requisite data for the period 1990-2010.<sup>50</sup> Having such a large panel allows us to slice the data into various groups of interest without issues of sample representativeness or degree of freedom becoming critical. The dependent variable is the VAT-to-Tax ratio. The choice of the VAT is motivated by the observed experience in

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<sup>49</sup> One shortcoming of FE techniques is that the estimates preclude the use of covariates that are not time-varying. Estimates that are shown below do not suffer from this shortcoming, since our baseline model includes only time-varying explanatory variables.

<sup>50</sup> Appendix C.1 presents the list of countries.



developing countries. In fact, VAT is one of the predominant (internal) taxation tools used to recover the resources lost that followed the liberalization (see figures 3.1 and 3.2 above). One could think that this indicator does not fully capture the tax transition mechanism effectively. However, we remind that the main focus of the chapter is rather to show that countries with a pegged ERR have more reliance on internal taxation.

To assess a country's exchange rate arrangement, we rely on the Ilzetzki, Reinhart and Rogoff (2010) database of de facto classification of ERR. Appendices C.3 and C.4 present the core and fine classification of the ERR variable. In appendix C.5, we detail the alternative dummies used as interest variable throughout the chapter.

Among the main determinants of the VAT revenue, we discuss the inclusion and the expected sign of the followings. Trade openness, measured as the ratio of the sum of exports and imports of goods and services over GDP, indicates the degree of openness to international trade.<sup>51</sup> This variable is a crucial determinant of tax transition. The effect of trade openness on revenue collected might be thought as follows. Liberalization, in other words, greater trade openness, may be beneficial in two ways: exporters experience a decrease in costs, while imported goods and services increase. This increase in the traded goods widens the tax base and makes the government more likely to move from cross-border taxation to internal taxation, thereby recovering the revenue loss entailed by the reform. We, thus expect the degree of openness to have a positive impact on the VAT revenue. The second control variable is the share of agricultural value added (*Agricultural VA*). As stated by Cukierman *et al.* (1992), the agricultural sector is often dubbed the “hard to tax sector,” due to the difficulty to collect revenue from this sector, especially in developing countries where the inefficiency of the tax administration exacerbates the revenue loss. In the same line we control for the existence of an informal sector, which characterizes the majority of developing countries. An informal sector is almost completely out of the control of the (fiscal) authorities and usually escapes taxation. Intuitively, we expect a negative and significant sign of this variable on the level of VAT revenue. We also control for inflation ( $\pi$ ), which is measured as the growth rate of the consumer price index. Its effect on the VAT-to-GDP ratio, commonly known as the Oliveira-Tanzi effect, stipulates a negative impact on tax revenue due to lags in

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<sup>51</sup> Some authors (Ebrill *et al.*, 1999; Adam, 2001; Agbeyegbe, 2006) use the international trade to GDP ratio as the measure of trade liberalization.

collection. In fact, inflation causes the real value of taxes to decrease between the time of implementation and the time that the tax is effectively levied. To mitigate the effects of hyperinflation episodes, we define ( $\pi'$ ) as the new inflation rate calculated as  $\pi' = (\pi/1 + \pi)$ . The growth rate of GDP per capita (*GDP pc growth*) is, in turn, a proxy of a country's level of development, as is often the case in the empirical literature. A positive sign is expected for this variable, since an increase in the GDP per capita is a signal of wealth. The increase in consumption, following higher GDP per capita directly increases the tax base and, accordingly, the tax revenue.

In addition to the abovementioned variables, we introduce, sequentially, the following variables in our regressions: Deposit interest rate (*Deposit IR*), *Corruption*, and *Natural resource rents* as percentage of GDP. Monetary policy actions may influence the tax policy through the deposit interest rate. An increase of the deposit rate may boost the savings from private agents, who decrease their consumption, insofar as the former option becomes more attractive. While the deposit interest rate variable catches the effect of monetary policy on tax policy, the political feature is carried through the variables *corruption* and *government stability*. The political and institutional environment of the economy is also prominent in the tax transition mechanism. The effectiveness of the transition process depends strongly on the efficiency of the tax administration. While political corruption negatively affects the level of VAT revenue collected, we expect a positive influence of government stability. Finally, we expect a mitigated impact of the natural resource rents. Using such a broad control group allows us to make inferences about the condition and characteristics distinguishing countries in the process of TT. Detailed descriptive statistics are provided in appendix C.2. Also, a broader discussion is provided below, when interpreting the estimation results.

### 3.4. Estimation results

#### 3.4.1. Main findings

This section discusses the estimated results. Before diving into our main results, Table 3.1 displays the estimation results relative to the link between total revenue, tax revenue, and the ERR.

In column (1), the dependent variable is the total revenue. We notice that ERR do not impact the level of total revenue. Nevertheless, we find that ERR influences the tax structure, i.e. the way that fiscal authorities implement their tax policy. Columns (2)-(3) show that ERR matter if one considers direct and indirect taxes. This finding is strengthened by the statistically significant coefficient of the ERR variable—*Pegged ERR*—in specification (4), where the VAT-to-Tax ratio is taken as the left-hand-side variable.

The hypothesis that countries with a pegged ERR, in the aftermath of the liberalization process, increased their reliance on internal taxation, such as the VAT, is supported by these early findings.

**Table 3.1: Total revenue, tax revenue and the ERR**

|                            | Total revenue<br>(1)    | Tax structure                    |                            |                            |
|----------------------------|-------------------------|----------------------------------|----------------------------|----------------------------|
|                            |                         | Direct and indirect taxes<br>(2) | Indirect taxes<br>(3)      | VAT<br>(4)                 |
| <b>Pegged ERR</b>          | <b>0.767</b><br>(1.544) | <b>0.455**</b><br>(2.236)        | <b>0.833***</b><br>(7.218) | <b>0.853***</b><br>(6.152) |
| Trade openness             | 0.288<br>(0.395)        | 0.879***<br>(2.635)              | 1.332***<br>(7.148)        | 0.852***<br>(4.123)        |
| Inflation                  | -0.023<br>(-0.178)      | -0.040<br>(-0.605)               | -0.039<br>(-1.249)         | -0.060<br>(-1.390)         |
| GDP pc growth              | -0.091***<br>(-2.982)   | 0.053***<br>(3.404)              | 0.053***<br>(6.015)        | 0.044***<br>(4.111)        |
| Natural res.               | 1.146***<br>(3.941)     | 0.363***<br>(3.171)              | 0.019<br>(0.371)           | 0.041<br>(0.770)           |
| Obs.                       | 1375                    | 1325                             | 1453                       | 1209                       |
| R <sup>2</sup>             | 0.019                   | 0.035                            | 0.111                      | 0.073                      |
| Fischer ( <i>stat</i> )    | 5.137                   | 9.212                            | 34.33                      | 18.09                      |
| Fischer ( <i>p-value</i> ) | 0.000                   | 0.000                            | 0.000                      | 0.000                      |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. The F-test for fixed effects and the Breusch-Pagan LM test for random effects both rejected (with p-value=0.00) the null hypothesis that there are no specific effects. We then use the fixed effect estimators. Random effect estimations are also performed for robustness concerns. For all specifications, the joint significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.

Besides the main interest variable—*Pegged ERR*—the explanatory variables mostly appear with the expected signs.

Table 3.2 presents the baseline estimates, with the VAT-to-Tax ratio as the main dependent variable. We notice that the coefficients of interest are statistically significant with the expected positive sign, with the coefficients ranging from 3.0 to 5.8. This can be interpreted saying that the increase in VAT-to-Tax ratio in countries with pegged regimes is 3.8 percentage points higher, compared to those with intermediate or floating ERR (column 6).

**Table 3.2: Baseline estimates with all countries**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                 |                 |                 |                 |                 |                 |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Baseline estimates                             |                 |                 |                 |                 |                 |                 |
|  | (1)             | (2)             | (3)             | (4)             | (5)             | (6)             |
| <b>Pegged ERR</b>                              | <b>5.810***</b> | <b>3.369***</b> | <b>3.833***</b> | <b>3.005***</b> | <b>3.352***</b> | <b>3.768***</b> |
|  | (6.857)         | (3.825)         | (3.758)         | (3.295)         | (3.713)         | (3.556)         |
| Trade openness                                 |                 | -3.685***       | -6.024***       | -4.087***       | -3.517**        | -6.019***       |
|  |                 | (-2.777)        | (-3.770)        | (-2.933)        | (-2.527)        | (-3.521)        |
| Agricultural VA                                |                 | -7.622***       | -6.463***       | -6.932***       | -7.623***       | -5.451***       |
|  |                 | (-8.826)        | (-5.825)        | (-7.237)        | (-8.001)        | (-4.042)        |
| Inflation                                      |                 | -0.352          | -0.282          | -0.310          | -0.346          | -0.222          |
|  |                 | (-1.388)        | (-1.015)        | (-1.217)        | (-1.341)        | (-0.789)        |
| GDP pc growth                                  |                 | 0.223***        | 0.154**         | 0.233***        | 0.251***        | 0.209***        |
|  |                 | (3.550)         | (2.164)         | (3.617)         | (3.767)         | (2.763)         |
| Deposit IR                                     |                 |                 | -1.627***       |                 |                 | -1.585***       |
|  |                 |                 | (-4.278)        |                 |                 | (-3.933)        |
| Corruption                                     |                 |                 |                 | -1.017***       |                 | -0.755*         |
|  |                 |                 |                 | (-2.773)        |                 | (-1.811)        |
| Natural res.                                   |                 |                 |                 |                 | -0.011          | 0.291           |
|  |                 |                 |                 |                 | (-0.031)        | (0.688)         |
| Nb. of Obs.                                    | 1302            | 1200            | 993             | 1102            | 1114            | 851             |
| R-squared                                      | 0.04            | 0.11            | 0.13            | 0.11            | 0.10            | 0.13            |
| Fischer ( <i>stat</i> )                        | 47.02           | 26.41           | 23.31           | 20.73           | 19.54           | 14.91           |
| Fischer ( <i>p-value</i> )                     | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            | 0.00            |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. The F-test for fixed effects and the Breusch-Pagan LM test for random effects both rejected (with p-value=0.00) the null hypothesis that there are no specific effects. We then use the fixed effect estimators. Random effect estimations are also performed for robustness concerns. For all specifications, the joint significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.

Besides, the core determinants significantly affect the level of VAT revenue. First, we see that high share of agricultural value added significantly impacts negatively the VAT revenue collection. In other words, the greater the contribution of the agricultural sector to the overall GDP, the lower the revenue collected from this “hard to tax” sector. To quantify the effect, we interpret our coefficients as semi-elasticities, since our independent variables are log-transformed and the left-hand-side variable is in its original metric. Therefore a 10% increase in the contribution of the agricultural sector to national income reduces the VAT-to-Tax ratio, on average, by nearly 0.52 percentage points. This negative effect is also observed for inflation variable, a phenomenon that is consistent with the well-known Oliveira-Tanzi effect, which argues that inflation deteriorates the real tax proceeds, even with non-statistically

significant coefficients. As evidenced earlier by Desai and Hines (2005),<sup>52</sup> our estimates show that trade openness also displays a negative impact on VAT revenue. Likewise, monetary policy, through the deposit interest rate impacts negatively the level of VAT revenue.<sup>53</sup> When the deposit interest rate goes up, private agents prefer saving more than they consume, knowing that saving becomes more attractive. Reducing consumption leads to a lower tax base and then reduces the VAT revenue indirectly collected through consumption. Note that this negative effect is persistent and strongly significant.

Contrary to the above variables, GDP per capita growth has a significant positive effect on the level of VAT collected. Intuitively, increasing GDP per capita translates into greater purchasing power that increases, in turn, the level of consumed goods. As a consequence, fiscal authorities collect more revenue, thanks to the tax base expansion. The wealth effect of GDP per capita growth is strongly verified at a 99 percent confidence level. The natural resource variable displays a statistically null effect.

### 3.4.2. Further discussions

In this subsection, we conduct additional tests to reinforce the validity of our previous findings. In columns (2) and (3) of Table 3.3, we split the sample into developing and developed economies according to the income-level-based classification of the world bank.

The estimated coefficients of the *Pegged ERR* dummy strongly increase in magnitude but remain positive and statistically significant at a high confidence level when considering developing countries (column 3), while the latter turns out to be statistically null for developed economies (column 2). Splitting the sample on the basis of economic development challenged our previous finding. This preliminary finding seems then sensitive to the income-based level of development.

We also conduct a second round of checks to assess the extent to which our findings are robust to changes in either the estimator used or the inclusion of time dummies. Column (4) shows that our results are robust to the inclusion of time dummies. These findings persist

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<sup>52</sup> According to these authors, the imperfections in the refund system, and/or excessive statutory exemptions, may have meant that the VAT has in practice functioned largely as a tax on exports and intermediate production, and so tended to reduce exports and national output.

<sup>53</sup> In the robustness checks, the impact of fiscal policy is addressed using the one-time-lagged public debt as a proxy.

even with a change in the estimation methodology, as shown in columns 5 and 6 where the random effect estimator is used.

**Table 3.3: Developing vs. developed countries, time effects**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                 |               |                 |                  |                 |                  |
|--|-----------------|---------------|-----------------|------------------|-----------------|------------------|
|  | Baseline        | Developed     | Developing      | Time dummies, FE | Random effects  | Time dummies, RE |
|  | (1)             | (2)           | (3)             | (4)              | (5)             | (6)              |
| <b>Pegged ERR</b>                              | <b>3.768***</b> | <b>-0.130</b> | <b>6.390***</b> | <b>3.598***</b>  | <b>3.801***</b> | <b>3.560***</b>  |
|  | (3.556)         | (-0.143)      | (3.450)         | (3.466)          | (3.715)         | (3.538)          |
| Trade openness                                 | -6.019***       | 8.597***      | -8.569***       | -12.048***       | -4.768***       | -8.795***        |
|  | (-3.521)        | (3.961)       | (-3.435)        | (-6.729)         | (-3.160)        | (-5.674)         |
| Agricultural VA                                | -5.451***       | 4.430***      | -10.329***      | 2.464            | -4.214***       | 0.223            |
|  | (-4.042)        | (3.016)       | (-5.031)        | (1.570)          | (-3.784)        | (0.183)          |
| Inflation                                      | -0.222          | 0.383         | -0.367          | -0.223           | -0.207          | -0.227           |
|  | (-0.789)        | (0.905)       | (-1.011)        | (-0.826)         | (-0.735)        | (-0.834)         |
| GDP pc growth                                  | 0.209***        | 0.033         | 0.135           | 0.257***         | 0.197***        | 0.267***         |
|  | (2.763)         | (0.349)       | (1.312)         | (3.258)          | (2.615)         | (3.369)          |
| Deposit IR                                     | -1.585***       | -1.729***     | -2.066***       | 0.085            | -1.481***       | 0.124            |
|  | (-3.933)        | (-3.573)      | (-3.664)        | (0.197)          | (-3.774)        | (0.293)          |
| Corruption                                     | -0.755*         | -0.738*       | -0.815          | -0.180           | -0.949**        | 0.073            |
|  | (-1.811)        | (-1.732)      | (-1.293)        | (-0.415)         | (-2.475)        | (0.174)          |
| Natural res.                                   | 0.291           | -0.156        | 1.070           | 0.234            | 0.322           | -0.056           |
|  | (0.688)         | (-0.496)      | (1.262)         | (0.549)          | (0.859)         | (-0.146)         |
| Nb. of obs.                                    | 851             | 370           | 481             | 851              | 851             | 851              |
| R-squared                                      | 0.13            | 0.18          | 0.20            | 0.23             | 0.13            | 0.23             |
| Fischer ( <i>stat</i> )                        | 14.91           | 9.483         | 13.52           | 8.639            | 111.5           | 216.3            |
| Fischer ( <i>p-value</i> )                     | 0.00            | 0.00          | 0.00            | 0.00             | 0.00            | 0.00             |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. For all specifications, the joint significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.

To assess the extent to which political variables affect the tax collection process we interact our interest dummy, *Pegged ERR*, with the political variables corruption ( $Peg\ ERR \times Corruption$ ) and government stability ( $Peg\ ERR \times Gov.\ stab.$ ). Our estimation results also show that the political feature indeed matters in the tax collection process. Table 4.4 below provides detailed results.

Our former finding of a positive and significant effect of pegged ERR on the level of VAT revenue persists, except for specification (3).

The coefficient of the interactive variable  $Peg\ ERR \times Corruption$  shows that the effect of a pegged ERR is negative for highly corrupt countries. Corruption represents a serious threat, as it distorts the economic environment and strongly reduces the efficiency of the government and business, by enabling people to assume positions that they do not really deserve through, for instance, nepotism or job reservation. Corruption may also affect the efficiency of the tax administration and increase the cost of collecting taxes. Government stability assesses a

government's ability to carry out its declared program and its ability to stay in office through government unity, legislative strength, and popular support. The higher the score, the greater the government stability, with the latter significantly improving the level of VAT collected in the presence of a fixed regime. As one knows, the shift from external to internal taxation translates into a shift in the targeted individuals that face the tax burden. While trade taxation is directly supported by the trade market players (usually exporters and importers), the burden of internal taxation—such as VAT—is faced by the final consumers. Stable governments with popular support may have greater tax bargaining power to make the individuals less reluctant to tax policy reform.

**Table 3.4: Additional tests with political and natural resources variables**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                 |                     |                |                   |                 |
|--|-----------------|---------------------|----------------|-------------------|-----------------|
|  | Baseline        | Political variables |                | Natural resources |                 |
|  | (1)             | (2)                 | (3)            | (4)               | (5)             |
| <b>Pegged ERR</b>                              | <b>3.369***</b> | <b>7.731***</b>     | <b>-3.430</b>  | <b>1.596*</b>     | <b>2.479***</b> |
|  | (3.825)         | (3.573)             | (-1.288)       | (1.666)           | (2.817)         |
| <b>Peg ERR × Corruption</b>                    |                 | <b>-1.338**</b>     |                |                   |                 |
|  |                 | (-2.407)            |                |                   |                 |
| <b>Peg ERR × Gov. stab.</b>                    |                 |                     | <b>0.753**</b> |                   |                 |
|  |                 |                     | (2.428)        |                   |                 |
| <b>Peg ERR × Oil</b>                           |                 |                     |                | <b>0.520***</b>   |                 |
|  |                 |                     |                | (5.402)           |                 |
| <b>Peg ERR × Mineral</b>                       |                 |                     |                |                   | <b>5.426***</b> |
|  |                 |                     |                |                   | (6.265)         |
| Corruption                                     |                 | -0.594              |                |                   |                 |
|  |                 | (-1.461)            |                |                   |                 |
| Government stability                           |                 |                     | 0.702***       |                   |                 |
|  |                 |                     | (4.436)        |                   |                 |
| Oil  |                 |                     |                | -1.106***         |                 |
|  |                 |                     |                | (-6.740)          |                 |
| Mineral  |                 |                     |                |                   | -0.184          |
|  |                 |                     |                |                   | (-1.266)        |
| Nb. of obs.                                    | 1200            | 1102                | 1102           | 1145              | 1197            |
| R-squared                                      | 0.11            | 0.11                | 0.14           | 0.14              | 0.14            |
| Fischer ( <i>stat</i> )                        | 26.41           | 18.68               | 23.77          | 24.49             | 25.00           |
| Fischer ( <i>p-value</i> )                     | 0.000           | 0.000               | 0.000          | 0.000             | 0.000           |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. For all specifications, the joint significance tests (with p-value=0.00) reject the hypothesis that all slopes are statistically null.

Furthermore, natural resource endowments, as reported in columns 4 and 5, seem to significantly impact the relationship between the ERR and the tax structure. Both the interactive variables *Peg ERR × Oil* and *Peg ERR × Mineral* show stronger positive impact of a pegged ERR on VAT revenue for naturally-endowed countries. This effect operates through the widening of the tax base that flows from oil and mining windfalls.

Additional important results are given in Table 3.5 below. Column (1) replicates the estimates, with pegged regimes used as the benchmark. We then replace the Pegged ERR dummy with Intermediate ERR (column 2) and Floating ERR (column 3). Column (4) includes both pegged and intermediate regime dummies in the same specification. As a reminder, Intermediate ERR (Floating ERR) are dummy variables that take value 1 if country  $i$  is ruling under an intermediate (floating) regime at time  $t$ , and 0 otherwise. While we clearly expect a negative sign for the Floating ERR dummy, the expected sign of the middle regimes is less clear, since the comparison group includes both the peg and floating regimes.

**Table 3.5: Comparing Pegged ERR to other intermediate and floating regimes**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                            |                         |                           |                            |                            |                            |
|--|----------------------------|-------------------------|---------------------------|----------------------------|----------------------------|----------------------------|
|  | Baseline<br>(1)            | Intermediate<br>(2)     | Floating<br>(3)           | Peg and Interm.<br>(4)     | Peg vs. Interm.<br>(5)     | Peg vs. Floating<br>(6)    |
| <b>Pegged ERR</b>                              | <b>3.369***</b><br>(3.825) |                         |                           | <b>5.459***</b><br>(4.951) |                            |                            |
| Intermediate                                   |                            | <b>0.109</b><br>(0.160) |                           | <b>2.658***</b><br>(3.128) |                            |                            |
| Floating                                       |                            |                         | <b>-0.714</b><br>(-0.796) |                            |                            |                            |
| Peg vs. Intermediate                           |                            |                         |                           |                            | <b>3.030***</b><br>(3.166) |                            |
| Peg vs. Floating                               |                            |                         |                           |                            |                            | <b>7.389***</b><br>(4.467) |
| Trade openness                                 | -3.685***<br>(-2.777)      | -4.106***<br>(-3.086)   | -4.000***<br>(-2.992)     | -3.395**<br>(-2.562)       | -4.099***<br>(-2.740)      | 0.405<br>(0.184)           |
| Agricultural VA                                | -7.622***<br>(-8.826)      | -8.565***<br>(-10.124)  | -8.549***<br>(-10.244)    | -7.586***<br>(-8.817)      | -8.296***<br>(-8.847)      | -5.469***<br>(-4.016)      |
| Inflation                                      | -0.352<br>(-1.388)         | -0.337<br>(-1.320)      | -0.340<br>(-1.331)        | -0.355<br>(-1.405)         | -0.339<br>(-1.214)         | -0.291<br>(-1.120)         |
| GDP pc growth                                  | 0.223***<br>(3.550)        | 0.234***<br>(3.700)     | 0.238***<br>(3.761)       | 0.200***<br>(3.179)        | 0.280***<br>(4.105)        | 0.306***<br>(3.491)        |
| Nb. of obs.                                    | 1200                       | 1200                    | 1200                      | 1200                       | 992                        | 647                        |
| R-squared                                      | 0.105                      | 0.093                   | 0.093                     | 0.112                      | 0.123                      | 0.093                      |
| Fischer ( <i>stat</i> )                        | 26.41                      | 23.19                   | 23.32                     | 23.81                      | 26.03                      | 12.06                      |
| Fischer ( <i>p-value</i> )                     | 0.000                      | 0.000                   | 0.000                     | 0.000                      | 0.000                      | 0.000                      |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. For all specifications, the joint significance tests (with  $p$ -value=0.00) reject the hypothesis that all slopes are statistically null. In column (4), we perform the equality test of the dummies Pegged ERR and Intermediate ERR and also test the hypothesis that these two dummies are jointly null. The  $p$ -values of the F-test, which are 0.00, both rejected the null hypotheses of the equality test and the joint significance test.

As expected, the dummy Intermediate ERR (column 2) has no significant effect on the VAT-to-Tax ratio. Adversely, adopting a floating ERR (column 3) is negatively correlated with the collection of VAT revenue, although with weak statistical evidence.

In line with the former findings, if pegged regimes have a positive effect on the VAT-to-Tax ratio compared to other regimes, then floating regimes are expected to display the opposite sign. These results should be taken cautiously, however. The ERR is not the sole determinant



of the level of the tax revenue collected by the different tax administrations. However, these findings support that ERR have significant effect on the structure of tax policy.

On the other hand, instead of contrasting pegged regimes with all other alternatives, we make a pair-wise comparison, namely pegged regimes against intermediates regimes (column 5) and pegged regimes against floating regimes (column 6). As for the baseline estimation (column 1), the coefficients of interest here, the dummies *Peg vs. Intermediate* and *Peg vs. Floating* remain positive and statistically significant with a high confidence level. It is worth mentioning that the coefficient of the dummy *Peg vs. Floating* (7.4) is greater than that of *Peg vs. Intermediate* (3.0) in absolute terms. According to our line of reasoning, floating regimes have much less constraints to raise seigniorage revenue compared to intermediates and are known to better accommodate real shocks, thanks to the flexibility of the exchange rate. Therefore, these types of exchange rate arrangement are expected to have alternatives to make up the resource loss than exclusively relying on domestic taxation and the adoption of VAT.

We take the study a step further and contrast the evolution of the VAT-to-Tax ratio within the peg category. This allows for more fine-tuned scrutiny, albeit for a reduced country sample. Drawing upon Ilzetki, Reinhart and Rogoff's (2010) fine classification of ERRs instead of the core classification formerly used, we built new dummies that account for each type of regime within the peg group.

*Pegged ERR* remains the benchmark (column 1). The *Currency board* dummy is coded 1 for countries that are under a currency board arrangement and 0 if the countries adopted either an intermediate or floating regime (column 2). Likewise, *Conventional peg* captures the effect of countries that have a de facto peg arrangement (column 3). This latter arrangement is also combined with dollarized countries (column 4). Finally, we restrict the definition of the benchmark pegged ERR by dropping observations classified in the freely falling category (column 5).<sup>54</sup>

Estimation results in Table 3.6 show persistence of the positive and statistically significant coefficient of the ERR dummies as expected. Note that these estimates are remarkably similar

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<sup>54</sup> The *narrow peg* variable restricts the definition of the pegged ERR dummy by dropping points of observation identified as freely falling and those with dual markets where data on parallel markets are missing. "Freely falling" refers to a situation where the inflation rate is above 40%

to the baselines. It is worth pointing out that the estimated effect of pegged regimes in increasing the VAT-to-Tax ratio is larger for countries that have a currency board arrangement (columns 2), compared to other types of pegged arrangement. In quantifying these effects, Table 3.6 shows that being under a currency board increases the VAT-to-Tax ratio by 0.95 percentage points, while a conventional peg regime increases the ratio by 0.67 percentage points. These changes in magnitude were somewhat expected, since our baseline estimates, which pools across various categories of the pegged regimes, represent an average of these category-by-category estimates.<sup>55</sup>

**Table 3.6: Tax transition within Pegged ERR**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                 |                  |                |               |                 |
|--|-----------------|------------------|----------------|---------------|-----------------|
|  | Baseline        | Within pegs      |                | Narrow peg    |                 |
|  | (1)             | (2)              | (3)            | (4)           | (5)             |
| <b>Pegged ERR</b>                              | <b>3.369***</b> |                  |                |               |                 |
|  | (3.825)         |                  |                |               |                 |
| <b>Currency board</b>                          |                 | <b>11.900***</b> |                |               |                 |
|  |                 | (5.940)          |                |               |                 |
| <b>Conventional peg</b>                        |                 |                  | <b>2.753**</b> |               |                 |
|  |                 |                  | (2.290)        |               |                 |
| <b>Dollarization and CP</b>                    |                 |                  |                | <b>1.668*</b> |                 |
|  |                 |                  |                | (1.697)       |                 |
| <b>Narrow peg</b>                              |                 |                  |                |               | <b>3.084***</b> |
|  |                 |                  |                |               | (3.678)         |
| Trade openness                                 | -3.685***       | -0.822           | -3.092*        | -3.036**      | -5.092***       |
|  | (-2.777)        | (-0.589)         | (-1.905)       | (-2.106)      | (-3.775)        |
| Agricultural VA                                | -7.622***       | -6.745***        | -9.079***      | -7.836***     | -7.559***       |
|  | (-8.826)        | (-6.860)         | (-8.111)       | (-8.526)      | (-8.956)        |
| Inflation                                      | -0.352          | -0.395           | -1.179*        | -0.631        | -0.332          |
|  | (-1.388)        | (-1.565)         | (-1.844)       | (-1.371)      | (-1.390)        |
| GDP pc growth                                  | 0.223***        | 0.114*           | 0.201***       | 0.220***      | 0.151**         |
|  | (3.550)         | (1.807)          | (2.631)        | (3.250)       | (2.260)         |
| Observations                                   | 1200            | 890              | 965            | 1137          | 1132            |
| R-squared                                      | 0.105           | 0.117            | 0.097          | 0.09          | 0.105           |
| Fischer ( <i>stat</i> )                        | 26.41           | 21.87            | 19.51          | 21.16         | 25.05           |
| Fischer ( <i>p-value</i> )                     | 0.000           | 0.000            | 0.000          | 0.000         | 0.000           |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. For all specifications, the joint significance tests (with p-value=0.00) reject the hypothesis that all slopes are statistically null.

These findings are in line with our underlying assumption that the probability of tax transition, measured via the evolution of the VAT-to-Tax ratio is positively linked with the fixity of the ERR. Tighter constraint in implementing discretionary monetary actions

<sup>55</sup> Note that our sample falls from 1200 (in the baseline) to the minimum of 890 observations, due to that, in contrasting each category of pegged regime with the intermediate and floating regimes, the remaining categories of pegs should be excluded from the sample. In other words, to assess the effects of ERR for *currency borders* alternatively to intermediate and floaters, countries with dollarization as ERR and conventional peg are dropped.

translates into greater reliance on domestic taxation. Knowing that currency boards lose total (discretionary) control of their monetary policy, and consequently the seigniorage revenue, the revenue loss is considerable once the liberalization takes place. As a result, they seem more likely to increase their reliance on domestic taxation, such as the VAT.

### 3.4.3. Solving the endogeneity issue: the GMM estimators

As stated in the literature, the choice of the ERR might be perceived endogenous. In fact, the choice of any regime might be influenced by fiscal policy choices, even to a lesser degree. In addition, the GDP-per-capita growth rate may be considered endogenous. Ignoring this would lead reverse causality bias with misleading coefficient since the ERR and GDP growth rate variables are used to explain the evolution of VAT revenue. To solve the endogeneity problem, we draw upon the Generalized Method of Moments (GMM) dynamic panel data estimator. This approach has the advantage of addressing the joint endogeneity of all explanatory variables in a dynamic formulation and of potential biases induced by country-specific effects. We use the following specification:

$$Y_{it} = \alpha + \beta Y_{it-1} + \delta ERR_{it} + \sum_{k=1}^K \lambda_k X_{k,it} + \eta_i + \varepsilon_{it} \quad (3.2)$$

As a reminder, the dependent variable  $Y_{it}$  is the VAT-to-Tax ratio. The dynamic features of the model are captured through the lagged dependent variable  $Y_{it-1}$ . The coefficients  $\beta$  give the inertia of the tax policy, in other words, the extent to which the actual level of VAT revenue collected depends on its lagged value.  $\beta$  coefficient close to unit signals high inertia. Notice that the dynamic panel procedure of the GMM-system estimator accounts also for the biases induced by the lagged dependent variable among the regressors. As in the baseline specification, this model includes a matrix of explanatory variables,  $X_{k,it}$ , other than the ERR. We also control for country-specific characteristics,  $\eta_i$  which may explain some structural differences across countries.  $\varepsilon_{it}$  is the stochastic error term.

Table 3.7 presents the estimation results using to the GMM-system estimator. We notice that the ERR dummies appear with the statistical significance and expected signs in four out of six specifications. By replicating the baseline estimation (column 1), we show that countries

with pegged regimes collect more revenue, compared to those with intermediate or flexible regimes, a result that is in line with our baseline hypothesis.

Interestingly, the sign and statistical significance of the dummy Pegged ERR persist, even when we narrow the definition of the Pegged ERR dummy and include additional explanatory variables in the specification (column 4). The magnitude of the coefficient changes slightly though.

Likewise, estimations performed within the peg category (columns 2 and 3) display significant positive coefficients, except for countries with a conventional peg. Again, we notice that the magnitude of the coefficient is stronger for currency boarders since this latter is more compelling as an exchange rate arrangement and leaves less room for seigniorage, compared to alternative regimes in the peg category. Columns 5 and 6 of Table 3.7 perform pair-wise estimations and compare Peg and Intermediate regimes, and Peg and Floating regimes. We find that our baseline finding holds only when peggers are compared with floaters. The VAT collected is higher for countries under pegged regimes, compared to floating regime countries, but there is no statistical difference between peggers and countries with intermediate regimes.

The GMM estimations strengthen our baseline finding that the ERR significantly influences the TT mechanism, a result that is not driven by an endogeneity bias.

**Table 3.7: IV estimations of the effect of ERR on the VAT-to-Tax ratio: the dynamic system-GMM**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                          |                          |                        |                         |                        |                          |
|--|--------------------------|--------------------------|------------------------|-------------------------|------------------------|--------------------------|
|  | Baseline                 | Within pegs              |                        | Narrow peg              | Peg vs. Interm.        | Peg vs. Float.           |
|  | (1)                      | (2)                      | (3)                    | (4)                     | (5)                    | (6)                      |
| Lagged VAT                                     | 0.890***<br>(24.15)      | 0.838***<br>(17.29)      | 0.899***<br>(21.18)    | 0.914***<br>(25.29)     | 0.888***<br>(21.62)    | 0.857***<br>(17.10)      |
| <b>Pegged ERR</b>                              | <b>1.380**</b><br>(1.97) |                          |                        |                         |                        |                          |
| <b>Currency board</b>                          |                          | <b>4.451**</b><br>(2.21) |                        |                         |                        |                          |
| <b>Conventional peg</b>                        |                          |                          | <b>0.743</b><br>(0.92) |                         |                        |                          |
| <b>Narrow peg</b>                              |                          |                          |                        | <b>1.148*</b><br>(1.68) |                        |                          |
| <b>Peg vs. Intermediate</b>                    |                          |                          |                        |                         | <b>1.241</b><br>(1.44) |                          |
| <b>Peg vs. Floating</b>                        |                          |                          |                        |                         |                        | <b>4.910**</b><br>(1.98) |
| Trade openness                                 | -2.371<br>(-1.45)        | -2.153<br>(-1.08)        | -4.054*<br>(-1.73)     | -2.222<br>(-1.32)       | -0.482<br>(-0.22)      | -1.716<br>(-0.61)        |
| Agricultural VA                                | -0.348<br>(-0.71)        | -0.295<br>(-0.57)        | -0.883<br>(-1.18)      | -0.348<br>(-0.71)       | 0.096<br>(0.14)        | 0.017<br>(0.02)          |
| Inflation                                      | 0.047<br>(0.25)          | -0.028<br>(-0.16)        | 0.720**<br>(2.36)      | 0.044<br>(0.25)         | -0.016<br>(-0.12)      | -0.043<br>(-0.33)        |
| GDP pc growth                                  | -0.011<br>(-0.23)        | -0.030<br>(-0.61)        | -0.019<br>(-0.40)      | 0.009<br>(0.21)         | 0.002<br>(0.04)        | 0.028<br>(0.34)          |
| Nb. of obs.                                    | 1138                     | 835                      | 906                    | 1082                    | 941                    | 615                      |
| AR(1)  | 0.000                    | 0.000                    | 0.000                  | 0.000                   | 0.000                  | 0.003                    |
| AR(2)  | 0.209                    | 0.318                    | 0.253                  | 0.248                   | 0.664                  | 0.289                    |
| Hansen   | 0.148                    | 0.610                    | 0.506                  | 0.334                   | 0.0930                 | 0.216                    |
| Countries                                      | 64                       | 56                       | 59                     | 64                      | 60                     | 52                       |
| Instruments                                    | 15                       | 15                       | 15                     | 15                      | 15                     | 15                       |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics calculated with robust standard errors are given in brackets. Following Roodman (2006), the number instruments is strongly limited to avoid the over-fitting problem. In all specification, we reject the null of AR(1) of no autocorrelation in the error terms, while this latter is not rejected for two time lags, AR(2). The robust (to heteroskedasticity and autocorrelation) Hansen's p-value validates the over-identification restrictions in all specifications. Then, the lagged variables can be safely used as instruments.

### 3.5. Robustness analysis

This section presents a series of sensitivity tests aimed at strengthening our baseline findings. We first re-estimate our core regressions and include a set of control variables to strongly mitigate the omitted variable bias. Then, we change the baseline dependent variable and use the VAT-to-GDP ratio instead of the VAT-to-Tax ratio to see whether our results are influenced by the evolution of the overall GDP. In a final step, we develop a duration model to estimate the probability of VAT adoption conditional to the ERR.

### 3.5.1. Adding specific control variables

The first range of robustness exercises consists of adding relevant controls to the baseline specifications, namely: the GDP per capita, the size of the government proxied by the government consumption, the size of the population, remittances and aid flows; and the nominal and real interest rates.

**Table 3.8: Baseline estimates with additional controls**

| <i>Dependent variable: VAT (% Tax revenue)</i> |                                   |                 |                 |                 |                |                 |                 |                 |
|--|-----------------------------------|-----------------|-----------------|-----------------|----------------|-----------------|-----------------|-----------------|
|  | Baseline with additional controls |                 |                 |                 |                |                 |                 |                 |
|  | (1)                               | (2)             | (3)             | (4)             | (5)            | (6)             | (7)             | (8)             |
| <b>Pegged ERR</b>                              | <b>2.888***</b>                   | <b>3.427***</b> | <b>3.366***</b> | <b>3.626***</b> | <b>2.498**</b> | <b>6.215***</b> | <b>4.121***</b> | <b>4.228***</b> |
|  | (3.369)                           | (3.959)         | (3.821)         | (4.363)         | (2.065)        | (4.354)         | (4.146)         | (4.016)         |
| Agricultural VA                                | -2.695**                          | -4.353***       | -3.693***       | -6.774***       | -5.625***      | -3.300*         | -4.950***       | -3.269**        |
|  | (-2.044)                          | (-3.330)        | (-2.782)        | (-5.296)        | (-3.386)       | (-1.859)        | (-3.068)        | (-2.224)        |
| GDP pc growth                                  | -6.321***                         | -2.883***       | -7.543***       | -2.334**        | -12.067***     | -12.758***      | -8.182***       | -8.853***       |
|  | (-7.295)                          | (-2.611)        | (-8.607)        | (-2.511)        | (-9.799)       | (-8.873)        | (-8.248)        | (-8.732)        |
| Inflation                                      | -0.335                            | -0.339          | -0.360          | -0.280          | -0.217         | -0.386          | -0.409          | -0.439          |
|  | (-1.433)                          | (-1.362)        | (-1.415)        | (-1.170)        | (-0.880)       | (-1.093)        | (-1.472)        | (-1.542)        |
| Trade openness                                 | 0.193***                          | 0.169***        | 0.219***        | 0.135**         | 0.283***       | 0.137           | 0.207***        | 0.199***        |
|  | (3.240)                           | (2.711)         | (3.460)         | (2.260)         | (3.878)        | (1.567)         | (2.872)         | (2.902)         |
| Lagged Public debt                             | -0.039***                         |                 |                 |                 |                |                 |                 |                 |
|  | (-3.545)                          |                 |                 |                 |                |                 |                 |                 |
| GDP per capita                                 |                                   | 5.374***        |                 |                 |                |                 |                 |                 |
|  |                                   | (6.699)         |                 |                 |                |                 |                 |                 |
| Gov. consumption                               |                                   |                 | -1.006          |                 |                |                 |                 |                 |
|  |                                   |                 | (-0.532)        |                 |                |                 |                 |                 |
| Population                                     |                                   |                 |                 | 35.953***       |                |                 |                 |                 |
|  |                                   |                 |                 | (11.837)        |                |                 |                 |                 |
| Remittances                                    |                                   |                 |                 |                 | -0.209         |                 |                 |                 |
|  |                                   |                 |                 |                 | (-1.060)       |                 |                 |                 |
| Aid  |                                   |                 |                 |                 |                | -0.450***       |                 |                 |
|  |                                   |                 |                 |                 |                | (-3.834)        |                 |                 |
| Real IR  |                                   |                 |                 |                 |                |                 | -0.029          |                 |
|  |                                   |                 |                 |                 |                |                 | (-0.835)        |                 |
| Official ER                                    |                                   |                 |                 |                 |                |                 |                 | 0.001*          |
|  |                                   |                 |                 |                 |                |                 |                 | (1.928)         |
| Nb. of obs.                                    | 1118                              | 1198            | 1200            | 1200            | 774            | 738             | 992             | 1064            |
| R-squared                                      | 0.11                              | 0.14            | 0.11            | 0.20            | 0.16           | 0.19            | 0.11            | 0.12            |
| Fischer ( <i>stat</i> )                        | 21.36                             | 30.23           | 22.04           | 48.07           | 22.60          | 27.24           | 18.91           | 22.58           |
| Fischer ( <i>p-value</i> )                     | 0.00                              | 0.00            | 0.00            | 0.00            | 0.00           | 0.00            | 0.00            | 0.00            |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. The F-test for fixed effects and the Breusch-Pagan LM test for random effects both rejected (with p-value=0.00) the null hypothesis that there are no specific effects. For all specifications, the joint significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.

The results displayed in Table 3.8 are consistent with our baseline findings. In all specifications, the dummies Pegged ERR are statistically significant with the expected positive sign. Countries with a pegged ERR increase their VAT-to-Tax ratio by an average 3.5 percentage points once

they complete trade liberalization process. While the fiscal policy variables (one-time-lagged public debt) and aid flows significantly reduces the level of VAT revenue collected as a share of the tax revenue, GDP per capita, the size of the population, and the nominal exchange rate positively impact the VAT-to-Tax ratio. Government consumption, the real interest rate, and remittances display a statistically null impact on the VAT-to-Tax ratio. Since the supplementary controls left our interest variable—the dummy Pegged ERR—unchanged, we confirm that our findings are robust to the inclusion of additional control variables.

### 3.5.2. Changing the dependent variable: using the VAT-to-GDP ratio

The second set of sensitivity checks consists of changing the left-hand-side variable. Our benchmark left-hand-side variable VAT-to-Tax ratio is replaced with the VAT-to-GDP. To dismiss any suspicion of erroneous estimations that would be driven by the evolution of the GDP, we control for the evolution of GDP through the GDP per capita growth rate.

The coefficients of the *Pegged ERR* dummy remains positive and statistically significant with a 99 percent confidence level. These findings are in line with our baseline that peggers collect more VAT revenue, even though the magnitude of the coefficient significantly decreased.<sup>56</sup> We also disentangle results within the peg category using the new VAT-to-Tax ratio. Additional estimates displayed in appendix C.7 strengthen the findings that the effect of the Pegged ERR on the VAT-to-GDP ratio is stronger for currency boarders; and confirm that the difference is more pronounced when pegged ERR are compared with floating regimes than intermediate regimes. The magnitude of the dummy *Peg vs. Floating* is twice greater than the one of the dummy *Peg vs. Intermediate*.

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<sup>56</sup> This change in the magnitude of the coefficient is expected, since the level of the VAT-to-Tax ratio is higher than the VAT-to-GDP ratio.

**Table 3.9: Baseline estimates with alternative dependent variable**

|                             | <i>Dependent variable: VAT (% GDP)</i> |                |                 |               |                 |                 |                 |                  |
|-----------------------------|--|----------------|-----------------|---------------|-----------------|-----------------|-----------------|------------------|
|                             | Baseline                               | Time dummies   | Random effects  | Developing    | Developed       | Peg and Intern. | Peg vs. Intern. | Peg vs. Floating |
|                             | (1)                                    | (2)            | (3)             | (4)           | (5)             | (6)             | (7)             | (8)              |
| <b>Pegged ERR</b>           | <b>0.417***</b>                        | <b>0.327**</b> | <b>0.349***</b> | <b>-0.092</b> | <b>0.943***</b> | <b>0.744***</b> |                 |                  |
|                             | (2.935)                                | (2.434)        | (2.615)         | (-0.666)      | (3.885)         | (4.184)         |                 |                  |
| <b>Intermediate</b>         |  |                |                 |               |                 | <b>0.416***</b> |                 |                  |
|                             |  |                |                 |               |                 | (3.038)         |                 |                  |
| <b>Peg vs. Intermediate</b> |  |                |                 |               |                 |                 | <b>0.439***</b> |                  |
|                             |  |                |                 |               |                 |                 | (2.800)         |                  |
| <b>Peg vs. Floating</b>     |  |                |                 |               |                 |                 |                 | <b>0.801***</b>  |
|                             |  |                |                 |               |                 |                 |                 | (2.951)          |
| Trade openness              | 0.042                                  | -1.394***      | -0.899***       | 0.596**       | 0.251           | 0.087           | 0.204           | 0.451            |
|                             | (0.196)                                | (-6.018)       | (-4.237)        | (2.041)       | (0.823)         | (0.409)         | (0.830)         | (1.250)          |
| Agricultural VA             | 1.202***                               | 0.359**        | 0.030           | -0.685***     | -1.915***       | -1.196***       | -1.168***       | -1.130***        |
|                             | (-8.628)                               | (1.997)        | (0.198)         | (-4.939)      | (-7.585)        | (-8.618)        | (-7.597)        | (-5.058)         |
| Inflation                   | -0.044                                 | -0.020         | -0.021          | -0.008        | -0.074          | -0.044          | -0.048          | -0.032           |
|                             | (-1.072)                               | (-0.513)       | (-0.532)        | (-0.167)      | (-1.279)        | (-1.087)        | (-1.056)        | (-0.761)         |
| GDP pc growth               | 0.055***                               | 0.043***       | 0.044***        | 0.052***      | 0.041***        | 0.051***        | 0.062***        | 0.061***         |
|                             | (5.412)                                | (4.117)        | (4.103)         | (4.209)       | (2.774)         | (5.046)         | (5.504)         | (4.252)          |
| Nb. of obs.                 | 1200                                   | 1200           | 1200            | 553           | 647             | 1200            | 992             | 647              |
| R-squared                   | 0.12                                   | 0.24           | 0.24            | 0.15          | 0.16            | 0.13            | 0.13            | 0.11             |
| Fischer ( <i>stat</i> )     | 30.98                                  | 14.08          | 327.1           | 18.00         | 22.43           | 27.54           | 27.91           | 14.50            |
| Fischer ( <i>p-value</i> )  | 0.00                                   | 0.00           | 0.00            | 0.00          | 0.00            | 0.00            | 0.00            | 0.00             |

Significance: \* 10%; \*\* 5% and \*\*\* 1% with t-statistics in brackets. The F-test for fixed effects and the Breusch-Pagan LM test for random effects both rejected (with p-value=0.00) the null hypothesis that there are no specific effects. For all specifications, the joint significance tests, with p-value=0.00, reject the hypothesis that all slopes are statistically null.



All in all, our first (two) robustness checks show that our results are neither driven by an omitted variable that might impact the level of VAT revenue collected through the ERR variable, nor a measurement error that might plague our left-hand-side variable. We pursue additional sensitivity checks with alternative estimation strategies.

### 3.5.3. Qualitative variable estimates: a duration model of tax transition

How can alternative ERR influence the tax transition mechanism? The rationale is that countries with a pegged exchange rate regime have a higher probability of undergoing tax transition after liberalization to offset their resource loss. Since the VAT is one of the most common tax policy instruments, we rely on countries' decision to adopt the VAT as a measurement of the transition process.

Appendix C.6 develops an analytical framework showing that countries with pegged ERR have higher probability of VAT adoption. This assumption is tested using a duration model where the dependent variable is a dummy capturing the VAT adoption, instead of the VAT-to-Tax ratio.

Knowing that our dependent variable is binary (1 if the country has adopted VAT, and 0 otherwise), one would be tempted to estimate the probability of adopting the VAT, conditional to the ERR in place and a set of controls using the following qualitative variable model:

$$\Pr(VAT_{it} = 1 | ERR_{it}, \sum_{k=1}^K X_{k,it}) \quad (3.3)$$

As one knows, countries repeal rarely the VAT once they introduce it. Thus, VAT adoption is an “absorbing state” mechanism. With such consideration, the VAT dummy takes the value 0 before the adoption and 1 afterwards; and no changes will be noted further in the dependent variable unless the country repeals the VAT.<sup>57</sup> A more appropriate way to deal with such a data structure is to specify a duration model, which estimates the effect of the ERR on the lapse of time until the VAT adoption:

$$h(t | X_i, v_i) = \lambda_0(t) \exp\left(\sum_{k=1}^K \beta_k X_{k,i}\right) v_i \quad (3.4)$$

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<sup>57</sup> Only Malta, in our sample, has repealed the VAT.

$h(t | X_i, v_i)$  represents the hazard function. The value of the hazard function is identified as the hazard rate or (VAT) adoption rate, i.e. the rate at which a country adopts the VAT. In other words, the hazard function estimates the effect of the explanatory variable on the time until the country introduces the VAT.  $\lambda_0(t)$  refers to the baseline hazard, that is, the time path of the probability of adopting the VAT that is the same for all countries, apart from a shift due to variation in the regressors.  $X_{ki}$  corresponds to the measurable characteristics of each country, including the ERR.  $v_i$  accounts for the the time-invariant and unobservable heterogeneity.  $\beta_k$  are the parameters to be estimated.<sup>58</sup>

The distribution of the time  $t$  until the occurrence of an event  $X$  (the VAT adoption, for instance) is most often asymmetric and possibly bimodal. Thus, estimating equation (3.4) via OLS or Probit/Logit, which assumes the normality of the error term, may be misleading (Cleves *et al.* 2004).<sup>59</sup> Thus, the parameters  $\beta_k$  are estimated using the partial likelihood under a specification of the baseline hazard. The partial maximum likelihood has the advantage of being independent from the baseline hazard function ( $\lambda_0(t)$ ), which can be estimated either parametrically or semi-parametrically. This independence property is an additional advantage of the duration models.

Before diving into the interpretation of the coefficients, one should notice that the duration model estimates a hazard rate, that is, the rate of exit from a given situation. The sign of the coefficients indicates how a covariate affects the hazard rate. A positive coefficient increases the hazard rate and decreases the duration. To calculate the factor change, the estimated parameters are exponentiated.

Panel A of table 3.10 drops countries that have adopted the VAT before 1990 (first year of the time span), while Panel B considers all countries. The negative sign of the baseline

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<sup>58</sup> Lancaster (1990) argues that  $v_i$  can be seen to some extent as the measurement error.

<sup>59</sup> Using the OLS or Probit/Logit techniques violates the *normality assumption*: this assumption is always unrealistic in the context of duration models where it exhibits asymmetry, particularly if some observations have a very long duration. OLS may return negative predicted values even though that is impossible. Duration must be positive. OLS does not easily distinguish between censored and uncensored observations. Dropping uncensored observations leads to a sample selection problem. Finally, OLS cannot easily accommodate independent variables that change value over time. These problems are overcome in the hazard model, which does not require any assumptions on the error term.

dummy Pegged ERR means that this regime negatively affects the hazard rate. In other words, for countries under a pegged ERR the time before adopting the VAT is reduced by 62 percent.<sup>60</sup> As a result, countries with pegged regimes have a higher probability of adopting the VAT, compared to those with intermediate or floating regimes. The rule of thumb here for interpreting the coefficient is that a negative (positive) sign has a positive (negative) impact on the probability of VAT adoption. While a growing rate of the GDP per capita also increases the likelihood of adopting the VAT, one should notice that inflation displays a negative impact on the probability of VAT adoption. It is also worth mentioning that the coefficient of Currency board is greater throughout in absolute value. In line with our hypothesis, the more binding the constraint on the alternative ways to offset the resource loss is—such as raising seigniorage revenue—the more willing the fiscal authorities will be to operate TT through VAT adoption.

However, our estimation outputs show that, among the peg group, countries with a conventional pegged regime have a lower probability of adopting the VAT, showing that discrepancies exist in the way that the ERR affects the TT mechanism. The effect of ERR on the transition process depends on the category of exchange rate arrangement under consideration.

Our duration analysis confirms the link between the ERR and VAT adoption. Using a dummy variable of VAT adoption, we find that countries with a pegged regime have a greater probability of adopting the VAT in response to trade liberalization.

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<sup>60</sup> The magnitude of the change is obtained as follows:  $0.623 = \exp(-0.978) - 1$ .

**Table 3.10: Cox's semi-parametric estimations of duration models of VAT adoption**

|                             | <i>Panel A</i>            |                             |                           |                           |                            |                        | <i>Panel B</i>           |                             |                    |                          |                     |                           |                          |
|-----------------------------|---------------------------|-----------------------------|---------------------------|---------------------------|----------------------------|------------------------|--------------------------|-----------------------------|--------------------|--------------------------|---------------------|---------------------------|--------------------------|
|                             | Baseline                  | Within pegs                 |                           | Narrow                    | Pair-wise                  |                        | Baseline                 | Within pegs                 |                    | Narrow                   | Pair-wise           |                           |                          |
|                             | (1)                       | (2)                         | (3)                       | (4)                       | (5)                        | (6)                    | (7)                      | (8)                         | (9)                | (10)                     | (11)                | (12)                      |                          |
| <b>Pegged ERR</b>           | <b>-0.978*</b><br>(-1.71) |                             |                           |                           |                            |                        | <b>-0.779</b><br>(-1.59) |                             |                    |                          |                     |                           |                          |
| <b>Currency board</b>       |                           | <b>-2.949***</b><br>(-5.54) |                           |                           |                            |                        |                          | <b>-2.359***</b><br>(-3.96) |                    |                          |                     |                           |                          |
| <b>Conventional peg</b>     |                           |                             | <b>1.738***</b><br>(2.94) |                           |                            |                        |                          |                             |                    | <b>1.125*</b><br>(1.68)  |                     |                           |                          |
| <b>Dollarization and CP</b> |                           |                             |                           |                           |                            |                        |                          |                             |                    |                          |                     |                           |                          |
| <b>Narrow peg</b>           |                           |                             |                           | <b>-0.956*</b><br>(-1.70) |                            |                        |                          |                             |                    | <b>-0.718</b><br>(-1.53) |                     |                           |                          |
| <b>Peg vs. Intermediate</b> |                           |                             |                           |                           | <b>-1.064**</b><br>(-1.97) |                        |                          |                             |                    |                          |                     | <b>-0.938*</b><br>(-1.93) |                          |
| <b>Peg vs. Floating</b>     |                           |                             |                           |                           |                            | <b>0.072</b><br>(0.06) |                          |                             |                    |                          |                     |                           | <b>-0.895</b><br>(-0.78) |
| Trade openness              | 0.094<br>(0.29)           | 0.863**<br>(2.47)           | 0.641**<br>(2.47)         | 0.074<br>(0.20)           | -0.287<br>(-0.85)          | -0.553<br>(-0.95)      | 0.191<br>(0.58)          | 0.802**<br>(2.14)           | 0.545<br>(1.59)    | 0.236<br>(0.72)          | -0.420<br>(-1.26)   | 0.200<br>(0.31)           |                          |
| Agricultural VA             | -0.028**<br>(-2.11)       | -0.058***<br>(-3.04)        | -0.044***<br>(-2.63)      | -0.027<br>(-1.62)         | -0.036***<br>(-2.62)       | 0.019<br>(0.38)        | -0.011<br>(-0.85)        | -0.030*<br>(-1.85)          | -0.024*<br>(-1.70) | -0.006<br>(-0.47)        | -0.032**<br>(-2.52) | 0.007<br>(0.18)           |                          |
| Inflation                   | 5.976***<br>(2.67)        | 10.433***<br>(3.35)         | 10.771***<br>(3.77)       | 5.867**<br>(2.41)         | 3.672*<br>(1.78)           | 5.638**<br>(2.03)      | 1.220<br>(0.51)          | 3.955<br>(1.02)             | 5.103<br>(1.48)    | 0.593<br>(0.61)          | 0.557<br>(0.83)     | 3.081<br>(0.58)           |                          |
| GDP pc growth               | -0.038<br>(-0.68)         | -0.153**<br>(-2.06)         | -0.083*<br>(-1.74)        | -0.037<br>(-0.61)         | -0.035<br>(-0.67)          | -0.014<br>(-0.20)      | -0.010<br>(-0.18)        | -0.120**<br>(-1.97)         | -0.056<br>(-1.21)  | 0.014<br>(0.24)          | -0.009<br>(-0.16)   | 0.034<br>(0.46)           |                          |
| Countries                   | 35                        | 30                          | 29                        | 33                        | 32                         | 16                     | 37                       | 32                          | 30                 | 35                       | 34                  | 17                        |                          |
| Pseudo R <sup>2</sup>       | 0.069                     | 0.209                       | 0.128                     | 0.061                     | 0.071                      | 0.140                  | 0.037                    | 0.120                       | 0.044              | 0.037                    | 0.061               | 0.069                     |                          |
| Pseudo Log likelihood       | -80.34                    | -54.46                      | -59.98                    | -74.39                    | -71.66                     | -23.82                 | -86.74                   | -63.57                      | -68.55             | -79.82                   | -76.17              | -26.92                    |                          |
| Wald (p-value)              | 0.042                     | 0.000                       | 0.004                     | 0.199                     | 0.019                      | 0.062                  | 0.685                    | 0.002                       | 0.312              | 0.499                    | 0.053               | 0.905                     |                          |
| CU Pseudo-R <sup>2</sup>    | 0.291                     | 0.623                       | 0.460                     | 0.256                     | 0.292                      | 0.395                  | 0.165                    | 0.424                       | 0.192              | 0.161                    | 0.256               | 0.215                     |                          |
| GH concordance coeff.       | 0.697                     | 0.806                       | 0.747                     | 0.683                     | 0.684                      | 0.735                  | 0.616                    | 0.694                       | 0.664              | 0.617                    | 0.662               | 0.599                     |                          |
| PH test (p-value)           | 0.8938                    | 0.3397                      | 0.9101                    | 0.8848                    | 0.8869                     | 0.8767                 | 0.8708                   | 0.2712                      | 0.7270             | 0.9859                   | 0.9931              | 0.5979                    |                          |

Significance: \* 10%, \*\* 5% and \*\*\* 1%. Student's statistics, with robust standard errors are given in parentheses. We reject, at 5% level, the null hypothesis of the Wald test that coefficients are jointly null (except in columns 7, 9, 10 and 12). CU stands as the Cragg and Uhler pseudo R-squared. The Gönen and Heller's K concordance coefficient (GH) calculates the proportion of all usable subject pairs in which the predictions and outcomes are concordant. It thus proxy the predictive power of the model, which lies from 60% to 80% of the observations correctly predicted. The null of the PH test assumes that coefficients are constant over time and assumes that the proportional hazard assumption holds. Thus, the non-rejection of the null validates the assumption of proportional model. At 10% level, our models pass the PH test since the p-values >0.1.

### 3.6. Conclusion

This chapter investigated the relationship between tax transition and ERR using a panel of developing and developed countries over the period 1990-2010. Our results show that countries with a pegged ERR collect more VAT revenue, compared to countries with intermediate or floating regimes. The rationale of this finding can be explained as follows. In the wake of trade liberalization process, authorities try to offset the resource loss entailed by the liberalization, either by mobilizing more seigniorage revenue or operating tax transition with a greater reliance on domestic taxation. Since countries with a pegged ERR partially lose (or totally in certain cases) the revenue that could flow from seigniorage, they seem more willing to operate tax transition, and thereby mobilize more revenue through the VAT for instance. These findings might also be supported by the optimum currency area theory, which assumes that countries within a pegged arrangement implement less external taxes to promote cross-border trade. Giving up border taxation leads the authorities to increase their reliance on internal taxation. Further, we find that the more restrictive the ERR is, the greater the impact of exchange rate regime on VAT revenue. These substitution (VAT vs. seigniorage) and competitiveness (VAT vs. border taxation) effects are only observed for developing countries. Robustness exercises show that our estimation results are neither driven by differences in the ERR classification, nor by temporary shocks that can affect countries simultaneously. Our findings are also robust to the endogeneity bias caused by omitted variables or reverse causality problem.

This chapter is a step forward in understanding the evolution and structure of tax revenue. We have shed light on the nexus between the exchange rate regime and tax policy. Trade and tax policy are closely linked with the ERR in place. Therefore, structural reforms such as trade liberalization should be implemented, taking in due consideration the exchange rate arrangement.

## **Appendices C**

### **Appendix C.1: List of countries**

#### **Developing countries:**

Algeria, Argentina, Belarus, Bhutan, Bolivia, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Comoros, Costa Rica, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Eritrea, Ethiopia, Guatemala, Guinea, India, Indonesia, Iran, Jamaica, Jordan, Kenya, Kyrgyz Republic, Latvia, Lesotho, Malaysia, Maldives, Mauritius, Mexico, Moldova, Mongolia, Mozambique, Namibia, Nepal, Nicaragua, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Romania, Rwanda, Seychelles, Sierra Leone, South Africa, Sri Lanka, St. Vincent & Grenadine, Sudan, Syrian Arab Republic, Tanzania, Thailand, Tunisia, Turkey, Ukraine, Uruguay, Venezuela, Zambia, Zimbabwe.

#### **Developed countries:**

Australia, Austria, Bahamas, Bahrain, Belgium, Canada, Croatia, Czech Republic, Denmark, Equatorial Guinea, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Singapore, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom, United States.

## Appendix C.2: Descriptive statistics

| Variables   | Obs. | Mean  | Std. Dev. | Min   | Max    |
|---|------|-------|-----------|-------|--------|
| <b>Tax policy variables</b>                         |      |       |           |       |        |
| Customs revenue (in % of GDP)                       | 1692 | 1.9   | 3.3       | 0.0   | 40.8   |
| Tax revenue (in % Total revenue)                    | 1617 | 71.0  | 20.5      | 0.7   | 117.9  |
| Tax revenue (in % of GDP)                           | 2004 | 17.0  | 7.6       | 0.1   | 61.0   |
| Taxes on GS (in % of GDP)                           | 1975 | 7.5   | 3.9       | 0.0   | 18.1   |
| Taxes on IPK (in % of GDP)                          | 1995 | 6.2   | 4.4       | 0.0   | 30.4   |
| Taxes on IT (in % of GDP)                           | 1830 | 2.7   | 4.5       | -1.6  | 41.5   |
| VAT revenue (in % of GDP)                           | 959  | 19.3  | 10.7      | 0     | 51.0   |
| VAT revenue (in % of Tax revenue)                   | 1329 | 27.7  | 13.6      | 0     | 66.6   |
| VAT revenue (in % of Total revenue)                 | 1329 | 5.0   | 2.8       | 0     | 12.7   |
| <b>Macroeconomic variables</b>                      |      |       |           |       |        |
| Agricultural value added (in % of GDP)              | 1980 | 13.1  | 12.8      | 0.0   | 96.6   |
| Deposit interest rate (IR)                          | 1745 | 26.1  | 281.2     | 0.0   | 9394.3 |
| GDP growth (percentage)                             | 2085 | 3.6   | 5.4       | -50.2 | 71.2   |
| GDP pc growth (percentage)                          | 2085 | 2.2   | 5.2       | -47.3 | 65.7   |
| GDP per capita (in thousands USD)                   | 2110 | 10.3  | 14.5      | 0.1   | 112.0  |
| Government consumption (in % of GDP)                | 2104 | 10.4  | 6.8       | 2.9   | 53.3   |
| Inflation (percentage)                              | 2063 | 0.8   | 1.0       | -20.3 | 16.4   |
| Official development assistance (in % of GDP)       | 1531 | 5.1   | 8.6       | -0.7  | 94.4   |
| Official exchange rate                              | 1935 | 449.4 | 1923.8    | 0.0   | 25000  |
| Population (in millions)                            | 2121 | 49    | 164       | 0.07  | 1300   |
| Public debt (in % of GDP)                           | 1899 | 63.5  | 65.4      | 0.7   | 2092.9 |
| Real interest rate                                  | 1737 | 7.8   | 19.6      | -97.6 | 508.7  |
| Remittances (in % of GDP)                           | 1251 | 2.6   | 4.1       | 0.0   | 26.4   |
| Trade openness                                      | 2104 | 84.7  | 52.9      | 9.5   | 440.4  |
| <b>Natural resource and Institutional variables</b> |      |       |           |       |        |
| Mineral rent (in % of GDP)                          | 2112 | 0.9   | 3.3       | 0.0   | 35.3   |
| Natural resource rents (in % of GDP)                | 2112 | 5.4   | 9.7       | 0.0   | 80.7   |
| Oil rent (in % of GDP)                              | 1858 | 2.9   | 8.2       | 0.0   | 79.5   |
| Corruption  | 1706 | 3.3   | 1.4       | 0.0   | 6.0    |
| Government stability                                | 1706 | 8.1   | 1.9       | 1.0   | 12.0   |

### Appendix C.3: Ilzetzi, Reinhart and Rogoff classification of ERR

| Fine classification  | Freq. | Percent | Coarse classification |
|--|-------|---------|-----------------------|
| No separate legal tender   | 193   | 9.5     |                       |
| Pre announced peg or currency board arrangement  | 269   | 13.3    | Fix                   |
| Pre announced horizontal band that is narrower than or equal to +/-2%  | 2     | 0.1     |                       |
| De facto peg   | 207   | 10.2    |                       |
| Pre announced crawling peg   | 32    | 1.6     |                       |
| Pre announced crawling band that is narrower than or equal to +/-2%  | 32    | 1.6     | Intermediate          |
| De factor crawling peg   | 265   | 13.1    |                       |
| De facto crawling band that is narrower than or equal to +/-2%   | 312   | 15.4    |                       |
| Pre announced crawling band that is wider than or equal to +/-2%   | 8     | 0.4     |                       |
| De facto crawling band that is narrower than or equal to +/-5%   | 185   | 9.1     |                       |
| Moving band that is narrower than or equal to +/-2%<br>(i.e., allows for both appreciation and depreciation over time) | 80    | 3.9     |                       |
| Managed floating   | 179   | 8.9     | Floating              |
| Freely floating  | 103   | 5.1     |                       |
| Freely falling   | 143   | 7.1     | Excluded              |
| Dual market in which parallel market data is missing.  | 13    | 0.6     |                       |

### Appendix C.4: Descriptive statistics of ERR

| Variable         | Obs. | Mean | Std. Dev. | Min | Max |
|------------------|------|------|-----------|-----|-----|
| Fixed/Pegged     | 2010 | 0.33 | 0.47      | 0   | 1   |
| Intermediate     | 2010 | 0.45 | 0.50      | 0   | 1   |
| Float            | 2010 | 0.14 | 0.35      | 0   | 1   |
| Narrow fixed     | 1867 | 0.36 | 0.48      | 0   | 1   |
| Currency board   | 1608 | 0.17 | 0.37      | 0   | 1   |
| Conventional peg | 1546 | 0.13 | 0.34      | 0   | 1   |

Narrow fixed or pegged regime dummy variable excludes conventional peg from the group of pegged regimes.



### Appendix C.5: Different specifications of the exchange rate regime dummies

| Reinhart and Rogoff fine classification of Exchange Rate Regimes  | Baseline dummy variables               |  | Pair-wise comparison                     |                         | Finer classification within peg category |  |                        |                    |  |  |  |  |  |  |
|---|--|--|--|-------------------------|--|--|------------------------|--------------------|--|--|--|--|--|--|
|   | <b>Peg group=1</b>                     |  | <b>Peg vs. Intermediate vs. Floating</b> |                         | <b>No separate=1</b>                     | <b>Currency board=1</b>                | <b>De facto peg=1</b>  | <b>Hard pegs=1</b> |  |  |  |  |  |  |
|   | (1)                                    | (2)                                    | (3)                                      | (4)                     | (5)                                      | (6)                                    | (7)                    | (8)                |  |  |  |  |  |  |
| No separate legal tender  | <b>Peg group</b>                       |  | <b>Peg group</b>                         |                         | <b>Peg group</b>                         | <i>Excluded regime</i>                 | <i>Excluded regime</i> | <b>Peg group</b>   |  |  |  |  |  |  |
| Pre announced peg or currency board arrangement   |  |  |  |                         | <i>Excluded regimes</i>                  | <b>Peg group</b>                       |                        |                    |  |  |  |  |  |  |
| De facto peg  |  |  |  |                         | <i>Excluded regime</i>                   | <b>Peg group</b>                       | <i>Excluded regime</i> |                    |  |  |  |  |  |  |
| Pre announced crawling peg  | <b>Intermediate and floating group</b> | <b>Intermediate and floating group</b> | <b>Intermediate group</b>                | <b>Excluded regimes</b> |  | <b>Intermediate and floating group</b> |                        |                    |  |  |  |  |  |  |
| Pre announced crawling band that is narrower than or equal to +/-2%   |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| De facto crawling peg   |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| De facto crawling band that is narrower than or equal to +/-2%  |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| Pre announced crawling band that is wider than or equal to +/-2%  |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| De facto crawling band that is narrower than or equal to +/-5%  |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time) |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| Managed floating  |  |  | <b>Excluded regimes</b>                  | <b>Floating group</b>   |  |  |                        |                    |  |  |  |  |  |  |
| Freely floating   |  |  |  |                         |  |  |                        |                    |  |  |  |  |  |  |
| Freely falling  | <i>Dropped regime</i>                  |  | <i>Dropped regime</i>                    |                         |  | <i>Dropped regime</i>                  |                        |                    |  |  |  |  |  |  |

## Appendix C.6: Tax transition process: An analytical framework

Assume that government maximizes a utility function  $U(\bullet)$ , within an open economy framework, where public expenditures  $g$  constitutes the main argument.<sup>61</sup>  $g$  consists of productive spending  $\kappa$  and other public goods  $\chi$  provided by the authority.  $g$  are financed using the revenues collected by the government. The maximizing problem is:

$$\underset{g(\kappa, \chi)}{\text{Max}} U = U(g[\kappa, \chi]) \quad (\text{C.5.1})$$

subject to:

$$g = \phi(y; \Theta) \quad (\text{C.5.2})$$

$U(\bullet)$  is a concave utility function with  $U'_g > 0$  and  $U''_g < 0$ . Equation (C.5.2) is the government budget constraint with  $g = (\bullet)$  entirely financed by the revenues  $\phi(y, \Theta)$  collected by the authorities.<sup>62</sup>  $\phi(y, \Theta)$  depends on the public revenues  $y = (\bullet)$  and other characteristics that are specific to the country,  $\Theta$ . The public revenues are subdivided into tax revenues and non-tax revenues. These latter include all sources of financing other than taxation:

$$y = \Gamma + \eta \quad (\text{C.5.3})$$

$\Gamma =$  Tax revenue ( $\Gamma = \tau_{dom} + \tau_{tariff}$ ) and  $\eta =$  Non-tax revenue

Tax revenue include domestic (direct and indirect) taxes ( $\tau_{dom}$ ) and external taxes or tariff revenue ( $\tau_{tariff}$ ). Equation C.5.3 can be rewritten as follow:

$$y = \tau_{dom} + \tau_{tariff} + \eta \quad (\text{C.5.3}')$$

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<sup>61</sup> The underlying idea of maximizing  $g$  hinges entirely on the purposes of Barro (1990) which supports that productive public spending allows for long-run endogenous growth. Aschauer (1989 a,b,c); Easterly and Rebelo (1993) and Morrison and Schwartz (1996) also find a positive correlation between public expenditures and economic growth. Therefore, by maximizing  $g$ , government contributes to enhance growth prospects.

<sup>62</sup> We assume that government has no room for deficit.

We now assume that government undertook a trade liberalization process at  $t-1$  which is completed at  $t+1$ . Trade liberalization is considered as a cross-countries agreement that (tends to) remove trade barriers in a long run perspective.

Let us recall the revenue equation of the government before liberalization,  $y_{t-1} = \Gamma_{t-1} + \eta_{t-1}$ . Subscripts  $t-1$  and  $t+1$  denote respectively the government behavior before after the liberalization process.

At  $t+1$ , government loses a portion  $\delta$  of its tax revenues. The revenue loss  $\delta(\Gamma)$  corresponds to the revenues of international trade taxation before liberalization i.e. the tariff revenues which tend to be zero in the long run ( $\tau_{tariff} \xrightarrow{\text{liberalization}} 0$ ).

$\Gamma_{t+1} \cong \Gamma_{t-1} - \tau_{tariff}$ , with  $\tau_{tariff} > 0$ . Consequently,  $\Gamma_{t+1} < \Gamma_{t-1}$

The revenue equation of the government at  $t+1$  becomes:

$$y_{t+1} = \Gamma_{t+1} + \eta_{t+1} \tag{C.5.4}$$

Keeping all other parameters constant, the liberalization process tightens the government budget constraint:

$$\phi_{t-1}(y_{t-1}, \Theta) > \phi_{t+1}(y_{t+1}, \Theta) \tag{C.5.5}$$

We now consider two different countries **A** and **B**. Country *A* is characterized by a fixed exchange rate regime and *B*, a flexible one. At  $t+1$ , governments try to offset their temporary loss of revenues from trade liberalization. Two alternative strategies of recovering the revenue loss are at stake. Governments can raise seigniorage revenue. As one knows, countries with fixed regime give up (or have very little) control on their own inflation rate. Consequently, the seigniorage revenue received is significantly limited, or even inexistent in some cases.<sup>63,64</sup> As a

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<sup>63</sup> Seigniorage or inflation revenues are modeled as the product of the rate of the price rise and the real stock of money (Friedman, 1971).  $\zeta_t = \frac{m_t - m_{t-1}}{m_{t-1}}$ ;  $m_t$  = real quantity of money.

result, seigniorage revenue of country A (under fixed regime) are null  $\zeta_{a,t+1} = 0$  and those of country B are  $\zeta_{b,t+1}^* \neq 0$ .

The revenue equations of countries **A** and **B** become:

$$\begin{cases} \tilde{y}_{a,t+1} = \Gamma_{a,t+1} + \eta_{a,t+1} \\ \tilde{y}_{b,t+1} = \Gamma_{b,t+1} + \eta_{b,t+1} + \zeta_{b,t+1}^* \end{cases} \quad (\text{C.5.6})$$

The budget constraints of **A** and **B** are respectively  $\phi_{a,t+1}(\tilde{y}_{a,t+1}, \Theta_a)$  and  $\phi_{b,t+1}(\tilde{y}_{b,t+1}, \Theta_b)$

Another possibility for government to make-up their revenue shortfall is to undertake tax transition mechanism, which consists of raising more tax revenues from internal taxation.

We define  $\rho$  as the probability of tax transition (TT),  $\rho \equiv \rho[TT = 1 | \phi(\cdot)]$ .  $\rho$  is positively correlated with the government budget constraint  $\phi(\cdot)$ . The tighter the government budget constraint the higher the probability ( $\rho$ ) of tax transition.

Equation C.5.6 shows that the budget constraint of country **A** is tighter than that of country **B**:

$$\tilde{y}_{a,t+1} < \tilde{y}_{b,t+1} \Rightarrow \phi_{a,t+1}(\tilde{y}_{a,t+1}, \Theta_a) < \phi_{b,t+1}(\tilde{y}_{b,t+1}, \Theta_b) \quad (\text{C.5.7})$$

Given that the budget constraint of country A is tighter, the probability of tax transition for country is higher.

$$\rho_a[TT = 1 | \phi_{a,t+1}(\cdot)] > \rho_b[TT = 1 | \phi_{b,t+1}(\cdot)] \quad (\text{C.5.8})$$

Equation C.5.9 shows that, under liberalization, countries with fixed ERR have higher probability to operate TT compared to those that run intermediate or flexible regimes. The rationale behind this hypothesis is that, with the liberalization process, countries with fixed ERR get tighter budget constraint with the liberalization process taking place. In addition, these

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<sup>64</sup> Fisher (1981) goes further and argues that government loses all seigniorage revenues once it uses a foreign currency. This is the case for dollarized countries or those using another currency within a currency union.

countries, due to the constraint in maintaining a certain level of exchange rate have less seigniorage discretion. Therefore, they seem more willing to undertake a tax transition process, by shifting toward from international to higher domestic taxation.

## Appendix C.7: Additional GMM-system estimates

|                             | <i>Dependent variable: VAT (in % of GDP)</i> |                         |                     |                         |                     |                         |                      |
|-----------------------------|--|-------------------------|---------------------|-------------------------|---------------------|-------------------------|----------------------|
|                             | Baselines                                    |                         | Within pegs         |                         | Narrow peg          | Peg vs. Interm.         | Peg vs. Float        |
|                             | (1)  | (2)                     | (3)                 | (4)                     | (5)                 | (6)                     | (7)                  |
| Lagged VAT                  | 0.873***<br>(16.47)                          | 0.884***<br>(14.58)     | 0.820***<br>(11.59) | 0.867***<br>(16.19)     | 0.926***<br>(22.28) | 0.853***<br>(15.36)     | 0.901***<br>(14.9)   |
| <b>Pegged ERR</b>           | 0.201<br>(1.61)                              | <b>0.172*</b><br>(1.74) |                     |                         |                     |                         |                      |
| <b>Currency board</b>       |  |                         | 0.427<br>(1.37)     |                         |                     |                         |                      |
| <b>Conventional peg</b>     |  |                         |                     | <b>0.260*</b><br>(1.79) |                     |                         |                      |
| <b>Narrow peg</b>           |  |                         |                     |                         | 0.169<br>(1.22)     |                         |                      |
| <b>Peg vs. Intermediate</b> |  |                         |                     |                         |                     | <b>0.199*</b><br>(1.64) |                      |
| <b>Peg vs. Floating</b>     |  |                         |                     |                         |                     |                         | 0.595<br>(1.39)      |
| Agricultural VA             | -0.142<br>(-1.33)                            | -0.022<br>(-0.25)       | -0.01<br>(-0.07)    | -0.138<br>(-1.07)       | -0.161<br>(-1.31)   | -0.129<br>(-0.83)       | -0.125<br>(-0.73)    |
| Inflation                   | -0.031<br>(-0.93)                            | -0.035<br>(-0.78)       | -0.022<br>(-0.80)   | -0.09<br>(-0.39)        | -0.057*<br>(-1.80)  | -0.039<br>(-1.44)       | -0.058***<br>(-2.61) |
| Trade openness              | -0.459<br>(-1.03)                            | 0.041<br>(0.11)         | 0.156<br>(0.28)     | -0.44<br>(-0.80)        | -0.47<br>(-1.13)    | -0.302<br>(-0.64)       | -0.247<br>(-0.43)    |
| GDP pc growth               | 0.014<br>(1.39)                              | 0.005<br>(0.41)         | 0.006<br>(0.44)     | 0.014<br>(1.03)         | 0.022***<br>(2.95)  | 0.017<br>(1.4)          | 0.024<br>(1.12)      |
| Nb. of obs.                 | 1138   | 1138                    | 835                 | 906                     | 1082                | 941                     | 615                  |
| AR(1)                       | 0.000  | 0.000                   | 0.000               | 0.000                   | 0.000               | 0.000                   | 0.011                |
| AR(2)                       | 0.445  | 0.508                   | 0.48                | 0.32                    | 0.455               | 0.602                   | 0.760                |
| Sargan                      | 0.313  | 0.274                   | 0.073               | 0.600                   | 0.344               | 0.601                   | 0.157                |
| Hansen count.               | 0.259  | 0.195                   | 0.45                | 0.831                   | 0.183               | 0.492                   | 0.158                |
| Instr.                      | 64   | 64                      | 56                  | 59                      | 64                  | 60                      | 52                   |
|                             | 16   | 35                      | 16                  | 15                      | 16                  | 16                      | 16                   |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics calculated with robust standard errors are given in brackets. Following Roodman (2006), the number instruments is strongly limited to avoid the over-fitting problem. Column 2 includes time dummies. In all specification, we reject the null of AR(1) of no autocorrelation in the error terms, while this latter is not rejected for two time lags, AR(2). The robust (to heteroskedasticity and autocorrelation) Hansen's p-value validates the over-identification restrictions in all specifications. Then, the lagged variables can be safely used as instruments.

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## Main findings of Part I

Part one of this thesis, which comprises three chapters, explored several aspects of exchange rate regimes. Our first chapter analyzed the potential stabilizing effect of exchange rate regimes, within a panel of developing countries. Our results first confirmed that fiscal policy is pro-cyclical. Using the IMF's classification of exchange rate regime, we showed that fixed exchange rate regime help stabilizing fiscal policy. In other words, the magnitude of pro-cyclicality is reduced for countries under pegged regimes, compared to those with flexible ones. We also found that the stabilizing effect strongly depends on the fiscal policy indicator as well as the exchange rate regime classification. A step further, we noticed that, within the pegged regimes, the stabilizing effect is solely observable for countries with a conventional peg arrangement. The rationale of such stabilizing mechanism is supported by the thinking that countries under pegged regimes reduce their incentives to overspend during booms in order to avoid excessive money growth, and inflation pressures that would threatening the peg. In addition, such (constraining) regimes do not offer sufficient room for debt monetization.

In our second chapter, when assessing the vulnerability of alternative exchange rate regimes to banking, currency and debt crises, we vigorously broke down the bipolar view, suggesting that the corner regimes *–to peg or to float–* are safer than intermediate regimes. There is no clear link between crisis probability and the exchange rate regime at place, but the fundamentals (*fiscal, financial and monetary variables*) matter when it comes to gauging the crisis proneness of several types of exchange rate regimes.

The remaining chapter three of part one explored the link between exchange rate and trade policies. Our findings unveiled a significant link between exchange rate regime and tax policy. Countries with pegged exchange rate regimes tend to collect more VAT revenue, compared to those with either intermediate or floating regimes. This result is economically supported by the substitution and the composition effects. The former hypothesis argues that fiscal authorities try to offset the resource loss entailed by the early-nineties trade liberalization reform, either by mobilizing more seigniorage revenue or operating tax transition with a greater reliance on domestic taxation. Since countries with a pegged regime cannot use the seigniorage as an off-setting mechanism, their alternative would be to undertake tax transition reform, using the VAT



channel for instance. The competitiveness effect assumes that countries within a pegged arrangement implement less border taxation to promote cross-border trade. Giving-up border taxation leads the policymakers to increase their reliance on domestic taxation. Further, we found that, in developing countries, the more the exchange rate regime is restrictive and the stronger is the link between exchange rate regime and tax policy.

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# **PART II:**

# **Fiscal Policy and Decentralization**

*“One of the few positive effects of the recent financial crisis has been the revival of interest in the short-run macroeconomic impacts of government spending and tax changes...”*

Ramey (2011)

# Introduction

Fiscal policy, due to its ineffectiveness has taken a backseat to monetary policy.<sup>65</sup> The limited boundaries within which fiscal policy is allowed to roam made it unenviable, compared to monetary policy. *This time is different...* The unprecedented virulence of the financial crash pushed the conventional monetary policy tools to their utmost limits. The leading monetary policy instrument, the central bank interest rate, hit the zero lower bound, allowing no additional room to boost private demand and stem deeper collapse. Then, unconventional monetary tools (quantitative easing, qualitative easing and forward guidance) stepped in the policy-making scene.<sup>66</sup> In the meantime, fiscal policy was called into rescue to prime the pump of economic growth. This phenomenon has brought to the forefront the new role of fiscal policy. In addition to automatic stabilizers designed to automatically dampen the downsides of the crisis, governments made an active and wide-spread use of bail-out packages to restore growth.

The second piece of this thesis shifts the analysis towards fiscal policy and decentralization issues. It first reassesses the reaction of fiscal policy vis-à-vis the business cycle in the recent episodes of high debt and macroeconomic instability. Notice that discussing the success and failures of fiscal policy-based stabilization plans goes beyond the scope of this thesis. Second, following the wave of fiscal decentralization reform underway<sup>67</sup>, this thesis wisely emphasizes the potential impact of fiscal decentralization on various policy outcomes.

Though decentralization process requires a lengthy gestation period before it starts producing benefits, two main arguments might explain the infatuation with fiscal decentralization in developing countries: (i) the *allocative efficiency*, and (ii) the *productive efficiency*. In the former, the local proximity between subnational governments and local population help alleviating the informational asymmetry. In addition, this will foster higher accountability. The combination effect would lead to a better targeting and preference matching of local citizens' needs. The productive efficiency channel rests on the assumption that decentralization triggers

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<sup>65</sup> IMF, World Economic Outlook (2008).

<sup>66</sup> Dedola *et al.* (2013); IMF (2013); Jones and Kulish (2013); Roache and Rousset (2013); Bauer and Neely (2014); Ellison and Tischbirek (2014); Lambert and Ueda (2014); Wu (2014); Neely (2015); Rafiq (2015).

<sup>67</sup> Caldeira and Rota-Graziosi (2014) offer a comprehensive survey on this issue.

competition among local jurisdictions, and increase efficiency of public services on the supply side. Otherwise, local citizens vote with their feet by moving from one to another more attractive jurisdiction.

However, in the presence of economies of scale, the critics of decentralization process point the fact that decentralization may significantly reduce the efficiency in delivering public goods and services.

Amid, the existing controversy, part two of this thesis tackles the empirical vagueness inherent to several aspects of decentralization, including the impact of asymmetric decentralization, and the stabilizing property of fiscal decentralization.

Chapter four starts with reconsidering the cyclical reaction of fiscal policy and the role of public debt and fiscal rules. We use a sample of 56 advanced economies and emerging market and developing economies over twenty two years starting from 1990. First, our results refresh the finding of counter-cyclical fiscal policy in the sample. This result is in line with the recent finding of Frankel *et al.* (2013), which illustrates that developing countries are graduating toward less pro-cyclical or even counter-cyclical fiscal policy. Further, GMM-system-based estimations show that fiscal policy remains counter-cyclical when the debt-to-GDP ratio is below 54%. However, fiscal policy turns pro-cyclical when the public debt goes beyond 117% in share of GDP. This evidence of non-linear cyclical reaction of fiscal induced by the debt-to-GDP ratio is strengthened by the panel threshold regressions *à la* Hansen (1999), which illustrated that fiscal policy becomes pro-cyclical when the public debt to GDP ratio is above the average endogenously-estimated threshold of 87%. This finding seems in line with the recent finding of Egert (2012) for OECD countries. Chapter 4 takes the study a step further and identified a way of mitigating the destabilizing effect of public debt on fiscal policy. Drawing upon the two-stage method of Aghion and Marinescu (2007), combined with the instrumental variable techniques, it comes out that fiscal rules can help mitigating the detrimental effect of public debt and restoring counter-cyclicality of fiscal policy. This discipline-enhancing effect of fiscal rules operates *ex ante* by keeping the debt path within a reasonable band, thus preserving the debt sustainability. It's worth mentioning that not all types of rules are discipline-enhancing. While golden rules and national rules prove their superiority, supra national rules and rules with escape clause showed inefficient for fiscal policy stabilization purpose in times of high debt.

In the last two chapters of the thesis, we analyze the effects of decentralization on the efficiency of public service delivery, and fiscal policy performance. In line with the existing literature, we adopt the conventional measurement of fiscal decentralization which is taken as the share of local government expenditure (or revenue) over the central government expenditure (or revenue). Chapter five emphasizes that expenditure decentralization, combined with the sufficient level of revenue decentralization increase the efficiency of public service delivery in health and educational sectors. Further, we found that, to be effective, fiscal decentralization needs to reach a certain threshold (estimated at 35%). In other words, central government needs to share at least one third of expenditure or revenue responsibilities with the local levels. Besides, the political and institutional environment is critical for fiscal decentralization to deliver positive outcomes. Next, the last chapter six explores the impact of decentralization on the cyclical aspect of fiscal policy and the structural fiscal policy. We notice that decentralization helps strengthening the structural fiscal stance. However, fiscal decentralization appears to be destabilizing in the sense that it contributes to reducing (increasing) the counter-cyclical (pro-cyclical) of fiscal policy. Finally our estimates report that the asymmetry between expenditure assignments and revenue capacities of local governments generates vertical fiscal imbalances. These imbalances are bridged using transfers from the central level. Then, the greater the imbalances, and the higher the transfer dependency will be. As a consequence, this transfer dependency weakens the structural balance of the general government. These findings emphasize the need for central authorities to implement decentralization reform progressively, and match expenditure assignments adequately with revenue capacities of the local entities.

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## **CHAPTER 4:**

# **Is Fiscal Policy Always Counter (Pro-) Cyclical? The Role of Public Debt and Fiscal Rules**



### **Abstract**

We investigate the role of public debt in the cyclical reaction of fiscal policy within a panel of 54 countries over the period 1990-2011. First of all, we find that fiscal policy is, on average, counter-cyclical. Additionally, our results reveal a non-linear response of fiscal policy to the business cycle, conditional to the outstanding debt stock. When the public debt-to-GDP ratio goes beyond an endogenously-estimated threshold of 87%, fiscal policy loses its counter cyclical properties, and behaves rather pro-cyclically. Next, we emphasize the effectiveness of fiscal rules in supporting counter-cyclical fiscal policy. We illustrate that fiscal rules help reducing the destabilizing effect of higher public debt. Our results also show that the disciplinary aspect of fiscal rules is not generalizable across all types of fiscal rules.

**Keywords:** business cycle; fiscal policy; public debt; fiscal rules; non linear effects.

## 4.1. Introduction

In response to the economic crisis, many central banks around the world adopted measures of quantitative easing, involving, among others, credit easing and remarkably low interest rates. Given the limited room available for monetary policy measures, the debate focused on the relevance of fiscal policy to cope with the detrimental effects of the crisis in terms of output recession, deficit and debt accumulation, especially in developed and emerging market economies (Andersen, 2009; Delong *et al.* 2012). Indeed, in addition to automatic stabilizers designed to automatically dampen the downsides of the crisis, governments widely used bail-out packages put the economy back on track and restoring output growth (Detragiache and Ho, 2010; ECB, 2010; Doraisami, 2011; Tagkalakis, 2013).

However, the extent to which conventional fiscal policy tools are efficient to generate the trifecta growth-employment-financial stability, and particularly to stabilize the economy, is subject to major controversies, especially in a scenario of high public debt (Reinhart and Rogoff, 2010; Blanchard *et al.*, 2013).<sup>68</sup> According to Blanchard *et al.* (2013), in the current context of rising deficits and debt,<sup>69</sup> investors worry about a higher risk of default and require higher returns on government bonds (because of higher risk premium), making more difficult for governments to service their debt, and thus leaving less space for stabilizing fiscal policy.<sup>70</sup> Two articles provide an econometric assessment of these effects. Focusing on emerging market economies (EME), the IMF (2003) concludes that the response of the primary surplus to the economic cycle weakens as the debt-to-GDP ratio rises, and simply stops when debt exceeds

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<sup>68</sup> One illustration is the strongly debated fiscal cliff in the US, where Democrats and Republicans faced major difficulties in finding a way out of the fiscal distress that plagued the US economy. Similarly, despite the sluggish recovery of some leading European economies, most European countries are equally experiencing fiscal turbulences. While the Greek economy seems trapped into the vicious circle of deficit-recession-indebtedness, Spain experienced an unprecedented episode of youth-unemployment and a steadily shrinking economy, while French fiscal authorities acknowledged their inability to respect in the short-term the 3% fiscal deficit-to-GDP target stipulated by the Treaty of Maastricht for euro zone countries.

<sup>69</sup> Alesina and Ardagna (2009) stated that after the large reduction in government deficits of the nineties and early new century, public finances in the OECD are back in the deep red. This finding is also supported by Tagkalakis (2013), who argued that the deterioration of the fiscal position led to a substantial increase in the debt-to-GDP ratio in many OECD countries, roughly by 30 percentage points since the beginning of the crisis. For a detailed discussion of public debt dynamics in emerging and developing economies, see Hausmann and Panizza (2010).

<sup>70</sup> For example, during banking crises, Baldacci *et al.* (2009) showed that expansionary fiscal policies are difficult to implement because of funding constraints in countries with limited fiscal space.

50% of GDP. In an analysis close to ours, Egert (2012) shows that the reaction of fiscal policy to the cycle becomes pro-cyclical in OECD countries above a certain debt threshold.

Against this background, the role of medium-term fiscal frameworks in stabilizing economic activity and promoting longer-term sustainability has gained prominence on the academic ground and the policy scene as well. As stated by Budina *et al.* (2012), a key response to the fiscal legacy of the crisis is, for fiscal authorities, to strengthen their fiscal frameworks, particularly through the adoption of fiscal rules (FR).<sup>71</sup> The proponents of fiscal rules highlight their capacity of imposing effective restrictions to prevent governments from running excessive deficit and piling up unsustainable levels of debt, thus leaving fiscal space for conducting counter-cyclical fiscal policy. For example, Tapsoba (2012) concludes that FR have significant disciplinary effects on fiscal balances. On the contrary, the critics put forth the role of FR in limiting considerably the discretion of policymakers. For example, Fatas and Mihov (2006) show that the presence of FR amplifies the business cycle, by reducing the responsiveness of fiscal policy to output shocks. On the whole, as emphasized by Ghosh *et al.* (2011) or Perotti (2012), despite the presence of FR, some major developed and emerging countries continue experiencing difficulties in stabilizing their economies.<sup>72</sup>

Taking stock of this literature, the goal of this chapter is to explore the potential influence of public debt and FR in stabilizing fiscal policy. To this end, we perform an econometric analysis on a panel of 56 developed, emerging and developing countries over the period 1990-2011. Our results can be summarized as follows.

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<sup>71</sup> Shortly taken, fiscal rules impose a long-lasting constraint on fiscal policy through numerical limits on budgetary aggregates. Debrun *et al.* (2008) state that the number of countries utilizing such rules has increased more than 10-fold over the last 20 years. The majority of them target the budget balance, the public debt, or a combination thereof. Nowadays, the emergence of “next-generation” fiscal rules, which combine the sustainability goal with the need for flexibility in response to shocks (i.e. stabilization), creates new challenges for their implementation (Budina *et al.* 2012). For a very interesting review of the literature on fiscal rules, and their definition and macroeconomic impact on fiscal policy, see Kopits and Symansky (1998), Von Hagen (2005), Garcia *et al.* (2011) or Wyplosz (2012). Fatas and Mihov (2006), Honjo (2007), Budina *et al.* (2012) and our Appendix D.4 provide a thorough discussion on the pros and cons of fiscal rules.

<sup>72</sup> In the same vein, Brzozowski and Siwinska-Gorzela (2010) argue that fiscal rules will increase or decrease policy volatility depending, for example, on the type of fiscal rules. As such, many countries combine two or more fiscal rules to fill the gaps of a particular rule to support the sustainability of fiscal policy and perform economic stabilization.

First, we find that fiscal policy is counter-cyclical for the countries in our sample. Robust to alternative specifications, this result is coherent with previous findings emphasizing strong counter-cyclical fiscal policy in advanced and emerging market economies (Gavin and Perotti, 1997; Galì and Perotti, 2003; Aghion and Marinescu, 2007), and, more recently, even in developing countries that graduated from pro-cyclical (Kaminsky *et al.* 2004; Talvi and Vegh, 2005) to counter-cyclical fiscal policy (Frankel *et al.* 2013).

Second, we illustrate the importance of public debt in assessing the cyclicity of fiscal policy. GMM-system estimators with polynomial interactive terms show that fiscal policy turns from counter to pro-cyclical when public debt is above 117% in ratio of GDP. In particular, this result holds when considering the demeaned, instead of the observed, public debt. Next, to take a closer look at these nonlinear effects, we draw upon the method of Coricelli *et al.* (2008), and provide GMM-based estimations at different exogenous levels of public debt. Interestingly, despite a negative effect of public debt, fiscal policy remains counter-cyclical for a public debt ratio below 54%, but becomes pro-cyclical when public debt is above 74%. Finally, panel threshold regressions *à la* Hansen (1999) illustrate that fiscal policy becomes pro-cyclical when the public debt to GDP ratio is above the endogenously-estimated value of 87%. Overall, coherent with the recent findings of Egert (2012) for OECD countries, our estimations employing a wide variety of econometric techniques show that the cyclicity of fiscal policy is subject to important nonlinearities driven by the public debt, as it switches from counter- to pro-cyclical when public debt is high.

Finally, since our results show the difficulties of conducting stabilization policies in a context of high public debt, we focus on identifying ways to mitigate this negative effect by looking at the effect of FR. Drawing upon the two-stage method of Aghion and Marinescu (2007), we find, on the one hand, that FR enhance by themselves the counter-cyclicity of fiscal policy, and, on the other hand, that FR mitigate the detrimental effect of high (i.e. above the previously-estimated threshold of 87%) public debt, by making fiscal policy less pro-cyclical. In addition, we unveil that the type of FR at work is of crucial importance when it comes to assessing their effects on the cyclicity of fiscal policy in high debt contexts. Indeed, some types of FR, including expenditure, debt or supranational FR, have no significant effect when public debt is high. Moreover, FR with escape clause are harmful for stabilization purposes

when public debt is high, since they make fiscal policy even more pro-cyclical, contrary to deficit rules, which make fiscal policy less pro-cyclical. On the contrary, other types of FR, such as golden rules or national rules, are particularly efficient for stabilization in high-debt contexts by completely offsetting the negative effect of high public debt and allowing fiscal policy to remain counter-cyclical. Consequently, much caution is needed in the design of FR aimed at dampening the constraint imposed by high public debt when counter-cyclical fiscal policy needs to be implemented, particularly regarding the type of FR.

The chapter proceeds as follows. Section 2 clarifies the methodological considerations and details the data. Section 3 shows that fiscal policy is counter-cyclical in our sample of countries. Section 4 emphasizes the effect of public debt on the cyclicity of fiscal policy. Section 5 focuses on the effect of FR on the cyclicity of fiscal policy. Finally, section 6 presents concluding remarks and discusses the policy implications.

## 4.2. Methodological considerations and data

### 4.2.1. Methodological considerations

To measure the cyclicity of fiscal policy, let us start with the following simple model:

$$PFB_{it} = \alpha + \beta PFB_{it-1} + \delta Y_{it}^* + \sum_{k=1}^K \phi X_{k,it} + \eta_i + \varepsilon_{it} \quad (4.1)$$

$PFB_{it}$  is the primary fiscal balance in percentage of GDP, with subscripts  $i$  and  $t$  denoting respectively the individual and time dimensions of the panel.  $Y_{it}^*$  measures the business cycle, i.e. the output gap. The coefficient of interest is  $\delta$ , showing that fiscal policy is counter- (pro-) cyclical if  $\delta > 0$  ( $< 0$ ) and statistically significant, while acyclical or neutral otherwise. Moreover, to capture the potential persistence of fiscal policy, we specify our equation dynamically and include lagged fiscal policy in equation (4.1); this also allows tackling a possible omitted variable bias in a static model (Clayes, 2006). Finally, the vector  $X_{k,it}$  captures time-varying country specific characteristics,  $\eta_i$  stands for country fixed effects, and  $\varepsilon_{it}$  is the error term.

Given the dynamic specification of equation (4.1), and since we can hardly assume output gap

and lagged public debt to be strictly exogenous in our context, we overcome the endogeneity problem using the two-step System Generalized Methods of Moments (GMM) estimator (Blundell and Bond, 1998). The GMM estimator has the additional advantage of mitigating the weak instruments problem in the case of persistent time series, such as the fiscal data. Due to the relatively large time dimension of the panel, we control for the instrument proliferation that may weaken the performed identification tests by restricting and collapsing the instrument set (Roodman, 2009).

#### 4.2.2. Data and unit root tests

On the basis of data availability, our study is conducted on a panel of 56 developed, emerging and developing economies over the period 1990-2011 (see Appendix D.1 for the list of countries). By using the primary fiscal balance (PFB) in percentage of GDP as our fiscal policy variable (see Appendix D.2 for descriptive statistics), we aim at focusing at best on the discretionary response of fiscal authorities to the business cycle, and thus abstract from the legacy of former fiscal policy actions reflected by the debt service payments. In addition, this variable is commonly used throughout the literature to assess the cyclical behavior of fiscal policy (Aghion and Marinescu, 2007; Aghion *et al.* 2014).

The matrix of right-hand-side variables consist of interest and control variables. Our interest variable is the output gap (OG), as a measure of the business cycle. A popular strategy to gauge the business cycle draws upon the Hodrick-Prescott (HP) filter.<sup>73</sup> By applying the HP filter to the observed real GDP we obtain the GDP trend. The business cycle or output gap is then defined as the difference between real GDP and its trend. Since we use annual data, we follow Ravn and Uhlig (2002) and set the smoothing parameter to 6.25.<sup>74</sup> Regarding control variables, we first consider inflation (*Inflation*), defined as the growth rate of the consumer price index.

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<sup>73</sup> Note that the HP filter is subject to criticisms especially due to the arbitrary choice of the smoothing parameter, and the fact that it disregards structural breakdowns, or its side effects. Despite these critiques, the HP filter is commonly used throughout the literature (Agenor *et al.* 2000; Talvi and Vegh, 2005; Aghion and Marinescu, 2007; Calderon *et al.* 2007). Alternatives methods, such as the Band-Pass filter of Baxter and King (1999), are not spared from criticisms.

<sup>74</sup> The robustness analysis equally considers the original value suggested by Hodrick and Prescott (1981) for the smoothing parameter, namely 100 for annual data.

Its expected effect on the primary fiscal balance is mitigated: on the one hand, inflation decreases the real value of tax-based public revenue between the time of imposition and the time of collection (the Oliveira-Keynes-Tanzi effect, Tanzi, 1992). On the other hand, governments can use inflation as a financing source, by raising seigniorage revenue from printing money. To mitigate the effects of hyperinflation episodes, we follow Talvi and Vegh (2005) and measure a transformed inflation rate  $\pi'$ , defined as  $\pi' = (\pi / (1 + \pi))$ . Second, we consider the current account balance (CAB), defined as the sum of net exports of goods, services, net income, and net current transfers in ratio of GDP. The expected effect of current account balance on the primary balance is positive, since a current account balance improvement, signaling resource in flows, helps governments consolidating their fiscal position.

Table 4.1 presents a summary of panel unit root tests for all variables used in our econometric specifications. Regardless the considered (i) test, namely abstracting (Maddala-Wu) or accounting for cross sectional dependence in the data (Pesaran), or (ii) specification, namely without or with trend, all tests (except one test for the current account balance and for the lagged public debt) reject, at the 5% level, the presence of unit roots. Thus, we draw, in the following, on appropriate panel techniques for stationary series.

**Table 4.1: Panel Unit Root Tests**

| Variables  | Maddala and Wu (1999) |                  |                       |                  | Pesaran (2007) |                  |               |                  |
|------------|-----------------------|------------------|-----------------------|------------------|----------------|------------------|---------------|------------------|
|            | without trend         |                  | with trend            |                  | without trend  |                  | with trend    |                  |
|            | <i>Chi-sq (stat.)</i> | <i>(p-value)</i> | <i>Chi-sq (stat.)</i> | <i>(p-value)</i> | <i>Zt-bar</i>  | <i>(p-value)</i> | <i>Zt-bar</i> | <i>(p-value)</i> |
| PFB        | 246.71                | 0.00             | 184.91                | 0.00             | -4.491         | 0.000            | -2.69         | 0.00             |
| Output gap | 710.17                | 0.00             | 498.41                | 0.00             | -15.378        | 0.000            | -11.31        | 0.00             |
| Lagged PD  | 233.37                | 0.00             | 206.80                | 0.00             | -11.718        | 0.043            | -0.86         | 0.19             |
| CAB        | 189.16                | 0.00             | 172.35                | 0.00             | -3.083         | 0.000            | -0.4          | 0.34             |
| Inflation  | 511.45                | 0.00             | 486.52                | 0.00             | -12.816        | 0.000            | -9.49         | 0.00             |

Note: We report the panel unit root tests developed by Maddala and Wu (1999) (MW) and Pesaran (2007) (CIPS). Both MW and CIPS test the null hypothesis that all panels contain a unit root. The alternative hypothesis, though it differs in how it is specified, assumes that some (but not all) panels contain unit root. One limitation of the MW test is the assumption of cross-sectional independence in the data. The CIPS specification overcomes this latter assumption.

### 4.3. Is fiscal policy counter- or pro-cyclical?

Table 4.2 reports the results of our estimations. A quick look at columns 1-4 shows the presence of strong inertia in fiscal policy, as current primary fiscal balance is predicted at 78-83% by the lagged fiscal stance. Regarding control variables, when significant, the current

account balance (inflation) has a positive (negative) effect on the primary fiscal balance, as expected.

Let us now focus on the effect of output gap on fiscal policy. In these baseline estimations, we measure the impact of output gap on the primary fiscal balance without controls (column 1). The significant and positive coefficient of output gap shows that fiscal policy is counter-cyclical. Next, to test the robustness of this result, we consider two alternative specifications. In columns 2 and 3 we add progressively inflation and current account balance as control variables, while in column 4 we follow Hodrick and Prescott (1981) and set the smoothing parameter of the filter to  $\lambda = 100$ . In all specifications, the coefficient of output gap is positive and statistically significant, confirming the counter-cyclical behavior of fiscal policy. Our finding is consistent with the literature emphasizing strong counter-cyclical fiscal policy in advanced and emerging market economies (Gavin and Perotti, 1997; Gali and Perotti, 2003; Aghion and Marinescu, 2007), and, more recently, even in developing countries that graduated from pro- to counter-cyclical fiscal policy (Frankel *et al.* 2013).

**Table 4.2: The cyclical response of fiscal policy to business cycle: GMM-system estimators**  
*Dependent variables: PFB (% GDP)*

|                        | (1)                      | (2)                      | (3)                       | (4)                      |
|------------------------|--------------------------|--------------------------|---------------------------|--------------------------|
| PFB <sub>(t-1)</sub>   | 0.83***<br>(18.45)       | 0.83***<br>(20.54)       | 0.80***<br>(21.32)        | 0.78***<br>(16.99)       |
| <b>Output gap (OG)</b> | <b>9.12***</b><br>(5.90) | <b>9.55***</b><br>(6.17) | <b>10.67***</b><br>(6.22) | <b>11.26***</b><br>(2.7) |
| Inflation              |                          | -0.49*<br>(-1.78)        | -0.41*<br>(-1.69)         | -0.51<br>(-0.92)         |
| CAB                    |                          |                          | 0.05<br>(2.47)            | 0.13<br>(1.67)           |
| Observations           | 1124                     | 1124                     | 1124                      | 1124                     |
| AR(2)                  | 0.164                    | 0.182                    | 0.159                     | 0.172                    |
| Hansen                 | 0.396                    | 0.29                     | 0.061                     | 0.001                    |
| Countries              | 56                       | 56                       | 56                        | 56                       |
| Instruments            | 8                        | 10                       | 12                        | 12                       |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets. All variables are considered to be endogenous. Following Roodman (2009), the number of instruments is strongly limited to avoid the over-fitting problem. In all specifications, we reject the null of the AR(1) test of no auto-correlation in the error terms, while we accept it for AR(2). Thus, lagged variables can be safely used as instruments. The Hansen's robust to heteroskedasticity and autocorrelation p-value validates the over-identification restrictions in columns 1 and 2.



#### 4.4. Is fiscal policy counter- or pro-cyclical? The role of public debt

The goal of this section is to explore a potential influence of public debt on the cyclical behavior of fiscal policy. To this end, we draw on simple polynomial approaches to capture potential nonlinearities.

##### 4.4.1. Public debt and the cyclical behavior of fiscal policy: *Polynomial-based estimations*

We consider the following econometric model

$$PFB_{it} = \alpha + \beta PFB_{it-1} + \delta Y_{it}^* + \gamma (Y_{it}^* \times PD_{it-1}) + \lambda PD_{it-1} + \sum_{k=1}^K \phi X_{k,it} + \eta_i + \varepsilon_{it} \quad (4.2)$$

which consists in augmenting equation (4.1) with the interaction term  $Y_{it}^* \times PD_{it-1}$  and the one-period lagged public debt  $PD_{it-1}$ . The interaction term measures the impact of public debt on the cyclical behavior of fiscal policy. Indeed, the cyclical property of fiscal policy is obtained by computing the derivative  $\partial PFB_{it} / \partial Y_{it}^* = \delta + \gamma PD_{it-1} \equiv \theta$  from equation 4.2. For example, public debt can change the cyclical behavior of fiscal policy if the sign of  $\delta$  is different from the sign of  $\gamma$ . We measure public debt by the one-period lagged level of gross public debt as percentage of GDP. Table 4.3 presents the results of the estimation of model (4.2).

Our baseline specification is reported in column 1.<sup>75</sup> Consistent with the findings in the previous section, the impact of output gap is positive and significant. However, according to the significantly negative coefficient of the interactive term ( $OG \times PD_{(t-1)}$ ), the magnitude of the counter-cyclical behavior is reduced as the public debt ratio increases. A similar conclusion arises from column 2, where the smoothing parameter  $\lambda = 100$ .

To check the robustness of this result, we draw upon an alternative interactive variable, namely

the demeaned public debt-to-GDP ratio (DPD), calculated as:  $DPD_{it} = PD_{it} - \frac{1}{N} \sum_{j=1}^J PD_j$ , with

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<sup>75</sup> Remark that the positive and significant coefficient of lagged public debt is consistent with one among the debt sustainability conditions (Bohn, 1998).

N the sample size. As emphasized in column 3, the negative and significant interactive term confirms that a higher (demeaned) public debt ratio decreases the magnitude of the counter-cyclicality. This result remains robust when considering a smoothing parameter equal to 100 in column 4.

Based on our estimations in column 1, fiscal policy loses half of its magnitude for a debt ratio around 58%, namely close to the average public debt ratio in our sample (56.7%). Interestingly, fiscal policy switches from counter- to pro-cyclical for debt ratios sufficiently high, namely above 117% according to regression 1, and roughly 34.3 percentage points above the mean according to regression 3.

**Table 4.3: Cyclicity of fiscal policy conditional to the level of public debt:  
polynomial-based GMM-system estimations**

| <i>Dependent variables: PFB (% GDP)</i> |                           |                           |                            |                           |
|---|---------------------------|---------------------------|----------------------------|---------------------------|
|   | (1)                       | (2)                       | (3)                        | (4)                       |
| PFB <sub>(t-1)</sub>                    | 0.76***<br>(15.18)        | 0.76***<br>(15.88)        | 0.76***<br>(15.23)         | 0.76***<br>(13.31)        |
| <b>Output gap (OG)</b>                  | <b>42.23***</b><br>(3.47) | <b>22.91***</b><br>(4.21) | <b>15.43***</b><br>(2.93)  | <b>9.50**</b><br>(2.38)   |
| <b>OG × PD<sub>(t-1)</sub></b>          | <b>-0.36**</b><br>(-2.20) | <b>-0.13**</b><br>(-2.09) |                            |                           |
| PD <sub>(t-1)</sub>                     | 0.05<br>(4.22)            | 0.05<br>(3.42)            |                            |                           |
| <b>OG × DPD</b>                         |                           |                           | <b>-0.45***</b><br>(-2.90) | <b>-0.18**</b><br>(-2.32) |
| Demeaned PD (DPD)                       |                           |                           | 0.02**<br>(2.34)           | 0.02*<br>(1.71)           |
| Inflation                               | -0.44***<br>(-3.32)       | -0.42***<br>(-3.10)       | -0.2<br>(-0.84)            | -0.22<br>(-1.08)          |
| CAB                                     | 0.2***<br>(4.38)          | 0.2***<br>(4.37)          | 0.23***<br>(4.81)          | 0.22***<br>(3.00)         |
| Observations                            | 1115                      | 1115                      | 1115                       | 1115                      |
| AR(2)                                   | 0.149                     | 0.145                     | 0.157                      | 0.149                     |
| Hansen                                  | 0.709                     | 0.806                     | 0.386                      | 0.169                     |
| Countries                               | 56                        | 56                        | 56                         | 56                        |
| Instruments                             | 18                        | 18                        | 18                         | 18                        |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets. All variables are considered to be endogenous. Following Roodman (2009), the number of instruments is strongly limited to avoid the over-fitting problem. In all specifications, we reject the null of the AR(1) test of no autocorrelation in the error terms, while we accept it for AR(2). Thus, lagged variables can be safely used as instruments. The Hansen's robust to heteroskedasticity and autocorrelation p-value validates the over-identification restrictions in all specifications.

To summarize, the presence of significant coefficients for the interactive variables supports the existence of an important role of public debt, when it comes to characterizing fiscal policy from a stabilization perspective. Irrespective of the considered econometric specification, we find that, in high public debt contexts, it is more difficult for fiscal authorities to conduct counter-cyclical fiscal policy. Importantly, when the public debt to GDP ratio is sufficiently high, roughly above 117% according to regression 1, fiscal policy turns pro-cyclical. Starting from this evidence, we explore in the following section in more details the structure of the nonlinearities related to the public debt ratio.

#### 4.4.2. Public debt and the cyclicity of fiscal policy 2: *Exogenous thresholds*

To capture the effect of public debt on fiscal policy in a more accurate way, we consider the following model:

$$PFB_{it} = \alpha + \beta PFB_{it-1} + \delta Y_{it}^* + \gamma (Y_{it}^* \times D_k) + \lambda PD_{it-1} + \sum_{k=1}^K \phi X_{k,it} + \eta_i + \varepsilon_{it} \quad (4.3)$$

where  $D_k$  is a dummy variable equal to one if the lagged debt-to-GDP ratio is larger than (or equal to)  $k$ , and zero otherwise. Coefficient  $\gamma$  measures the cyclicity of fiscal policy for lagged debt-to-GDP ratios higher than  $k$ . Compared to simple polynomial-based estimations, this procedure has the advantage of measuring the cyclical properties of fiscal policy for different exogenously-determined levels of public debt, while still allowing tackling the endogeneity issue using GMM estimators.<sup>76</sup>

The results are reported in Table 4.4. To determine the smallest value of  $k$ , we follow Coricelli *et al.* (2008) and leave out the bottom 5% of increasingly ordered (based on the public debt-to-GDP ratio) observations, leading to the value of 13.6%. Starting from this value, we present our results by considering increases of the debt ratio in steps of 10 percentage points (we stop

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<sup>76</sup> Even though this procedure does not yield a precise and consistent estimate of threshold values, the different values of  $k$  presents a prima facie evidence of possible thresholds (Coricelli *et al.* 2008).

such as to conserve more than 5% of increasingly-ordered observations in the last regime). For low public debt ratios (see columns 1 and 2), an increase in public debt reduces the counter-cyclical of fiscal policy. However, the influence of public debt becomes not significant for higher debt ratios, roughly between 34% and 53%. In this case, fiscal policy is either acyclical (column 3) or counter-cyclical (column 4). Moreover, for debt-to-GDP ratios above 54%, public debt continues reducing the magnitude of the counter-cyclical, with the interactive term ( $OG \times PD_{(t-1)}$ ) still significantly negative. Interestingly, starting with columns 6, and particularly 7, the coefficient of the interactive term becomes higher than the one of the output gap in absolute value. Thus, we find that above a debt threshold of 74%, public debt overturns the counter-cyclical fiscal policy into pro-cyclical. Furthermore, fiscal becomes more pro-cyclical with an increasing level of public debt.

These estimations support the existence of nonlinearities in the reaction of fiscal authorities to the business cycle, depending on the debt-to-GDP ratio. The next subsection explores more in detail the potential presence of such thresholds.

**Table 4.4: Non-linear reaction of fiscal policy to output gap: exogenous thresholds GMM-system estimators**

| Dependent variables: PFB(% GDP) |                            |                             |                         |                         |                            |                            |                           |                           |                           |                           |
|---------------------------------|----------------------------|-----------------------------|-------------------------|-------------------------|----------------------------|----------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
|                                 | LPD = 13.6                 | LPD = 23.6                  | LPD = 33.6              | LPD = 43.6              | LPD = 53.6                 | LPD = 63.6                 | LPD = 73.6                | LPD = 83.6                | LPD = 93.6                | LPD = 103.6               |
|                                 | (1)                        | (2)                         | (3)                     | (4)                     | (5)                        | (6)                        | (7)                       | (8)                       | (9)                       | (10)                      |
| PB <sub>(t-1)</sub>             | 0.73***<br>(10.02)         | 0.71***<br>(13.51)          | 0.76***<br>(12.91)      | 0.79***<br>(14.04)      | 0.80***<br>(17.35)         | 0.78***<br>(17.47)         | 0.75***<br>(16.72)        | 0.76***<br>(15.68)        | 0.76***<br>(17.95)        | 0.76***<br>(17.14)        |
| Output gap (OG)                 | 84.97***<br>(3.09)         | 61.64***<br>(5.23)          | 16.80<br>(1.60)         | 16.60*<br>(1.82)        | 27.35***<br>(2.94)         | 20.84**<br>(2.22)          | 19.45**<br>(2.34)         | 21.59**<br>(2.51)         | 21.48***<br>(2.88)        | 18.33***<br>(2.44)        |
| OG × PD <sub>(t-1)</sub>        | <b>-79.85**</b><br>(-2.80) | <b>-54.66***</b><br>(-4.11) | <b>-6.25</b><br>(-0.68) | <b>-7.38</b><br>(-0.85) | <b>-23.97**</b><br>(-2.51) | <b>-20.87**</b><br>(-2.15) | <b>-24.02*</b><br>(-1.92) | <b>-29.56*</b><br>(-1.75) | <b>-28.74*</b><br>(-1.71) | <b>-31.55*</b><br>(-1.74) |
| <i>Controls</i>                 | <i>Yes</i>                 | <i>Yes</i>                  | <i>Yes</i>              | <i>Yes</i>              | <i>Yes</i>                 | <i>Yes</i>                 | <i>Yes</i>                | <i>Yes</i>                | <i>Yes</i>                | <i>Yes</i>                |
| Observations                    | 1115                       | 1115                        | 1115                    | 1115                    | 1115                       | 1115                       | 1115                      | 1115                      | 1115                      | 1115                      |
| AR(2)                           | 0.171                      | 0.200                       | 0.167                   | 0.175                   | 0.192                      | 0.155                      | 0.180                     | 0.140                     |                           | 0.152                     |
| Hansen                          | 0.002                      | 0.371                       | 0.025                   | 0.021                   | 0.104                      | 0.212                      | 0.267                     | 0.246                     | 0.339                     | 0.264                     |
| Countries                       | 56                         | 56                          | 56                      | 56                      | 56                         | 56                         | 56                        | 56                        | 56                        | 56                        |
| Instruments                     | 17                         | 17                          | 17                      | 17                      | 17                         | 17                         | 17                        | 17                        | 17                        | 17                        |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets. All variables are considered to be endogenous. All specifications include control variables (current account balance and inflation) Following (Roodman 2009), the number of arguments is strongly limited to avoid the over-fitting problem. In all specifications, we reject the null of the AR(1) test of no autocorrelation in the error terms, while we accept it for AR(2). Thus, lagged variables can be safely used as instruments. The Hansen's robust to heteroskedasticity and autocorrelation p-value validates the over identification restrictions in all specifications (except in columns 1, 3 and 4).

### 4.4.3. Public debt and the cyclical policy 3: *Endogenous thresholds*

One major shortcoming of previous methods is the exogeneity of the thresholds. In the following, we undertake a more systematic approach to modeling thresholds in the cyclical reaction of fiscal policy, conditional to the public debt-to-GDP ratio. To this end, we draw upon the Hansen (1999) method, and estimate the following panel threshold regression (PTR) model:

$$PFB_{it} = \alpha + \sum_{j=1}^J \delta_j Y_{it}^* \Gamma(\tau_{j-1} < PD_{it-1} \leq \tau_j) + \sum_{k=1}^K \phi_k X_{k,it} + \eta_i + \varepsilon_{it} \quad (4.4)$$

Equation (4.4) illustrates a  $J$ -threshold model in which the threshold variable is the lagged debt-to-GDP ratio ( $PD_{(it-1)}$ ). Evidence of non-linearity in the fiscal policy-output gap nexus is more refined on at least two grounds. First, the estimated thresholds are endogenous. Second, this methodology provides tests assessing the mere existence of thresholds, which in particular control for the nuisance problem inherent to the threshold model through an appropriate bootstrap procedure for the computation of the significance level. Following Hansen (1999), we implement a multistage cascade procedure, with 5% trimming of observations (the same trimming percentage was used in the implementation of the GMM-based model in the previous sub-section).

The estimations are illustrated in Table 4.5. Starting from the simple country fixed-effects regression (column 1), we search in column 2 for the possible presence of a public debt threshold. The low p-value of the LR statistics (see the bottom of Table 4.5) supports the existence of a first public debt threshold, estimated at 87%. Next, conditional to this threshold, we search for the presence of a second threshold, which we estimate at around 11%. However, given the high p-value of the associated test (0.71), we cannot reject the equality of the coefficients in the regime below, compared to the regime above this second threshold. Consequently, we stop our cascade procedure and retain a panel threshold model with one

threshold.<sup>77</sup>

**Table 4.5: Debt thresholds in the reaction of fiscal policy to output gap: *endogenous thresholds PTR estimators***

| <i>Dependent variables: PFB (% GDP)</i>                         |                            |                            |                     |
|---|----------------------------|----------------------------|---------------------|
|   | Baseline,<br>FE            | Hansen Threshold model     |                     |
|   | (1)                        | (2)                        | (3)                 |
|   |                            | Single                     | Double              |
| <b>Estimated threshold</b>                                      |                            | <b>86.66***</b>            | <b>10.82</b>        |
| [Conf. Interval]  |                            | [65.60 ; 104.3]            | [6.13 ; 144.8]      |
| Output gap (OG)   | 48.46***<br>(3.63)         |                            |                     |
| <b>OG × Lagged PD</b>   | <b>-0.47***</b><br>(-2.33) |                            |                     |
| <b>OG with <math>(PD_{it-1} \leq \tau_1)</math></b>             |                            | <b>33.56***</b><br>(5.84)  | 53.47**<br>-4.82    |
| <b>OG with <math>(\tau_1 &lt; PD_{it-1} \leq \tau_2)</math></b> |                            | <b>-25.02**</b><br>(-2.51) | 29.25***<br>(4.56)  |
| <b>OG with <math>(\tau_2 &lt; PD_{it-1})</math></b>             |                            |                            | -24.59**<br>(-2.48) |
| <i>Controls</i>   | <i>Yes</i>                 | <i>Yes</i>                 | <i>Yes</i>          |
| Observations  | 1125                       | 1029                       | 1029                |
| Countries   | 56                         | 49                         | 49                  |
| LR (stat)   |                            | 15.91                      | 3.08                |
| Boots. (p)  |                            | 0.01                       | 0.77                |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. Heteroskedastic robust t-statistics are given in brackets. Tests for presence of thresholds use 300 bootstrap replications. The linearity hypothesis is tested against one threshold (column 2), using the LR test. Since the bootstrapped p-value equals 0.01, we reject in column 2 the null hypothesis that the model is linear. In column 3, the bootstrapped p-value equals 0.71, thus we accept the presence of a unique threshold (against the alternative of a second threshold). Since Hansen's method requires a balanced panel, we drop countries with missing data for fiscal policy variables. This leaves us with 49 countries (compared to 56 in the baselines).

Our findings point to public debt-driven nonlinearities in the relationship between fiscal policy and the business cycle, with an estimated threshold of lagged debt-to-GDP ratio around 87%. The proportion of in-sample countries that is above this threshold is 16%. If the debt stock lies below this threshold, fiscal policy remains counter-cyclical. However, when the debt-to-GDP ratio goes beyond 87%, fiscal policy turns into pro-cyclical. Remarkably, on the one hand,

<sup>77</sup> For robustness issues, we checked for the presence of a second threshold by dropping alternatively 10%, and then 15%, of increasingly-ordered extreme public debt observations. We report that the first debt threshold is significant and remarkably stable around 87%, while the corresponding p-values of the LR test for the second threshold equal respectively 0.60 and 0.77, thus refuting the presence of a second debt threshold.

properly accounting for threshold effects yields a lower debt ratio above which fiscal policy becomes counter-cyclical compared to simple fixed-effects estimations.<sup>78</sup>

GMM-based evidence established that fiscal policy stops being counter-cyclical for a debt ratio roughly above 64%, namely close to the bottom limit of the confidence interval of our threshold estimated in Table 4.5. Thus, properly controlling for endogeneity (through GMM-system estimators) or for threshold effects (through PTR estimators) leads to comparable results. Altogether, these results represent strong evidence that high-debt ratios, generating high interest payments, limit the available resources for running counter-cyclical fiscal policy.

#### **4.5. The cyclical behavior of fiscal policy and public debt one step further: the role of fiscal rules**

Keeping in mind the existence of a public debt threshold, we focus in this section on the effect of fiscal rules on the cyclical behavior of fiscal policy. As stated so far in the literature, well-designed and effectively implemented FR help reduce time-inconsistency in fiscal policy, strengthen government's commitment for credibility and fiscal sustainability, and facilitate counter-cyclical fiscal management (Ter-Minassian, 2010). Besides, FR help internalizing the externality arising from the fact that recipients of public spending do not fully internalize the cost that taxpayers assume (Wyplosz, 2012).

In this chapter, we explore an additional issue by looking for a potential effect of FR on the nonlinear relation between the cyclical behavior of fiscal policy and the debt-to-GDP ratio. With respect to our previous analysis of debt-driven nonlinearities, this could be tackled by at least two strategies: on the one hand, through interactive terms. However, since both public debt and FR are assumed to act non-linearly, this would lead to considering a three-variable interactive term in output gap, public debt and FR, which would considerably complicate the analysis based on GMM-system models. On the other hand, conditional to the presence of a debt threshold, we could consider FR as a subsequent threshold variable in the panel threshold model of Hansen (1999). Unfortunately, this strategy is unfeasible since fiscal rules are

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<sup>78</sup> According to the first column of Table 4.5, the debt turning point is estimated at around 103%.



captured through dummy variables.

Under these circumstances, an interesting alternative is to disentangle the effect of output gap, public debt and FR on fiscal policy into two blocks. To this end, we draw upon the Aghion and Marinescu (2007) two-stage approach. First, we estimate the cyclicality of fiscal policy

$$PFB_{it} = \alpha_{it} + \gamma_{it} Y_{it}^* + \varepsilon_{it} \quad (4.5)$$

where  $\varepsilon_{it} \rightarrow \mathcal{N}(0, \sigma^2 / \omega_i(\tau))$  and  $\omega_i(\tau) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(\tau-t)^2}{2\sigma^2}\right)$

$PFB_{it}$  stands for the primary fiscal balance,  $Y_{it}^*$  is the output gap, and  $\varepsilon_{it}$  is the error term. Using the Local Gaussian Weighted Ordinary Least Squares (LGWOLS), we compute coefficients  $\gamma_{it}$  using all available observations for each country  $i$ , and perform a regression for each period  $t$ , with observations weighted by a Gaussian centered at the considered period  $t$ .<sup>79</sup> Notice that the LGWOLS procedure is particularly appropriate for our analysis, since it yields estimates of the cyclical coefficient of fiscal policy  $\hat{\gamma}_{it}$  for each country and time period of the sample.

In the second step, we use the predicted  $\hat{\gamma}_{it}$  as the left-hand-side variable, and search for the nonlinear effect of public debt and of FR on the cyclicality of fiscal policy. To this end, we build an interactive term between lagged public debt (defined as a dummy variable that equals 1 if public debt is above the endogenous previously-estimated threshold of 87%) and the FR dummy (equal to 1 in the presence of a fiscal rule).

$$\hat{\gamma}_{it} = \alpha_{it} + \delta PD_{it-1} + \lambda FR_{it} + \beta (FR_{it} \times PD_{it-1}) + \sum_{k=1}^K \phi X_{k,it} + \eta_i + v_{it} \quad (4.6)$$

with  $\alpha_{it}$  the part of the budget balance independent from the business cycle, and  $v_{it}$  the error term. Coefficients  $\delta$  and  $\beta$  capture respectively the impact of debt, and the effectiveness of FR in altering the effects of public debt, on the cyclicality of fiscal policy. Since not all types of

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<sup>79</sup> Following Aghion and Marinescu (2007), we chose a value of 5 for  $\sigma$  (we report that our results are robust to changing this smoothing parameter to 10%).

FR are equally apt to support the sustainability of fiscal policy and economic stabilization, and possibly the size of government objectives, even when their designed features are fine-tuned, we consider alternative types of FR. First, we differentiate between expenditure (ER), deficit (DFR) and debt (DR) rules. Second, we look at fancier fiscal rules, including the cyclically-adjusted deficit rule (CADFR), the golden rule (GR) and fiscal rules with escape clauses (EC). Third, we consider alternatively national (NR) and supra-national (SNR) fiscal rules. Finally, given the trade-off between different rules, many countries combine two or more FR to compensate for potential shortcomings of a specific rule; thus, we account for the total number of rules (TR).<sup>80</sup>

From a methodological standpoint, since we explain the cyclical behavior of fiscal policy by debt, FR, and an interactive variable between the two (in addition to control variables), the estimation of equation (4.6) could be plagued by a simultaneity bias altering the causal relationship running from FR adoption to the cyclical behavior of fiscal policy. Intuitively, the adoption of any particular rule is endogenous to the macroeconomic conditions such as the fiscal stance. For example, Debrun and Kumar (2007) assert that disciplined governments may wish to adopt rules as a way of signaling and cementing their determination in conducting sound fiscal policy. In addition, the bias may also arise from unobserved features of the political and institutional contexts. Consequently, we draw upon instrumental variable techniques to account for the endogeneity problem, and estimate equation (4.6) using the two-stage least squares (2SLS) estimator in which all right-hand-side variables are considered to be endogenous and instrumented with their own lags.

The results are depicted in Table 4.6. The benchmark regression 1, in which the FR dummy equals 1 irrespective of the type of FR in place, shows the following. First, since the coefficient of lagged public debt is negative and significant, a high public debt ratio, i.e. above the threshold, makes fiscal policy more pro-cyclical compared to countries with low debt ratios, i.e. below the threshold.<sup>81</sup> Second, the presence of a FR makes fiscal policy more counter-

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<sup>80</sup> We abstract of Revenue Rules, since the remaining number of observations is not enough for statistical inference. Appendix D.4 summarizes the year of adoption of the different types of FR.

<sup>81</sup> Given the data availability on FR, the number of countries decreases from 49 to 40. In this case, the estimated public debt threshold is remarkably close to the one we use, namely around 91%. In addition, we report that our results regarding the effect of FR are robust to the use of this latter threshold.

cyclical, since the coefficient of FR is positive and significant. Third, and most interestingly, when public debt is high, the presence of FR makes fiscal policy more counter-cyclical (the coefficient of the interactive term is positive and significant). Consequently, our results show that a virtuous way to restore a counter-cyclical fiscal policy in high public debt contexts is to adopt FR.

Then, an immediate question is whether the type of FR matters when it comes to restoring the counter-cyclical. To answer this, we consider in regressions 2-10 of table 4.6 alternative types of rules. According to panel A (columns 2-4), we notice that deficit (DFR) and debt fiscal rules (DR) by themselves enhance the ability of the government to run counter-cyclical policy, contrary to expenditure rules (ER) which have no significant effect. We also find that only deficit rules are effective in reinforcing the counter-cyclical of fiscal policy in high-debt contexts.

Moreover, as illustrated by panel B (columns 5-7), cyclically-adjusted deficit rules (CADFR) and rules with escape clause (EC) impact positively the counter-cyclical of fiscal policy, contrary to golden rules (GR). Turning to their effect when public debt is high, cyclically-adjusted rules do not exert a significant effect (column 5), contrary to golden rules and rules with an escape clause. Golden rules (column 6) not only make fiscal policy less pro-cyclical (the coefficient of the interactive variable is positive), but even turn it into counter-cyclical, as the sum of the coefficients—of the interactive term ( $GR \times PD_{(t-1)}$ ) and the lagged PD variable—is statistically positive.<sup>82</sup> On the contrary, fiscal rules with escape clause (column 7) make fiscal policy even more pro-cyclical in high-debt contexts (the coefficient of the interactive variable ( $EC \times PD_{(t-1)}$ ) is negative). This effect might be attributed to the opacity of the definition of the clause. Misspecified clauses lead to a misuse of the FR in place by encouraging looser behavior of fiscal authorities when it comes to adopting measures to reduce pro-cyclical.

We account in panel C (columns 8-9) for national (NR) and supranational rules (SNR), which

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<sup>82</sup> The one-sided Chi-square statistic (and its p-value) equals 14.8 (0.00), thus rejecting the null hypothesis of a zero sum of the two coefficients of variables including lagged public debt.

are found to make fiscal policy more counter-cyclical by themselves. In addition, contrary to supranational rules, national FR enhance the counter-cyclical of fiscal policy when public debt is high. In this latter case, according to our estimations, fiscal policy turns from pro- to counter-cyclical. Indeed, the one-sided chi-squared statistic and its p-value equal 6.07 and 0.01 respectively, therefore supporting a strictly positive effect of national rules on the cyclical coefficient of fiscal policy in high-debt contexts.

Finally, we consider in panel D (column 10) the total number of rules. Albeit adopting several rules enhances the counter-cyclical of fiscal policy, the lack of statistical significance of the interactive variable shows that they do not seem to work when public debt is above the threshold.<sup>83</sup>

Our results, emphasizing a role for FR, and particularly deficit, golden and national rules, in making fiscal policy more counter-cyclical, are in line with early findings of Debrun *et al.* (2008), stating that rules specifically designed to prevent conflicts with the stabilization function of fiscal policy are associated with less pro-cyclical policy. Indeed, the impact of FR on fiscal policy may stem from the fact that rules aim at correcting distorted incentives and containing pressures to overspend, in order to ensure fiscal responsibility and debt sustainability (Budina *et al.* 2012). As a result, FR help keeping fiscal policy counter-cyclical.

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<sup>83</sup> Alternatively, we equally explored the joint behavior of a selection of several rules (instead of the total number of rules). Thus, focusing on panel A, we combined de cit rules, which exert a significant effect on cyclicity when debt is high, with expenditure and respectively debt rules. We report that the interactive term is never significant, therefore not supporting complementarities between different types rules, consistent with the lack of such complementarities when considering the total number of rules.

**Table 4.6: FR and the cyclicity of fiscal policy: IV-2SLS estimator**

*Dependent variable: Cyclical coefficient of fiscal policy*

|   | Rules                   | ER                   | DFR                      | DR                 | CADFR              | GR                         | EC                         | NR                       | SNR                | TR                 |
|---|-------------------------|----------------------|--------------------------|--------------------|--------------------|----------------------------|----------------------------|--------------------------|--------------------|--------------------|
|   | (1)                     | (2)                  | (3)                      | (4)                | (5)                | (6)                        | (7)                        | (8)                      | (9)                | (10)               |
| Lagged PD ( $PD_{t-1}$ )  | -125.02***<br>(-2.85)   | -45.46***<br>(-2.21) | -122.43***<br>(-2.80)    | -41.24<br>(-1.52)  | -44.92*<br>(-1.95) | -77.7***<br>(-3.47)        | -67.12***<br>(-2.66)       | -53.76**<br>(-2.17)      | -28.39<br>(-1.63)  | -56.29<br>(-1.58)  |
| Rules   | 34.16***<br>(6.08)      | 8.80<br>(0.98)       | 40.57***<br>(7.05)       | 20.42***<br>(3.12) | 43.76***<br>(4.83) | 4.76<br>(0.52)             | 92.42***<br>(10.41)        | 36.81***<br>(6.48)       | 24.15***<br>(2.96) | 11.84***<br>(5.03) |
| <b>Rules × <math>PD_{(t-1)}</math></b>  | <b>99.04**</b><br>(2.1) |                      |                          |                    |                    |                            |                            |                          |                    |                    |
| Panel A: Basic fiscal rules (columns 2-4)   |                         |                      |                          |                    |                    |                            |                            |                          |                    |                    |
| $ER \times PD_{(t-1)}$  |                         | -24.91<br>(-0.71)    |                          |                    |                    |                            |                            |                          |                    |                    |
| <b>DFR × <math>PD_{(t-1)}</math></b>  |                         |                      | <b>96.53**</b><br>(2.03) |                    |                    |                            |                            |                          |                    |                    |
| $DR \times PD_{(t-1)}$  |                         |                      |                          | -5.99<br>(-0.16)   |                    |                            |                            |                          |                    |                    |
| Panel B: Cyclically-adjusted deficit rules, golden rules and rules with escape clause (columns 5-7) |                         |                      |                          |                    |                    |                            |                            |                          |                    |                    |
| $CADFR \times PD_{(t-1)}$   |                         |                      |                          |                    | 2.92<br>(0.08)     |                            |                            |                          |                    |                    |
| <b>GR × <math>PD_{(t-1)}</math></b>   |                         |                      |                          |                    |                    | <b>108.98***</b><br>(3.75) |                            |                          |                    |                    |
| <b>EC × <math>PD_{(t-1)}</math></b>   |                         |                      |                          |                    |                    |                            | <b>-75.10**</b><br>(-2.16) |                          |                    |                    |
| Panel C: National and Supranational rules (columns 8-9)   |                         |                      |                          |                    |                    |                            |                            |                          |                    |                    |
| <b>NR × <math>PD_{(t-1)}</math></b>   |                         |                      |                          |                    |                    |                            |                            | <b>63.82**</b><br>(2.07) |                    |                    |
| $SNR \times PD_{(t-1)}$   |                         |                      |                          |                    |                    |                            |                            |                          | 11.69<br>(0.31)    |                    |
| Panel D: Combining different types of rules (column 10)   |                         |                      |                          |                    |                    |                            |                            |                          |                    |                    |
| $TR \times PD_{(t-1)}$  |                         |                      |                          |                    |                    |                            |                            |                          |                    | 10.77<br>(0.54)    |
| Controls  | Yes                     | Yes                  | Yes                      | Yes                | Yes                | Yes                        | Yes                        | Yes                      | Yes                | Yes                |
| Observations  | 737                     | 737                  | 737                      | 737                | 737                | 737                        | 737                        | 737                      | 737                | 737                |
| Countries   | 40                      | 40                   | 40                       | 40                 | 40                 | 40                         | 40                         | 40                       | 40                 | 40                 |
| F (p-value)   | 0.00                    | 0.02                 | 0.00                     | 0.00               | 0.00               | 0.00                       | 0.00                       | 0.00                     | 0.00               | 0.00               |
| KP (p-value)  | 0.01                    | 0.19                 | 0.02                     | 0.00               | 0.00               | 0.08                       | 0.01                       | 0.00                     | 0.00               | 0.01               |
| CD (stat)   | 59.31                   | 47.75                | 51.84                    | 46.26              | 54.83              | 60.23                      | 59.75                      | 55.95                    | 62.18              | 48.47              |
| Hansen (p-value)  | 0.01                    | 0.04                 | 0.01                     | 0.04               | 0.03               | 0.04                       | 0.00                       | 0.06                     | 0.00               | 0.01               |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. Robust t-statistics are reported in brackets. All right-hand-side variables are considered to be endogenous. We use the fixed-effects 2SLS estimator with two periods lags. The Fisher (F) test rejects the null hypothesis that all slopes are zero in all specifications. The Kleibergen-Paap (KP) test rejects the null hypothesis of under-identification (except in column 2). The Cragg-Donald (CD) test rejects the null hypothesis of weak identification. The Hansen's test rejects the null hypothesis of over-identification. Given the data availability for FR, the number of countries decreases to 40.

It is not surprising that some types of FR do not display an effective impact on the cyclicity of fiscal policy, neither by themselves (for example, expenditure and golden rules), nor in high public debt contexts (for example, expenditure, debt, cyclically-adjusted deficit and supranational rules). Besides, our results showed that rules with an escape clause make fiscal policy even more pro-cyclical when public debt is high. One explanation is that existing numerical rules vary widely from one country to another: while some rules impose a year-by-year constraint, others may set limits on fiscal aggregates over the medium term, or the duration of government. Additionally, the targets set by the authorities are different across countries even if they use the same type of FR. A subsequent argument harks back to the old debate on “rules versus discretion”, and the “time-inconsistency” problem. Because rules can never be fully contingent, situations may arise (the actual financial crisis being an example) that would make any rule costly to respect.

#### **4.6. Conclusion**

We focused in this chapter on the cyclical behavior of fiscal policy within a panel of 56 developed, emerging and developing economies over the period 1990-2011. Consistent with previous findings, including Gavin and Perotti (1997), Gali and Perotti (2003), Aghion and Marinescu (2007) or Frankel *et al.* (2013), we illustrated the presence of counter-cyclical fiscal policy. Capitalizing on this evidence, we developed our analysis in two steps.

On the one hand, we investigated the influence of public debt on the cyclicity of fiscal policy. Using GMM-system estimations with polynomial interaction terms between output gap and public debt, we emphasize that a higher public debt-to-GDP ratio decreases the counter-cyclicity of fiscal policy. According to our estimations, fiscal policy loses half of its magnitude for a debt ratio around 58%, and even turns from counter- to pro-cyclical for a debt ratio above 117%. To explore the robustness of these naïve polynomial-based estimations, we further drew upon two alternative techniques. First, using the method of Coricelli *et al.* (2008) involving exogenous thresholds, we computed the effect of public debt on the cyclicity of fiscal policy for increases in steps of 10 percentage points of the debt ratio. In particular, we find that the debt ratio above which fiscal policy turns pro-cyclical is around 74%. Second, and consistent with this finding, based on the method of Hansen (1999), we emphasize the presence of threshold effects: for debt ratios above a public

debt threshold endogenously-estimated around 87%, fiscal policy changes from counter- to pro-cyclical.

On the other hand, having emphasized the detrimental effect of public debt on fiscal policy cyclicity, we explored a possible remedy, related to the presence of FR. Combining the Aghion and Marinescu (2007) method with the 2SLS techniques, we showed that the presence of FR mitigates the negative effect of high public debt on the cyclicity of fiscal policy. A deeper analysis of FR reveals however remarkable heterogeneities related to the type of FR. First, there exist several types of rules that have no effect in high-debt contexts, including expenditure, debt or supranational FR. Second, the rules with escape clause have an adverse effect, by making fiscal policy even more pro-cyclical when public debt is high. Third, although deficit rules favor the counter-cyclicity of fiscal policy in a context of high public debt, their effect is not sufficiently strong to upturn the cyclicity of fiscal policy, which remains pro-cyclical. Finally, golden rules and national rules are found to have worked as an efficient device when public debt was high, by switching fiscal policy from pro- to counter-cyclical.

Two main policy implications can be derived. First, a thoughtful supervision of the public debt path is needed. Measures should be taken to ensure sustainability, since fiscal policy reaction to the business cycle considerably depends on the outstanding debt stock. Second, we emphasized strong support toward the adoption of FR. Indeed, the positive effect of FR stems from the fiscal discipline they induce upfront. Since FR impose restrictions to (fiscal) policy-makers, they constrain governments not to run excessive deficits and accumulate unsustainable levels of debt. However, our results equally illustrated that a particular attention must be given to the design and implementation of FR, since only some types of FR were found to be efficient in preserving the counter-cyclicity of fiscal policy in high public debt contexts.

## Appendices D

### Appendix D.1: List of countries

**Developed (OECD) economies:** Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States.

**Emerging Market and Developing (Non-OECD) economies:** Argentina, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Dominican Republic, Ghana, Haiti, Honduras, Hong Kong, Hungary, India, Indonesia, Iran, Mexico, Nicaragua, Pakistan, Panama, Paraguay, Peru, Philip-pines, Poland, Romania, Russian Federation, South Africa, Thailand, Turkey, Uruguay, Venezuela.

### Appendix D.2: Descriptive statistics

| Variables        | Obs. | Mean      | Std. Dev. | Min     | Max      |
|------------------|------|-----------|-----------|---------|----------|
| CAB              | 1230 | -0.989    | 5.700     | -28.383 | 18.035   |
| GDP              | 1230 | 647.195   | 1598.709  | 0.519   | 15075.67 |
| PFB              | 1185 | 1.165     | 3.726     | -28.174 | 20.570   |
| Public debt (PD) | 1208 | 56.717    | 35.250    | 1.026   | 289.554  |
| Output gap       | 1230 | -0.009    | 0.330     | -8.972  | 3.166    |
| Inflation        | 1229 | 0.750     | 0.882     | -15.393 | 16.384   |
| Demeaned PD      | 1152 | -9.24e-07 | 35.060    | -55.693 | 232.833  |



### Appendix D.3: The PSTR approach of modeling non-linearity

As an additional robustness check, we use the panel smooth transition regression (PSTR) technique to model the non-linear reaction of fiscal policy to the business cycle. The PSTR model is a suitable approach to solve simultaneously the problems of heterogeneity and time variability. It assumes parameters to change smoothly as a function of a threshold variable. Following González *et al.* (2005), in the case of extreme regimes and a single transition function, the model can be written as follows:

$$FP_{it} = \alpha + \eta_i + \delta_1 Y_{it}^* + \delta_2 Y_{it}^* \Gamma(PD_{it-1}; \gamma, \overline{PD}) + \sum_{k=1}^K \phi_k X_{kit} + \varepsilon_{it} \quad (D.3.1)$$

The dependent variable,  $FP_{it}$  is the primary fiscal balance in percent of GDP.  $Y_{it}^*$  measures the output gap, with  $i=1, \dots, N$  and  $t=1, \dots, T$  denoting respectively the cross-section and time horizon of the panel.  $X_{it}$  is a  $K$ -dimensional vector of time-varying regressors.  $\alpha, \delta_1, \delta_2, \phi_k$  ( $k=1, \dots, K$ ) represent the parameter to be estimated. The main feature of this model is the transition function,  $\Gamma(PD_{it-1}; \gamma, \overline{PD})$  bounded between 0 and 1 and depending on the transition variable  $PD_{it-1}$ , the one-time lagged debt-to-GDP ratio. The transition variable allows the estimated parameter,  $\delta_2$  to change smoothly as a function of  $PD_{it-1}$ . The parameter  $\gamma$  determines the slope of the transition function and  $\overline{PD}$ , the threshold, which are both endogenously estimated.  $\varepsilon_{it}$  is the residual term. Following Granger and Teräsvirta (1993), the transition function  $\Gamma(\bullet)$  is defined assuming the logistic or exponential specification:

$$\Gamma(PD_{it-1}; \gamma, \overline{PD}) = \left[ 1 + \exp\left(-\gamma \prod_{j=1}^m (PD_{it-1} - \overline{PD}_j)\right) \right]^{-1} \quad (D.3.2)$$

where  $\gamma > 0$  and  $\overline{PD}_1 \leq \overline{PD}_2 \leq \dots \leq \overline{PD}_m$ , a vector of threshold parameters. When  $\gamma \rightarrow \infty$ , for a given  $m$ , the PSTR converges towards a panel transition regression (PTR) model, with two regimes as specified in Hansen (1999). On the other hand, when  $\gamma \rightarrow 0$ , the transition function becomes a constant and the PSTR estimation becomes a panel with fixed effects.

In estimating equation (D.3.1), the impact of the public debt on cyclicality of the fiscal policy is obtained as follows:

$$\frac{\partial FP_{it}}{\partial Y_{it}^*} = \delta_1 + \delta_2 \Gamma(PD_{it-1}; \overline{PD}); \text{ with } \Gamma(PD_{it-1}; \overline{PD}) = \begin{cases} 1, & \text{if } PD_{it-1} \geq \overline{PD} \\ 0, & \text{otherwise} \end{cases} \quad (\text{D.3.3})$$

$\delta_1$  is the cyclical parameter and  $\delta_2$ , the cyclical parameter conditional to the lagged debt-to-GDP ratio.

To estimate the PSTR, we follow González *et al.* (2005) and adopt a three-step procedure for estimating the constructed model (equation D.3.1). We first test the linearity against the PSTR model. Then, if the linearity is rejected, we determine the optimal number of transition functions using no-remaining nonlinearity tests. Finally, the individual effects are eliminated by removing individual-specific means and applying nonlinear least squares to the transformed model.

The null hypothesis of the homogeneity test (linearity vs. PSTR) assumes that  $\gamma = 0$ . To circumvent the identification problem, we replace  $\Gamma(PD_{it-1}; \gamma, \overline{PD})$  in equation D.3.1 by its first order Taylor expansion around  $\gamma = 0$ . We then obtain the following model:

$$FP_{it} = \alpha + \eta_i + \delta_1 Y_{it}^* + \delta_2 Y_{it}^* PD_{it-1} \dots + \delta_m Y_{it}^* PD_{it-1}^m + \sum_{k=1}^K \phi_k X_{kit} + \varepsilon_{it} \quad (\text{D.3.4})$$

Testing  $\gamma = 0$  is equivalent to testing the hypothesis that  $\delta_1 = \dots = \delta_m$ . This restriction is tested using the LM test.

Estimating the set of parameters of equation  $\theta = (\alpha, \delta_1, \delta_2, \gamma, \overline{PD})$  is a straightforward application of the fixed effects and nonlinear least squares methods. We first eliminate the individual effects by removing individual specific means and then apply the nonlinear least squares method to the transformed model. While eliminating fixed effects using within transformation is standard, the PSTR model uses a more careful treatment. The following model is estimated:

$$F\tilde{P}_{it} = \delta_1 \tilde{Y}_{it}^* + \delta_2 \tilde{Y}_{it}^* \Gamma(PD_{it-1}; \gamma, \overline{PD}) + \sum_{k=1}^K \phi_k \tilde{X}_{kit} + \varepsilon_{it} \quad (\text{D.3.5})$$

From equation D.3.5, we see that the PSTR model is linear in  $\delta_i$ , conditional on  $\gamma$  and  $\overline{PD}$ . The number of transition function is determined using the no-remaining nonlinearity test Fouquau *et al.*, (2008).

Table D.3 presents the results of the PSTR, with 56 advanced and developing countries over 1990-2012. The positive and statistically significant output gap coefficient strengthens the counter-cyclicality of fiscal policy (columns 1-3). However, the interactive term appears throughout with a negative and strongly significant sign, validating the non linear reaction of fiscal policy to the business cycle. This non-linearity is driven by a threshold of debt-to-GDP ratio ( $\overline{PD}$ ), estimated on average at 87.8 percent, with a smoothing parameter ( $\gamma$ ) up to 5. Say, when the public debt-to-GDP ratio is below the endogenously estimated threshold, fiscal policy remains counter-cyclical. If the debt ratio hits the threshold, then fiscal policy loses its counter-cyclical aspect. This finding confirms the non-linear reaction of fiscal policy to the business cycle, induced by high level of public debt, as shown with the Hansen and GMM models.

**Table D.3: PSTR estimates***Dependent variable: primary fiscal balance (% of GDP)*

|                  | (1)                         | (2)                         | (3)                       |
|------------------|-----------------------------|-----------------------------|---------------------------|
| Output gap       | <b>20.81***</b><br>(3.98)   | <b>25.36***</b><br>(4.18)   | <b>12.90***</b><br>(3.36) |
| OG * Lagged PD   | <b>-32.19***</b><br>(-2.75) | <b>-63.38***</b><br>(-3.70) | <b>-27.50***</b><br>-3.05 |
| $\overline{PD}$  | 87.76***<br>(211.03)        | 92.13***<br>(39.52)         | 79.76***<br>(4588)        |
| $\gamma$         | 0.5                         | 5                           | 0.5                       |
| Inflation        |                             | 0.03<br>(0.39)              | 0.05<br>(0.51)            |
| TOT volatility   |                             | 4.84<br>(2.08)              | 4.93<br>(2.1)             |
| CAB              |                             | 0.14<br>(4.77)              | 0.14<br>(4.45)            |
| Obs. (countries) | 897 (56)                    | 897 (56)                    | 897 (56)                  |
| R squared        | 0.05                        | 0.01                        | 0.03                      |
| AIC (BIC)        | 2.12 (2.16)                 | 2.18 (2.20)                 | 2.13 (2.17)               |
| LM               | 0.00                        | 0.03                        | 0.00                      |
| Pseudo LRT       | 0.12                        | 0.79                        | 0.36                      |

Significance: \* 1%, \*\* 5% and \*\*\* 1% with t-student given in parenthesis.

**Appendix D.4: Type of Fiscal Rules, Pros and Cons and Years of adoption**

| Type of rule                     | Pros  | Cons  |
|----------------------------------|---|---|
| <b>Budget balance rule (BBR)</b> | <ul style="list-style-type: none"> <li>- Clear operation guidance</li> <li>- Close link to debt sustainability</li> <li>- Easy to communicate and monitor</li> </ul>  | <ul style="list-style-type: none"> <li>- No economic stabilization feature (can be procyclical)</li> <li>- Headline balance could be affected by developments outside the control of the government</li> <li>- No economic stabilization feature (can be procyclical)</li> </ul>  |
| <b>Debt rule</b>                 | <ul style="list-style-type: none"> <li>- Direct link to debt sustainability</li> <li>- Easy to communicate and monitor</li> </ul>   | <ul style="list-style-type: none"> <li>- No clear operational guidance in the short run as policy impact on debt ratio is not immediate</li> <li>- No economic stabilization feature (can be procyclical)</li> <li>- Rules could be met via temporary measures (e.g. below the line transactions)</li> </ul>            |
| <b>Expenditure rule</b>          | <ul style="list-style-type: none"> <li>- Clear operation guidance</li> <li>- Allows for economic stabilization</li> <li>- Steers the size of the government</li> <li>- Relatively easy to communicate and</li> </ul>  | <ul style="list-style-type: none"> <li>- Not directly linked to debt sustainability since there is no constraint on the revenue side</li> <li>- Could lead to unwanted changes in the distribution of spending if, to meet the ceiling, shifts to spending categories occur that are not covered by the rule</li> </ul> |
| <b>Revenue rule</b>              | <ul style="list-style-type: none"> <li>- Steers the size of the government</li> <li>- Can improve revenue policy and administration</li> <li>- Can prevent pro-cyclical spending (e.g. rules that constrain use of windfall revenue)</li> </ul>   | <ul style="list-style-type: none"> <li>- Not directly linked to debt sustainability since there is no constraint on the expenditure side (except rules constraining use of windfall revenue)</li> <li>- No economic stabilization feature (can be procyclical)</li> </ul>   |
| <b>Structural BBR</b>            | <ul style="list-style-type: none"> <li>- Relatively clear operational guidance</li> <li>- Close link to debt sustainability</li> <li>- Economic stabilization function (i.e. account for economic shocks)</li> <li>- Allows to account for other one-off and temporary factors</li> </ul> | <ul style="list-style-type: none"> <li>- Corrections for cycle is complicated, especially for countries undergoing structural changes</li> <li>- Need to pre-define one-off and temporary factors to avoid their discretionary use</li> <li>- Complexity makes it more difficult to communicate and monitor</li> </ul>  |

Source: Budina et al. (2012).

**Appendix D.5: Fiscal rules: years of adoption**

| Countries                   | BBR  | DR   | ER   | RR   | Countries                     | BBR       | DR        | ER        | RR   |
|-----------------------------|------|------|------|------|-------------------------------|-----------|-----------|-----------|------|
| Australia <sup>R</sup>      | 1985 | 1998 | 1985 | 1985 | Israel                        | 1992      | 2010      | 2005      |      |
| Argentina                   | 2000 |      | 2000 |      | Italy <sup>#</sup>            | 1992      |           |           | 1992 |
| Austria <sup>#,S</sup>      | 1995 | 1995 |      |      | Japan                         | 1947      |           | 2006/2010 |      |
| Belgium <sup>#</sup>        | 1992 | 1992 | 1993 | 1995 | South Korea <sup>*</sup>      |           |           |           |      |
| Bolivia <sup>*</sup>        |      |      |      |      | Mexico                        | 2006      |           |           |      |
| Brazil                      |      | 2000 | 2000 |      | Netherlands <sup>#</sup>      | 1992      | 1992      | 1994      | 1994 |
| Bulgaria <sup>#</sup>       | 2006 | 2003 | 2006 |      | New Zealand                   | 1994      | 1994      |           |      |
| Canada <sup>R</sup>         | 1998 | 1998 | 1998 |      | Nicaragua <sup>*</sup>        |           |           |           |      |
| Chile <sup>S</sup>          | 2001 |      |      |      | Norway <sup>S</sup>           | 2001      |           |           |      |
| China <sup>*</sup>          |      |      |      |      | Pakistan                      | 2005      | 2005      |           |      |
| Colombia <sup>S</sup>       | 2011 |      | 2000 |      | Panama <sup>S</sup>           | 2002/2009 | 2002/2009 |           |      |
| Costa Rica                  | 2001 |      |      |      | Paraguay <sup>*</sup>         |           |           |           |      |
| Denmark <sup>#,S</sup>      | 1992 | 1992 | 1994 | 2001 | Peru                          | 2000      |           | 2000      |      |
| Dominican Rep. <sup>*</sup> |      |      |      |      | Philippines <sup>*</sup>      |           |           |           |      |
| Finland <sup>#,S</sup>      | 1995 | 1995 | 2003 |      | Poland <sup>#</sup>           | 2004      | 1999      | 2011      |      |
| France <sup>#</sup>         | 1992 | 1992 | 1998 | 2006 | Portugal <sup>#</sup>         | 1992      | 1992      |           |      |
| Germany <sup>#,S</sup>      | 1969 | 1992 | 1982 |      | Romania <sup>#</sup>          | 2007      | 2007      | 2010      |      |
| Ghana <sup>*</sup>          |      |      |      |      | Russia <sup>#,R</sup>         | 2007      |           |           |      |
| Greece <sup>#</sup>         | 1992 | 1992 |      |      | South Africa <sup>*</sup>     |           |           |           |      |
| Haiti <sup>*</sup>          |      |      |      |      | Spain <sup>#,S</sup>          | 1992      | 1992      | 2011      |      |
| Honduras <sup>*</sup>       |      |      |      |      | Sweden <sup>#,S</sup>         | 1995      | 1995      | 1997      |      |
| Hong Kong                   | 1997 |      |      |      | Switzerland <sup>S</sup>      | 2003      |           |           |      |
| Hungary <sup>#</sup>        | 2004 | 2004 | 2010 |      | Thailand <sup>*</sup>         |           |           |           |      |
| Iceland <sup>R</sup>        |      |      |      |      | Turkey <sup>*</sup>           |           |           |           |      |
| India <sup>R</sup>          | 2004 |      |      |      | United Kingdom <sup>#,S</sup> | 1992      | 1992      |           |      |
| Indonesia                   | 1967 | 2004 |      |      | United States                 |           | 1986      | 1990/2011 |      |
| Iran <sup>*</sup>           |      |      |      |      | Uruguay <sup>*</sup>          |           |           |           |      |
| Ireland <sup>#</sup>        | 1992 | 1992 |      |      | Venezuela <sup>*</sup>        |           |           |           |      |

Note: Information on adoption of rules comes from the Fiscal Rules Dataset (1985-2012), compiled by the Fiscal Affairs Department (FAD) of the IMF. ER, RR, DFR and DR signal respectively an expenditure, revenue, deficit and debt fiscal rule.

\* There is no information whether countries adopted a FR or not.

# signals that countries adopted a supranational FR; R: stands for countries that repealed the rule in place during the time horizon.

Superscripts S mean that the rule consisted of the implementation of targets such as the cyclically-adjusted or structural balance with stabilization feature, while G means that countries defined a “golden rule”, which excludes public investment or other priority items (interest payments, specific transfers and social security items, unemployment benefits, oil related investment) from ceiling.

EC means that countries allow for escape clause(s) in the implementation of the rules.

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## **CHAPTER 5:**

# **Fiscal Decentralization and Public Service Delivery**

### **Abstract**

This chapter explores the linkage between fiscal decentralization and public policy in a new angle, using a panel of 64 advanced and developing countries. Three main results emerge. First, we show that fiscal decentralization has notable impact on public expenditure efficiency, depending on the level of development. Second, our findings reveal a non-linear relationship between decentralization and public service efficiency, suggesting an indicative threshold to be reached for decentralization to deliver positive outcomes. Finally, we highlight that the political and institutional environment (reducing corruption, promoting democracy and autonomy of local authorities) is key aspect to be considered when it comes to implementing decentralization reform.

**Keywords:** Fiscal decentralization, public service delivery, stochastic frontier, instrumental variables estimation.



## 5.1. Introduction

Fiscal decentralization has been motivated by various objectives, such as economical, political, historical, cultural and ethnic. Economically, decentralization is considered as a policy tool that can improve the provision of public service by the government to the population, and thereby, improve the overall macroeconomic performance. Politically, decentralization has been presented to voters as a vehicle that allows their close influence on the decision making process. Historically, culturally, and ethnically, decentralization has been used to protect the identity and independence of each group in the society from the interference or dominance of other groups.

The proponents of decentralization put forth the idea that it may improve public service delivery, while the critics emphasize the risks of worsening the efficiency, particularly if scale economy is significant and accountability is loose. Despite the importance of decentralization process, controversies are still persistent regarding the effects of fiscal decentralization on public service delivery, and empirical evidences on this claim remain surprisingly sparse.

This chapter contributes to fill this gap and analyzes the impacts of fiscal decentralization on public service delivery. While existing works directly focused in measuring the effect decentralization on public expenditure outcomes (infant mortality rate, school enrolment rate), this chapter rather proposes a novel approach and focuses on the efficiency of public service delivery. To this end, we perform an econometric analysis on a panel of 64 developed, emerging and developing countries over the period 1990-2012. This chapter takes stock of recent developments in the empirical literature and proceeds with a two-step approach. We first measure the efficiency of public service delivery using the stochastic frontier techniques. Then, we estimate the effects of fiscal decentralization on the predicted efficiencies via instrumental variable methods, to obtain bias-corrected coefficients.

Although this method might be criticized, the suitability of the two-step approach adopted here can be justified as follows. This method allows solving the endogeneity problem associated with the decentralization process, and to obtain bias-corrected parameters. The state-of-the-art of stochastic frontier techniques does not offer a convenient way to simultaneously predict the efficiencies, and deal with the omitted variable bias and the reverse causality problem that could

plague the estimated parameters in a single approach method. Our results can be summarized as follows.

First, we provide careful evidences that fiscal decentralization affects significantly the efficiency of public service delivery. Our results show that decentralization can serve as a credible policy tool to improve efficiency, under specific conditions. To obtain positive outcome, decentralization of expenditure needs to be accompanied by sufficient revenue decentralization. It's worth noting that fiscal decentralization operates differently, regarding the level of development.

Second, we illustrate a robust non-linear relationship between fiscal decentralization and the efficiency of public service delivery. Our estimates report a threshold of decentralization of 35.7%. In other words, positive outcomes of fiscal decentralization can be expected if central government devolves one third of public expenditure to local levels. Below this threshold, fiscal decentralization may hamper the efficiency of public service delivery.

Finally, we show that the effect of decentralization strongly depends on the political and institutional features of each country. The decentralization process requires adequate political and institutional environments. Fighting corruption within the political system can be highly beneficial to decentralization. Besides, governments should also promote democracy to guarantee positive effects of fiscal decentralization. In addition, we find that giving more autonomy to local entities (or reducing vertical constraint) helps strengthening the effectiveness of decentralization. These findings are robust to a range of sensitivity checks.

The rest of the chapter is structured as follows. Section 2 reviews the existing literature and summarizes the merits and risks of fiscal decentralization. Section 3 shows main stylized facts. Section 4 presents the empirical analysis on public service delivery and section 5 discusses the findings. Sensitivity checks are provided in section 6. Section 7 concludes with the main policy recommendations.

## **5.2. Related literature and theoretical background**

Arguments in favor of fiscal decentralization rest on the main assumption that decentralization process helps improving the efficiency in public service delivery. Central government, through

the decentralization process becomes more responsive by re-directing public priorities to areas of greatest needs. Besides, devolving more responsibilities to local authorities make the public service delivery more efficient, since local authorities can better target local citizens' needs. The theoretical literature identifies three mechanisms through which fiscal decentralization may lead to increased efficiencies.

First, the “*accountability*” hypothesis states that fiscal decentralization, by allowing geographical closeness of public institutions to the local population (final beneficiaries), fosters accountability. It can also improve public service outcome, particularly in social sectors such as education and health (Picazo *et al.*, 2001; Cantarero and Sanchez, 2006; Ahmad *et al.*, 2008). Local accountability pressures can foster larger spending in public investment and in growth-enhancing sectors, such as education and health (Keen and Marchand, 1997; Arze del Granado *et al.*, 2005; Bénassy-Quéré *et al.*, 2007; Kappeler and Valila, 2008; Fredriksen, 2013). In addition, decentralization may lead to a decrease in lobbying by interest groups, which distorts policy choices and increase waste of public funds.

Second, decentralization can improve public service delivery through the “*preference matching*” hypothesis. Local governments possess better access to local preferences and, consequently, have an informational advantage over the central government in deciding which provision of goods and services would best satisfy citizens' needs (Hayek, 1945; Tiebout, 1956; Musgrave, 1969). Devolving more responsibilities to local authorities make the public service delivery more efficient, since local authorities can better target local citizens' needs. When provided by the jurisdiction that has the control over the geographic area, costs and benefits of public services are fully internalized, which is expected to improve allocative efficiency (Oates, 1999).

Lastly, the “*voting with one's feet*” hypothesis emphasizes that decentralization gives voters more electoral control over the incumbent authorities (Seabright, 1996; Persson and Tabellini, 2000; Hindriks and Lockwood, 2005). Moreover, fiscal decentralization enables yardstick competition between sub-national governments. In fact, voters can use the performance of neighboring governments to make inferences about the competence or benevolence of their own local politicians (Bordignon *et al.*, 2004; Besley and Smart, 2007).

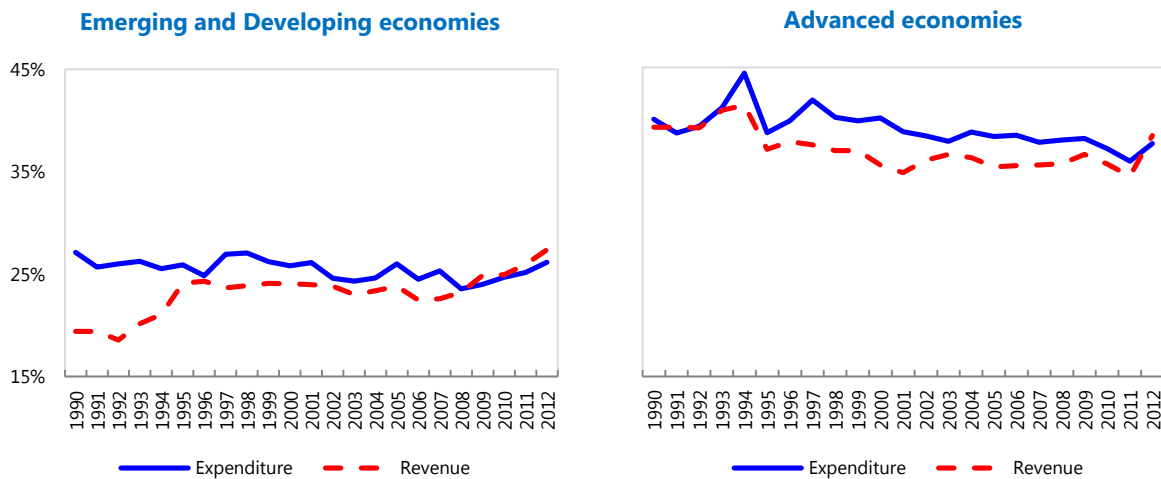
However, decentralization can worsen public service delivery if scale economy is significant, redistribution is hampered, and accountability is loose. Devolution of public service delivery to a small scale local government, for example in terms of population can increase costs if economies of scale are important. The ability of the central government to redistribute resources, for example through equalization funds, might be hindered if its share of revenue and expenditure is reduced (Ter-Minassian, 1997a). If accountability is not broadly anchored in a local democratic process, but is based on a rent-seeking political behavior, local governments would be tempted to allocate higher decentralized expenditure to non-productive expenditure items (such as wages and goods and services instead of capital expenditure); this can hinder economic growth and overall macroeconomic performance (Davoodi and Zou, 1998; Phillips and Woller, 1998; Zhang and Zou, 1998; Ezcurra and Rodríguez-Pose, 2010; Gonzalez-Alegre, 2010; Grisorio and Prota, 2011).

### **5.3. Fiscal decentralization and public service delivery: stylized facts**

Fiscal decentralization is measured as the share of local government expenditure (revenue) over the general government total expenditure (revenue). If one considers the expenditure side for example, a fiscal decentralization indicator of 35% means that the central government implements 65% of the expenditure, the remaining 35% is implemented by the sub-national level of government, which can be either local, regional or state. Then, the greater the ratio and the more decentralized is the country. In figures 5.1 and 5.2 below, we plot the evolution of fiscal decentralization. At first sight, we notice a higher level of expenditure and revenue decentralization in advanced economies, compared to emerging market and developing economies. On average, decentralization peaked at roughly 45% in the former group, in the mid-90, while the highest decentralization ratio in emerging and developing economies averaged 27% over the period 1990-2012. A closer look at emerging market and developing economies signals that expenditure decentralization is far higher than revenue decentralization in the early nineties. This gap went increasingly shrinking, due to an increasing level of revenue decentralization, combined with a slightly decreasing trend of expenditure decentralization. In the late-2000, we observe a reversing tendency with an increase in both expenditure and revenue decentralization, with the latter outperforming the former. The picture is slightly different in advanced economies. Although expenditure decentralization outpaces revenue decentralization, with a decreasing

trend, we observe a trend reversal in the evolution of decentralization ratios. While decentralization reaches its lowest values in 2010, the trend evolution starts increasing right after. A common feature observed in figures 5.1 and 5.2 is a higher degree in revenue decentralization in the late-2000 for both advanced and developing economies. This trend can be understood as an attempt of authorities to reduce vertical fiscal imbalances, by allowing subnational governments to have greater control over the revenue.

**Figures 5.1 and 5.2: Evolution of fiscal decentralization over the period 1990-2012**



The following figures 5.3 and 5.4 allow the comparison of the share of local government expenditure and revenue between the two groups. In a broad view, we notice that, as shown earlier, expenditure decentralization is higher than revenue decentralization. On the expenditure side, we see that advanced economies outperform the group of emerging and developing economies, over the three sub-periods. However, a deep analysis reveals a decreasing ratio of expenditure decentralization in advanced economies, while emerging market and developing economies experience a stable evolution of decentralization. A slight difference is observed when turning to revenue decentralization. We notice an increasing ratio of revenue decentralization in emerging market and developing economies.

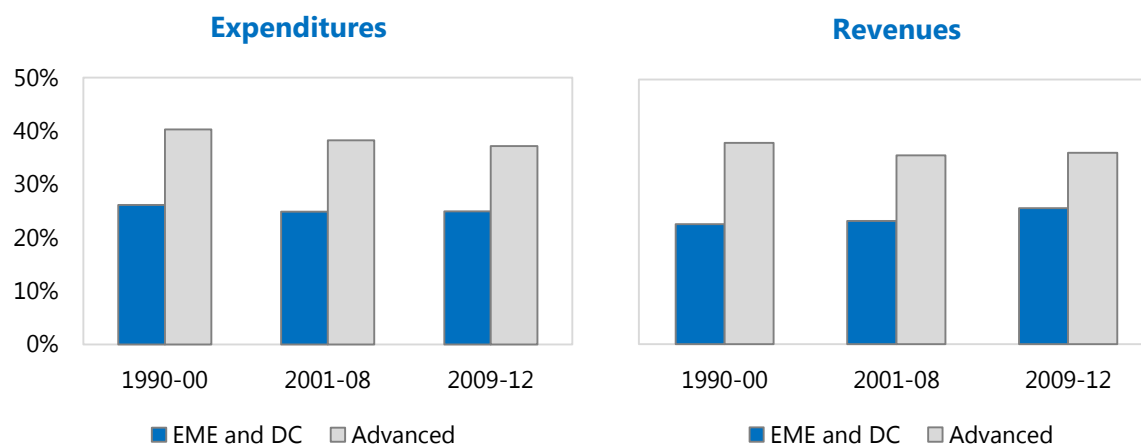
**Figures 5.3 and 5.4: Local government share of expenditure and revenue**

Table 5.1 gives figures of expenditure and revenue decentralization for individual countries, considering the years before and after the crisis. In 2008, the highest decentralization ratio was observed in Germany, where 69.5% of public expenditure is implemented at the subnational level. Central government is responsible for only 30% of the public expenditure. As regards the revenue side of decentralization, 71% of public revenue is devolved to local administrations.

**Table 5.1: Highest and lowest decentralization ratios**

| <u>Highest ratios, 2008</u> |       |             |       | <u>Highest ratios, 2012</u> |       |             |       |
|-----------------------------|-------|-------------|-------|-----------------------------|-------|-------------|-------|
| Expenditure                 |       | Revenue     |       | Expenditure                 |       | Revenue     |       |
| Germany                     | 69.5% | Germany     | 71.0% | Germany                     | 69.2% | Germany     | 70.4% |
| Switzerland                 | 67.7% | Switzerland | 66.5% | Switzerland                 | 68.8% | Switzerland | 68.1% |
| Canada                      | 65.5% | Spain       | 65.6% | France                      | 62.3% | France      | 66.3% |
| Spain                       | 62.2% | France      | 63.0% | Spain                       | 56.4% | Spain       | 65.5% |
| France                      | 57.4% | Canada      | 54.0% | Finland                     | 50.6% | Finland     | 55.6% |
| Finland                     | 50.3% | Finland     | 53.3% | United States               | 47.7% | Austria     | 50.6% |
| <u>Lowest ratios, 2008</u>  |       |             |       | <u>Lowest ratios, 2012</u>  |       |             |       |
| Bhutan                      | 0.0%  | Bhutan      | 0.0%  | Egypt                       | 0.0%  | Egypt       | 0.0%  |
| Egypt                       | 0.0%  | Egypt       | 0.0%  | Seychelles                  | 0.0%  | Seychelles  | 0.0%  |
| Maldives                    | 0.0%  | Maldives    | 0.0%  | Singapore                   | 0.0%  | Singapore   | 0.0%  |
| Seychelles                  | 0.0%  | Seychelles  | 0.0%  | Tunisia                     | 0.0%  | Tunisia     | 0.0%  |
| Singapore                   | 0.0%  | Singapore   | 0.0%  | Malta                       | 0.7%  | Malta       | 0.7%  |
| Tunisia                     | 0.0%  | Tunisia     | 3.0%  | Peru                        | 1.0%  | Uruguay     | 2.5%  |

Table 5.1 shows that the top six decentralized countries are high income countries, both in the expenditure and revenue side, with at least 50% of the public policy locally implemented. We

calculate the same ratio of decentralization in 2012. This allows to some extent to proxy the crisis effects in the decentralization process. Figures in table 5.1 show a little change, since we have the same top decentralized countries as in 2008. However, we notice that, in 2012, Austria and the United States joined the group of highly decentralized countries.

The bottom part of table 5.1 shows the lowest decentralized countries. It appears that, in some countries of our sample, public expenditure and revenue mobilization are fully centralized (Bhutan, Egypte, Maldives, Seychelles). In these countries, expenditure implementation or revenue mobilization are fully devolved to the central government. Building on these figures, it appears that fiscal decentralization is linked with the level of development. Table 5.1 have shown that advanced economies (Germany, Canada, France, United States) are more decentralized. Besides, countries with lowest decentralization ratios belong to the group of emerging market or developing countries (Bhutan, Egypt, Maldives and Seychelles), except Singapore. These findings are consistent with Dziobek *et al.* (2011) and Escolano *et al.* (2012), whom found earlier that the size of the countries matters in the decentralization process.

#### **5.4. Empirical assessment**

We test the hypothesis that shifts towards more decentralization would improve efficiency in public service delivery. Unlike the existing literature, we take advantage of up-to-date developments in the econometric literature and build upon a two-step methodology to estimate the effect of decentralization on the efficiency of public expenditure.

##### **5.4.1. Does fiscal decentralization improve the efficiency of public service delivery?**

We estimate the effect of fiscal decentralization on the efficiency of public service delivery, in health and education. The two-step approach adopted here allows to give strong focus to the efficiency of public expenditure rather than direct outcomes. First, we measure the efficiency of health and education expenditure, using the stochastic frontier models. Then, we analyze the effect of fiscal decentralization on the estimated efficiency. The first-step equation is specified as follow:

$$Y_{it} = \alpha + \gamma PE_{it-1} + \sum_{k=1}^K \varphi_k Z_{k,it-1} + \varepsilon_{it} \quad (5.1)$$

$$\begin{cases} \varepsilon_{it} = \omega_{it} \pm \eta_{it} \\ \eta_{it} = g(t) \cdot \eta_i \quad \text{and} \quad g(t) = \exp[-\lambda(t - T_i)] \end{cases} \quad (5.2)$$

The dependent variable  $Y_{it}$  represents public expenditure outcomes on health and education, mainly the infant mortality rate and the secondary school enrolment rate. Subscripts  $i$  and  $t$  denote respectively the country and time dimensions of the panel. Our interest variables correspond to the public expenditure on health and education as percent of GDP,  $PE_{it-1}$ . We control for a set of variables  $Z_{k,it}$  that are likely to influence the infant mortality rate and/or the enrolment rate. One important feature of equation (5.1) is that  $\varepsilon_{it}$  is a two-component error term.  $\omega_{it}$  represents an idiosyncratic disturbance, capturing measurement error or any other classical noise. The remaining part of the error term,  $\eta_{it}$  is a one-sided disturbance capturing the country-specific and time-varying efficiencies<sup>84</sup> of public expenditure.

Equation (5.1) is estimated using the stochastic frontier techniques.<sup>85</sup> These techniques assume that no economic agent can exceed the ideal “frontier” —*the frontier here refers to the optimal output (infant mortality rate/ enrolment rate) produced with limited input (public expenditure)*— and the deviations from this frontier represent the individual inefficiency. Efficient governments are those operating or very close to the frontier, trying to reduce (to improve) the infant mortality rate (enrolment rate), given a limited amount of public expenditure. Equations (5.1) and (5.2)

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<sup>84</sup> A stream of existing literature assumes time-invariant efficiency. However, the assumption of invariant efficiency might be questionable, especially in the presence of long panel data. We relax this assumption and allow for time-varying individual-specific efficiencies (Cornwell *et al.* 1990).

<sup>85</sup> Two assumptions are made while estimating equation (1). Regarding the health sector, we estimate a “*cost frontier model*”, assuming that governments minimize the infant mortality rate with a given amount of public resources. On the contrary, public authorities tend to maximize the school enrolment rate with the public expenditure on the education sector. Consequently, we estimated a “*production frontier model*”.



allow us to obtain country-specific and time-varying efficiencies of public expenditure, following the formula provided by Battese and Coelli (1988) and Jondrow et al. (1988).<sup>86</sup>

The second step, after computing the efficiencies, consists of measuring the extent to which fiscal decentralization affects these efficiencies. The benchmark model is the following:

$$\hat{\eta}_{it} = \alpha + \delta fd_{it-1} + \varphi GDP_{it-1} + \psi_{it} \quad (5.3)$$

The dependent variable  $\hat{\eta}_{it}$  is the country-specific and time-varying efficiencies, estimated from equations (5.1) and (5.2), and  $fd_{it-1}$  measures the ratio of fiscal decentralization.  $\psi_{it}$  is the stochastic error term.

Next, we amend equation (5.3) to explore non-linearities in the linkage between fiscal decentralization and public expenditure efficiency. We use a quadratic specification and include squared fiscal decentralization  $(fd_{it-1})^2$  to the benchmark model to obtain equation (5.4).

$$\hat{\eta}_{it} = \alpha + \delta_1 fd_{it-1} + \delta_2 (fd_{it-1})^2 + \varphi GDP_{it-1} + \psi_{it} \quad (5.4)$$

Non-linearities, if any, are detected by computing the derivatives.<sup>87</sup> Further, we investigate the effect of political and institutional environment in the relationship between decentralization and the efficiency of public service delivery. Political and institutional variables are introduced additively ( $I_{it-1}$ ), but also crossed with the decentralization variable ( $fd_{it-1} \times I_{it-1}$ ) in equation (5.5).

$$\hat{\eta}_{it} = \alpha + \delta fd_{it-1} + \tau (fd_{it-1} \times I_{it-1}) + \rho I_{it-1} + \varphi GDP_{it-1} + \psi_{it} \quad (5.5)$$

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<sup>86</sup> Results of the stochastic frontier estimations, predicting the efficiency scores are given in appendix E.4. The formula provided by Battese and Coelli (1988) to derive the efficiency is:  $E[\exp(-s \cdot \eta | \varepsilon)]$ , where  $s = -1$  ( $s = 1$ ) if a cost (production) frontier is estimated.

<sup>87</sup> By calculating the derivative of the efficiency over the fiscal decentralization we obtain the following:  
 $\frac{\partial \hat{\eta}_{it}}{\partial fd_{it-1}} = \delta_1 + 2 \times \delta_2 fd \Rightarrow fd^* = -\frac{\delta_1}{2\delta_2}$ .

Parameter  $\rho$  accounts for the direct effect of political and institutional variables on the efficiency. More importantly,  $\delta$  and  $\tau$  give respectively the effect of fiscal decentralization on the efficiency of public expenditure and the influence of the political and institutional environment on the causal link between fiscal decentralization and public expenditure efficiency.

While this method is not exempt from criticisms, the two-step approach adopted here is justified by three reasons. First, and more importantly, fiscal decentralization might be seen as an endogenous process. Fiscal authorities embark the path of decentralization to guarantee effectiveness of public expenditure; on the other hand, efficient public service delivery may favor fiscal decentralization. The state-of-the-art of stochastic frontier techniques does not offer a convenient way to simultaneously predict the efficiencies and deal with the omitted variable and reverse causality biases that could plague the estimated parameters in a single approach method. The resulting estimates might be misleading and the correlation between fiscal decentralization and government outputs may be attributed to omitted variable bias. Second, exploring directly the effect of fiscal decentralization on infant mortality/enrolment rate does not tell us much about the efficiency. This may reflect a pure quantitative effect, capturing an increase in public expenditure, rather than efficiency gains (qualitative effect). Finally, one could assume the decentralization affecting indirectly the infant mortality/enrolment rate, by increasing or reducing the efficiency of related expenditure. We discuss further the identification strategy used to confront these criticisms and correct these biases.

#### 5.4.2. Data

Our sample covers an unbalanced panel of 64 countries, including advanced, emerging and developing economies, over the period 1990-2012. Data are taken from various sources, including the IMF's GFS, the World Bank's WDI, Eurostat and OCED databases, among others. Appendix tables E.1 and E.2 present the full sample, variable definition and sources.

The main variable of interest is fiscal decentralization. In accordance with the existing literature, it is computed as the share of sub-national fiscal variables (expenditure and revenue) over the general government fiscal variables (Davoodi and Zoo, 1998; Davoodi *et al.* 1999; Thornton,

2007; Ahmad *et al.* 2008; Dziobek *et al.* 2011; Escolano *et al.* 2012). Our baseline estimates are performed using the expenditure side of fiscal decentralization.<sup>88</sup> The priority given to the expenditure side of decentralization can be intuitively understood, since expenditure decentralization could better reflect the efficiency of public health and education expenditure, compared to the revenue side of fiscal decentralization. Robustness analysis presents estimation results using alternative policy tool such as the government revenue to compute decentralization index.

Regarding the political and institutional variables, we focus on the level of corruption, the existence of autonomous region, the strength of the democracy and a variable measuring whether the country is under a presidential or parliamentary regime. Each one of these four variables is interacted with our measure of fiscal decentralization.

Two sets of control variables are used. The first one (equation 5.1) consists of those introduced in the stochastic frontier estimations to predict the efficiencies. It comprises the real GDP per capita as a measure of the level of development, the density and the size of the population, and the average year of primary and secondary schooling. All these variables are considered to influence the infant mortality rate and the secondary school enrolment rate.<sup>89</sup> Second, we control for the GDP per capita when estimating the effect of decentralization on the efficiency of public expenditure (equations 5.3- 5.5).

### 5.4.3. Identification strategy

As aforementioned, one could think decentralization as an endogenous process. Accordingly, the squared fiscal decentralization variable (equation 5.4) is considered to be endogenous, as well as the interactive variables, which are combination of fiscal decentralization and political/institutional variables (equation 5.5). Following Barankay and Lockwood (2007), a first

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<sup>88</sup> Due to the difficulties in obtaining data from local and regional governments, our fiscal decentralization index is obtained as the inverse of the ratio of central government share of expenditure over the total general government expenditure –which measures *fiscal centralization*-. We are aware of the fact that decentralization may not be considered as the perfect inverse of centralization, however, our figures describe to the best possible the actual level of fiscal decentralization.

<sup>89</sup> To avoid perfect collinearity, we exclude the variable average year of schooling while estimating the effect of public spending —on education— on the secondary school enrolment rate.

attempt in reducing the bias, is that all explanatory variables, including fiscal decentralization, are introduced with one-time lag. Further, we resort on instrumental variable techniques, namely the two-stage least squares estimators to tackle the endogeneity issue and describe a causal link running from fiscal decentralization to the efficiency of public expenditure.

What are the main drivers of fiscal decentralization? In answering this question, we can derive a set of instruments consisting of variables that likely affect the efficiency of public service delivery through the decentralization process. In line with the recent literature, the size of the economy, measured by the population size, is considered to be a significant variable affecting the decentralization process since larger countries tend to be more decentralized (Dziobek *et al.* 2011; Jiménez-Rubio, 2011 and Escolano *et al.* 2012). The rationale is that the larger the country, the more difficult it will be for central authorities to effectively target the needs of its citizens. One way to improve the efficiency in delivering public goods is to proceed to decentralization. Besides, natural resources can be taken as an obstacle against decentralization, due to the rent-seeking behavior of fiscal authorities that benefit directly from the resource windfalls. Under such circumstances, embarking on fiscal decentralization process would imply a subsequent private loss for incumbent authorities. On the contrary, natural resources might be seen as a blessing, triggering the decentralization process. Windfalls may constitute an additional source of revenue to be shared with the sub-national levels. In addition to these variables, we consider political and institutional variables that might be correlated with the decentralization process. Two dimensions of the political and institutional environment are at stake. We discuss the extent to which government fractionalization and fractionalization in the legislating system can affect the decentralization process and *in fine*, the efficiency of public expenditure. Fractionalization is perceived as the probability that two deputies randomly picked either from the government or the legislature will be from different parties. Higher fractionalization may either act against the decentralization process, due to political motives or accelerate it. The expected sign of these variables on the decentralization process remains mitigated.

To sum up, we use the size of the economy, natural resources rents and two measures of fractionalization to instrument our main variable of interest, fiscal decentralization.

Table 5.2 provides descriptive statistics of main variables used throughout. It shows that the average level of decentralization is nearly 30%, meaning that, on average, 30% of public expenditure are implemented by sub-national (local or regional) governments. This share becomes greater, when considering advanced economies, with sub-national governments controlling roughly 40% of public expenditure. The pace of decentralization in emerging markets and developing economies is much slower. Sub-national governments are assigned only one quarter of total government public expenditure. We also notice that the level of decentralization, in some countries, is null, meaning that public decision-making and implementation are fully centralized and implemented at the central level, thus leaving no room to local entities.

**Table 5.2: Descriptive statistics**

| Variables                     | Obs. | Mean  | Advanced | EME and DC | Std. Dev. | Minimum | Maximum |
|-------------------------------|------|-------|----------|------------|-----------|---------|---------|
| FD expenditure (%)            | 1086 | 29.55 | 38.97    | 25.42      | 21.31     | 0       | 98.44   |
| Real GDP pc (in thousands)    | 1467 | 22.65 | 34.67    | 17.55      | 15.74     | 1.31    | 97.41   |
| Natural res. rents (% GDP)    | 1467 | 4.54  | 1.88     | 5.67       | 8.08      | 0       | 63.98   |
| Government fractionalization  | 1381 | 0.29  | 0.29     | 0.29       | 0.29      | 0       | 1       |
| Fractionalization             | 1361 | 0.65  | 0.65     | 0.64       | 0.2       | 0       | 1       |
| Population size (in millions) | 1472 | 48.64 | 43.31    | 50.89      | 138.7     | 0.07    | 1236.7  |
| Corruption                    | 1280 | -2.72 | -3.52    | -2.32      | 1.31      | -5      | 0.67    |
| Parliamentary                 | 1433 | 0.57  | 0.87     | 0.44       | 0.49      | 0       | 1       |
| Democracy                     | 1425 | 30.06 | 51.01    | 20.88      | 26.39     | 1       | 82      |
| Autonomy                      | 1427 | 0.2   | 0.26     | 0.17       | 0.4       | 0       | 1       |

When considering political and institutional variables, we notice a high level of fractionalization in the legislating system, regardless of the level of development. On the contrary, it appears that governments are less fractionalized. The probability of two deputies coming from two different parties is only 29%. The corruption index is constructed in a way that the higher the score, the more corrupted is the government. Table 5.2 shows that corruption seems more spread in emerging markets and developing economies, where greater score is observed. The political system variable is coded 1 in countries where the system is parliamentary; and 0 otherwise. It shows that, in advanced economies, the political system is strongly parliamentary, meaning that the decision-making power is not exclusively at the discretion of the executive. This is not necessarily the case in emerging markets and developing economies. Political regime variable gives information of whether the regime is democratic or autocratic. A higher score reveals higher degree of democracy. Again, democracy is more strengthened in advanced economies

with a greater score, as compared to emerging markets and developing economies. We use a dummy variable to capture the existence of constitutionally autonomous regions. It can be seen that there is not a proliferation of autonomous regions, neither in advanced economies, nor in emerging markets and developing economies, although the former group seems outperforming the latter. More detailed descriptive statistics are provided in appendix E3. Next section discusses our estimation results.

## 5.5. Estimation results

We present the estimation results of equations 5.3-5.5. Before diving into the interpretation of our estimates, we report the predicted efficiencies from the stochastic frontier analysis in Table 5.3 below. It shows that the average estimated efficiencies of public expenditure are 82.2% and 87.8% for health and education expenditure respectively. If a country has an efficiency score of 82%, this means that the country realizes, on average, 82% of the objective (*reducing infant mortality rate or increasing school enrolment rate*) possible as compared to a fully efficient country having comparable input values (public expenditure). Columns (2) and (4) re-estimate the efficiency scores with the alternative method of Jondrow *et al.* (1982), while columns (3) and (6) take into account the heterogeneity and heteroskedasticity in predicting the efficiencies. These alternative efficiency estimates are used to perform robustness checks. We will not go further deep in interpreting these results, since we are mainly interested in the impact of fiscal decentralization on these efficiencies.

**Table 5.3: Stochastic frontier estimation of the public expenditure efficiency**

|                      | <u>Health</u> |              |              | <u>Education</u> |              |              |
|----------------------|---------------|--------------|--------------|------------------|--------------|--------------|
|                      | (1)           | (2)          | (3)          | (4)              | (5)          | (6)          |
| Mean of efficiencies | <b>0.822</b>  | <b>0.813</b> | <b>0.844</b> | <b>0.878</b>     | <b>0.876</b> | <b>0.883</b> |
| Standard deviation   | 0.091         | 0.095        | 0.112        | 0.101            | 0.101        | 0.129        |
| Minimum              | 0.299         | 0.285        | 0.313        | 0.327            | 0.326        | 0.270        |
| Maximum              | 0.944         | 0.943        | 0.980        | 0.981            | 0.981        | 0.988        |

*Note.* Maximum likelihood estimations are performed, assuming a truncated normal distribution. The efficiencies are predicted using the Battese and Coelli (1988) and Jondrow *et al.* (1982) approaches. Heterogeneous efficiencies estimated in columns (3) and (6) are highly correlated (66% to 88%) with the benchmark efficiency estimates in columns (1) and (4). Estimation details are given in appendix E.4.

### 5.5.1. Does fiscal decentralization affect the efficiency of public service delivery?

Table 5.4 presents the results of the estimation of equation 5.3. First, we notice that our instrumental variables are significantly correlated with the endogenous regressor in almost all cases (the associated p-values are  $< 0.05$ ). Besides, using the Kleibergen-Paap's p values, we reject, at 5% level, the null hypothesis that equations are under-identified. This means that instrumental variables used are relevant i.e. correlated with the endogenous regressor.<sup>90</sup>

Pooling together the advanced and the emerging market and developing economies (columns 1 and 5), it appears that fiscal decentralization has no significant effect on the efficiency.<sup>91</sup> This finding is strongly challenged when we split the sample. Following the WEO (2014)'s country classification, we divide our sample into two groups: the advanced economies and the group of emerging market and developing economies.

Estimation results display a significant positive effect of fiscal decentralization for advanced economies (column 2). In other words, high level of decentralization improves the efficiency of public health expenditure. To quantify this effect, one can say that one standard deviation increase in fiscal decentralization (21.3%), leads to 12.7% increase in public expenditure efficiency, relatively to the mean. In contrast, fiscal decentralization appears to have significant negative effect on public expenditure efficiency when considering the group of emerging markets and developing economies. Increasing share of fiscal decentralization decreases public expenditure efficiency by 6.8 percent (column 3). These contrasting effects of decentralization observed for advanced and developing economies are robust to the inclusion of time dummies, though with a slight reduction in the magnitude of the coefficients. These effects are not driven by common shock heating all countries at the same time, neither are these due a time trend evolution of the efficiency scores (columns 4-5). These results even hold for the education sector (see columns 9 and 10). These estimates show that the level of development significantly matters

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<sup>90</sup> First-step regressions of the instrumentation procedure are given in appendix E.5.

<sup>91</sup> The non-significance might be driven by differences in the level of decentralization between advanced and emerging market and developing economies.

in the relationship between fiscal decentralization and public expenditure efficiency. The next section explores additional non-linearities.

**Table 5.4: Two-stage least square (2SLS) estimates of the effect of fiscal decentralization (FD) on public expenditure efficiency**

*Dependent variable: estimated efficiencies*

|  | Health              |                            |                              |                            | Education                    |                      |                       |                             |                            |                             |
|--|---------------------|----------------------------|------------------------------|----------------------------|------------------------------|----------------------|-----------------------|-----------------------------|----------------------------|-----------------------------|
|  | All<br>(1)          | Advanced<br>(2)            | EME and DC<br>(3)            | Time dummies<br>(4)        | All<br>(6)                   | Advanced<br>(7)      | EME and DC<br>(8)     | Time dummies<br>(9)         | Time dummies<br>(10)       |                             |
| FD <sub>(t-1)</sub>                                    | 0.109<br>(0.925)    | <b>0.599***</b><br>(7.956) | <b>-0.322***</b><br>(-2.919) | <b>0.433***</b><br>(5.211) | <b>-0.187***</b><br>(-2.737) | 0.037<br>(0.126)     | -0.045<br>(-0.339)    | <b>-0.872**</b><br>(-2.545) | <b>0.800***</b><br>(3.674) | <b>-0.616**</b><br>(-2.305) |
| Real GDP pc <sub>(t-1)</sub>                           | 0.035***<br>(5.402) | 0.008<br>(0.778)           | 0.023***<br>(2.730)          | -0.061***<br>(-3.286)      | -0.093***<br>(-6.865)        | -0.020**<br>(-2.200) | -0.077***<br>(-4.339) | -0.006<br>(-0.386)          | 0.044<br>(1.284)           | -0.070**<br>(-2.564)        |
| <i>Time dummies</i>                                    | <i>No</i>           | <i>No</i>                  | <i>No</i>                    | <i>Yes</i>                 | <i>Yes</i>                   | <i>No</i>            | <i>No</i>             | <i>No</i>                   | <i>Yes</i>                 | <i>Yes</i>                  |
| Obs. (countries)                                       | 875 (55)            | 269 (14)                   | 606 (41)                     | 269 (14)                   | 606 (41)                     | 690 (53)             | 213 (14)              | 477 (39)                    | 213 (14)                   | 477 (39)                    |
| Fisher ( <i>p-value</i> )                              | 0.000               | 0.000                      | 0.000                        | 0.000                      | 0.000                        | 0.056                | 0.000                 | 0.041                       | 0.000                      | 0.249                       |
| Hansen OID ( <i>p-value</i> )                          | 0.000               | 0.008                      | 0.000                        | 0.000                      | 0.007                        | 0.000                | 0.000                 | 0.004                       | 0.042                      | 0.000                       |
| KP-under ( <i>p-value</i> )                            | 0.000               | 0.000                      | 0.000                        | 0.000                      | 0.000                        | 0.057                | 0.002                 | 0.048                       | 0.013                      | 0.034                       |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.000               | 0.000                      | 0.000                        | 0.000                      | 0.000                        | 0.052                | 0.000                 | 0.029                       | 0.019                      | 0.029                       |

*Note.* Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. FD stands for fiscal decentralization. The GMM specification has been used in all specifications. Fixed effects are taken into consideration to control for all time-invariant characteristics and exploit within country variations. FD<sub>(t-1)</sub> is considered to be endogenous. Instruments used are: the country size, natural resource rents, and measures of fractionalization.

### 5.5.2. Fiscal decentralization and public service delivery: exploring non-linearities

This section explores the non-linear impact of fiscal decentralization on the efficiency of public expenditure using equation (5.4) described above. Estimation results are presented in table 5.5.

Columns (1) and (4) show that fiscal decentralization and its squared term affect significantly the efficiency scores. Interestingly, these coefficients display opposite signs, evidencing a U-shape relationship between fiscal decentralization and public expenditure efficiency. This means that a lower level of decentralization may be unprofitable. Fiscal decentralization, to be effective needs to reach a certain threshold, which is estimated to be 35.7% for health expenditure, and 35.4% for the education sector.<sup>92</sup> At least, more than a third of public expenditure need to be shared with the local authorities to guarantee positive outcomes of fiscal decentralization.

<sup>92</sup> Based on the estimated parameters of table 5.5, we compute the decentralization threshold  $fd^*$  as follow:  $fd^* = \left( -\frac{(-2.247)}{(2 \times 3.149)} \right) \times 100 = 35.7$ . The same calculation is done for the education sector.



**Table 5.5: 2SLS estimates of the effect of FD on public expenditure efficiency: exploring non-linearities***Dependent variable: estimated efficiencies*

|  | <u>Health</u>                |                              |                           | <u>Education</u>            |                  |                       |
|--|------------------------------|------------------------------|---------------------------|-----------------------------|------------------|-----------------------|
|  | All                          | FD < $fd^*$                  | FD $\geq$ $fd^*$          | All                         | FD < $fd^*$      | FD $\geq$ $fd^*$      |
|  | (1)                          | (2)                          | (3)                       | (4)                         | (5)              | (6)                   |
| FD <sub>(t-1)</sub>  | <b>-2.247***</b><br>(-3.518) | <b>-0.797***</b><br>(-3.487) | <b>0.210**</b><br>(2.415) | <b>-1.307**</b><br>(-1.963) | 0.717<br>(0.980) | -0.061<br>(-0.395)    |
| (FD <sub>(t-1)</sub> ) <sup>2</sup>                                    | <b>3.149***</b><br>(3.622)   |                              |                           | <b>1.847**</b><br>(2.259)   |                  |                       |
| Real GDP pc <sub>(t-1)</sub>   | -0.003<br>(-0.226)           | 0.032***<br>(2.699)          | -0.006<br>(-1.056)        | -0.035**<br>(-2.537)        | 0.049<br>(1.513) | -0.047***<br>(-4.222) |
| Obs. (countries)   | 875 (55)                     | 481 (37)                     | 390 (29)                  | 690 (53)                    | 365 (35)         | 321 (27)              |
| Fisher ( <i>p-value</i> )  | 0.000                        | 0.000                        | 0.049                     | 0.036                       | 0.311            | 0.000                 |
| Hansen OID ( <i>p-value</i> )  | 0.010                        | 0.000                        | 0.188                     | 0.011                       | 0.051            | 0.176                 |
| KP-under   | 0.001                        | 0.004                        | 0.000                     | 0.077                       | 0.019            | 0.000                 |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> )                 | 0.000                        | 0.011                        | 0.000                     | 0.052                       | 0.052            | 0.000                 |
| (FD <sub>(t-1)</sub> ) <sup>2</sup> instrumentation ( <i>p-value</i> ) | 0.000                        |                              |                           | 0.006                       |                  |                       |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

Next, we perform separate estimations, considering observations below and above the estimated threshold. We notice that, when the decentralization ratio is below the estimated threshold of 35.7%, then, a percent increase in fiscal decentralization ratio reduces the efficiency by roughly 0.8 percentage points (column 2). In contrast, if the ratio of decentralization reaches 36% or beyond, then fiscal decentralization improves the efficiency of public service delivery. A one percent increase in the decentralization ratio increases the efficiency by 0.2 percentage points. This strengthens our findings of non linear linkage between decentralization and public expenditure efficiency.

These results are important in two aspects. First, they corroborate our former finding that the effect of fiscal decentralization depends on the level of development. Second, it has been found that decentralization affects positively the efficiency of public service delivery in advanced economies, where the ratio of fiscal decentralization is nearly 40% (which is greater than the estimated threshold of 35.7%). In contrast, we have found a negative linkage between decentralization and the efficiency of public service delivery in emerging markets and developing economies. In fact, the average level of fiscal decentralization in these countries is only 25.4%, more than ten percentage points below the critical level (35.7%) above which of fiscal decentralization is expected to have positive effects. Regarding the education sector, although the non-linear linkage holds, evidences are less clear-cut.

### 5.5.3. Fiscal decentralization and public service delivery: the role of political and institutional environment

Table 5.6 presents the results of the estimation of equation (5.5). It appears that decentralization ratio crossed with political and institutional variables are significantly associated with the efficiency of public expenditure, and their coefficients display in some cases opposite signs.

Regarding the health sector, we notice that increased degree of corruption worsens the negative effect of fiscal decentralization. Estimates of table 5.3 show that, on average, a one standard-deviation increase in the fiscal decentralization ratio (21.3%) is associated with 11.1% decrease in the efficiency of public expenditure relative to the mean efficiency (82.2%).<sup>93</sup> When crossed with the corruption variable, the effect becomes worst. Within a corrupted environment, the negative effect becomes more important since decentralization reduces much more the efficiency of public expenditure. This negative corruption effect is due to that, local interest groups are more powerful at the local level, with greater opportunity of pressure to the local authorities. Local authorities may also have more discretion and fewer obstacles to deviate from central government priorities, giving room for leakage of public resources, as supported by Gauthier and Wane (2008).<sup>94</sup>

On the contrary, the positive and statistically significant sign of decentralization, crossed with the political system variable ( $FD \times Parliamentary_{(t-1)}$ ) evidences that countries with a parliamentary system benefit from fiscal decentralization. Parliamentary regimes, as compared to presidential regime have the strength of limiting the executive's discretionary powers. Moreover, the political regime also reduces significantly the negative effect of decentralization taken solely. The variable capturing the strength of the democracy (*Regime*) is computed in the sense that higher scores reveal more democratic regimes. Therefore, implementing decentralization in a more democratic environment helps mitigating the downsides of fiscal decentralization itself. Furthermore, the existence of constitutionally autonomous region shall be considered as an

<sup>93</sup> The marginal effect of corruption is obtained as in Ebeke (2012) as follow:  $(-0.488 \times 0.213) \times 100 = -11.1$ .

<sup>94</sup> In this line, Treisman (1999, 2000a) argues that federal states may be perceived to be more corrupted, due to their larger size, as compared to unitary states; the existence of separate police forces at multiple level of governments and the likelihood of having bicameral legislature where the upper house is regionally elected and possesses veto power.

important feature, when it comes to implementing fiscal decentralization. In fact, autonomous regions may be free of any vertical constraint coming from the top level and influences the way that public expenditure are implemented locally. The non-significance of real GDP per capita used as control variable in some cases might be due to the fact that we already controlled for this variable in the first step, when estimating the efficiency.

**Table 5.6: 2SLS estimates of the effect of FD on public expenditure efficiency: political/institutional interactions**

|  | <u>Health</u>      |                              |                              |                              | <u>Education</u>             |                    |                            |                            |
|--|--------------------|------------------------------|------------------------------|------------------------------|------------------------------|--------------------|----------------------------|----------------------------|
|  | (1)                | (2)                          | (3)                          | (4)                          | (5)                          | (6)                | (7)                        | (8)                        |
| FD <sub>(t-1)</sub>                                    | -0.523<br>(-1.540) | -0.809<br>(-1.137)           | <b>-1.307***</b><br>(-2.703) | <b>-0.727***</b><br>(-3.159) | <b>-1.079*</b><br>(-1.780)   | -0.171<br>(-0.217) | <b>-0.764*</b><br>(-1.889) | -0.696<br>(-1.275)         |
| FD × Corruption <sub>(t-1)</sub>                       |                    | <b>-0.488***</b><br>(-3.291) |                              |                              | <b>-0.608***</b><br>(-2.738) |                    |                            |                            |
| FD × Parliamentary <sub>(t-1)</sub>                    |                    | <b>4.373**</b><br>(2.206)    |                              |                              |                              | 1.16<br>(0.836)    |                            |                            |
| FD × Regime <sub>(t-1)</sub>                           |                    |                              | <b>0.033***</b><br>(2.967)   |                              |                              |                    | 0.012<br>(1.477)           |                            |
| FD × Autonomy <sub>(t-1)</sub>                         |                    |                              |                              | <b>2.057***</b><br>(5.457)   |                              |                    |                            | <b>1.952***</b><br>(2.931) |
| Real GDP pc <sub>(t-1)</sub>                           | -0.039<br>(-1.535) | -0.122<br>(-1.598)           | -0.117***<br>(-2.803)        | 0.013<br>(1.154)             | -0.130**<br>(-2.371)         | -0.044<br>(-0.920) | -0.072**<br>(-2.257)       | -0.019<br>(-1.120)         |
| Obs. (countries)                                       | 810 (51)           | 875 (55)                     | 874 (55)                     | 875 (55)                     | 639 (49)                     | 690 (53)           | 689 (53)                   | 690 (53)                   |
| Fisher ( <i>p-value</i> )                              | 0.006              | 0.097                        | 0.001                        | 0.000                        | 0.029                        | 0.700              | 0.241                      | 0.061                      |
| Hansen OID ( <i>p-value</i> )                          | 0.408              | 0.868                        | 0.422                        | 0.139                        | 0.900                        | 0.012              | 0.004                      | 0.141                      |
| KP-under   | 0.04               | 0.175                        | 0.013                        | 0.001                        | 0.076                        | 0.134              | 0.067                      | 0.092                      |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.000              | 0.000                        | 0.000                        | 0.000                        | 0.038                        | 0.229              | 0.014                      | 0.047                      |
| FD × I <sub>(t-1)</sub> instrument. ( <i>p-value</i> ) | 0.058              | 0.226                        | 0.000                        | 0.000                        | 0.161                        | 0.115              | 0.000                      | 0.000                      |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

The same negative effect of fiscal decentralization is observed when considering the education sector. The significantly negative sign of fiscal decentralization denotes that decentralization reduces the efficiency of public service delivery. Once again, the negative sign of the fiscal decentralization variable interacted with corruption ( $FD \times Corruption_{(t-1)}$ ) confirms that the adverse effect of decentralization is worsened in highly corrupted countries. Our results also highlight the effectiveness of autonomous regions in dampening the downside of fiscal decentralization. These findings are closely related with those of Jiménez-Rubio (2011), who found considerable positive effect of fiscal decentralization on infant mortality rate only if a substantial degree of autonomy in the sources of revenue is devolved to local governments. Likewise, the strength of democracy and the nature of the political regime seem reducing the negative effect of fiscal decentralization, though not statistically significant.

In what follows, we re-estimate model (5.5) with political and institutional interactions, but we disentangle between advanced economies and the group of emerging market and developing economies. The results are presented in table 5.7.

We notice that the level of development matters, when it comes to measuring the effect of fiscal decentralization. Let us consider the health sector (columns 1 to 4). While fiscal decentralization displays either statistically null or positive sign for advanced economies (columns 1 and 2), the negative impact of decentralization on the efficiency of public expenditure persists for the group of emerging markets and developing economies (columns 3 and 4). Table 5.7 shows that, for this latter group, a one standard deviation increase in the decentralization ratio (20.4%) reduces public expenditure efficiency by 18.4% relative to the mean. Once again, the significant negative association between the interactive term ( $FD \times Corruption_{(t-1)}$ ) and the dependent variable shows that corruption phenomenon worsens the negative effect of decentralization. Adversely, the perverse effect of fiscal decentralization is strongly mitigated by the existence of autonomous regions. Regarding the education sector (columns 5-9), the negative relationship between fiscal decentralization and public expenditure efficiency holds, although differences persist between the two groups.

Corruption seems to have no effect on the efficiency when considering advanced economies (column 5). Low level of corruption might be a tentative explanation of the non-significant coefficients, although the negative correlation persists. On the contrary the adverse effect of corruption on the efficiency is confirmed for the group of emerging markets and developing economies, where the degree of corruption seems higher.<sup>95</sup> Results in columns (6) and (8) reinforces our former findings that more autonomy for subnational governments, that could be understood as less (vertical) constraint, reduces significantly the downside of fiscal decentralization.

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<sup>95</sup> See Table 5.2, descriptive statistics.

**Table 5.7 2SLS estimates of the effect of FD on public expenditure efficiency: income level comparison**  
*Dependent variable: estimated efficiencies*

|  | Health             |                          |                              |                              | Education          |                              |                              |                              |
|--|--------------------|--------------------------|------------------------------|------------------------------|--------------------|------------------------------|------------------------------|------------------------------|
|  | Advanced           |                          | EME and DC                   |                              | Advanced           |                              | EME and DC                   |                              |
|  | (1)                | (2)                      | (3)                          | (4)                          | (5)                | (6)                          | (7)                          | (8)                          |
| FD <sub>(t-1)</sub>                                    | 0.106<br>(0.264)   | <b>0.874*</b><br>(1.692) | <b>-0.734***</b><br>(-4.688) | <b>-0.489***</b><br>(-3.894) | 0.17<br>(0.392)    | <b>-1.255***</b><br>(-2.614) | <b>-1.455***</b><br>(-4.384) | <b>-0.975***</b><br>(-2.864) |
| FD × Corruption <sub>(t-1)</sub>                       | -0.274<br>(-1.254) |                          | <b>-0.287***</b><br>(-4.618) |                              | -0.13<br>(-0.448)  |                              | <b>-0.470***</b><br>(-3.294) |                              |
| FD × Autonomy <sub>(t-1)</sub>                         |                    | -0.264<br>(-0.509)       |                              | <b>1.344***</b><br>(3.908)   |                    | <b>1.754**</b><br>(2.540)    |                              | <b>1.835***</b><br>(2.942)   |
| Real GDP pc <sub>(t-1)</sub>                           | -0.108<br>(-1.146) | 0.013<br>(0.802)         | 0.002<br>(0.147)             | 0.017*<br>(1.698)            | -0.154<br>(-1.115) | -0.064**<br>(-2.077)         | -0.056*<br>(-1.694)          | -0.010<br>(-0.560)           |
| Obs. (countries)                                       | 266 (14)           | 269 (14)                 | 544 (37)                     | 606 (41)                     | 211 (14)           | 213 (14)                     | 428 (35)                     | 477 (39)                     |
| Fisher ( <i>p-value</i> )                              | 0.003              | 0.000                    | 0.000                        | 0.000                        | 0.002              | 0.006                        | 0.000                        | 0.005                        |
| Hansen OID ( <i>p-value</i> )                          | 0.472              | 0.036                    | 0.400                        | 0.002                        | 0.228              | 0.404                        | 0.922                        | 0.101                        |
| KP-under   | 0.521              | 0.036                    | 0.004                        | 0.000                        | 0.642              | 0.049                        | 0.064                        | 0.007                        |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.000              | 0.000                    | 0.000                        | 0.000                        | 0.000              | 0.000                        | 0.0269                       | 0.018                        |
| FD × I <sub>(t-1)</sub> instrum. ( <i>p-value</i> )    | 0.171              | 0.000                    | 0.002                        | 0.000                        | 0.538              | 0.002                        | 0.050                        | 0.000                        |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

To sum up, our results show that fiscal decentralization has a significant influence on public expenditure efficiency, but in a non-linear fashion. Our results give empirical support to an efficiency-improving effect of decentralization for advanced economies, while the impact is mitigated for emerging market and developing economies. We also highlight that the effect of decentralization depends significantly on the political and institutional environment of countries. While corruption phenomenon significantly worsens the negative effect of fiscal decentralization on public expenditure efficiency, high degree of democracy helps mitigating the adverse effects. Additionally, the existence of autonomous regions, as well as the choice of parliamentary regime, as compared to presidential regime allows the fiscal decentralization to perform better in improving the efficiency of public expenditure. These findings bode well with those of Barankay and Lockwood (2007), whom found earlier a robust positive relationship between expenditure decentralization and productive efficiency of public good provision in different Swiss cantons, effect even important with the degree of competence of local governments.

## 5.6. Robustness analysis

A range of sensitivity analysis is performed to assess the robustness of our findings. First we exclude outliers from the baseline estimates. Then, we re-estimate the benchmark model, but change the dependent variable. Moreover, we use alternative political and institutional variables. Finally, we replace the benchmark expenditure decentralization variable with revenue decentralization.

### 5.6.1. Fiscal decentralization and public service delivery: excluding outliers

Our first attempt in this sensitivity checking consists of excluding outliers from the sample. We exclude countries with extreme ratio of fiscal decentralization. Besides, we narrow the fiscal decentralization variable to exclude countries that are totally centralized, i.e. countries where fiscal decentralization ration is zero. We also ignore countries that have extremely high level of decentralization, i.e. where fiscal decentralization ratio is  $\geq 90\%$ .

**Table 5.8: 2SLS estimates of the effect of FD on public expenditure efficiency: excluding outliers**

|  | <u>Health</u>              |                              |                            |                              | <u>Education</u>      |                             |                      |                             |
|--|----------------------------|------------------------------|----------------------------|------------------------------|-----------------------|-----------------------------|----------------------|-----------------------------|
|  | Excluding outliers         |                              | 0% < <i>fd</i> < 90%       |                              | Excluding outliers    |                             | 0% < <i>fd</i> < 90% |                             |
|  | Advanced                   | EME and DC                   | Advanced                   | EME and DC                   | Advanced              | EME and DC                  | Advanced             | EME and DC                  |
|  | (1)                        | (2)                          | (3)                        | (4)                          | (5)                   | (6)                         | (7)                  | (8)                         |
| FD <sub>(t-1)</sub>                                    | <b>0.599***</b><br>(7.956) | <b>-0.338***</b><br>(-3.023) | <b>0.599***</b><br>(7.956) | <b>-0.388***</b><br>(-3.315) | -0.045<br>(-0.339)    | <b>-0.884**</b><br>(-2.560) | -0.045<br>(-0.339)   | <b>-0.931**</b><br>(-2.410) |
| Real GDP pc <sub>(t-1)</sub>                           | 0.008<br>(0.778)           | 0.022***<br>(2.627)          | 0.008<br>(0.778)           | 0.013<br>(1.426)             | -0.077***<br>(-4.339) | -0.008<br>(-0.437)          | -<br>(-4.339)        | -0.007<br>(-0.341)          |
| Obs. (countries)                                       | 269 (14)                   | 593 (40)                     | 269 (14)                   | 531 (37)                     | 213 (14)              | 467 (38)                    | 213 (14)             | 426 (35)                    |
| Fisher ( <i>p-value</i> )                              | 0.000                      | 0.000                        | 0.000                      | 0.000                        | 0.000                 | 0.039                       | 0.000                | 0.056                       |
| Hansen OID ( <i>p-value</i> )                          | 0.008                      | 0.000                        | 0.008                      | 0.000                        | 0.000                 | 0.005                       | 0.000                | 0.037                       |
| KP-under   | 0.000                      | 0.000                        | 0.000                      | 0.000                        | 0.002                 | 0.056                       | 0.002                | 0.061                       |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.000                      | 0.000                        | 0.000                      | 0.000                        | 0.000                 | 0.033                       | 0.000                | 0.035                       |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

Results displayed in table 5.8 show that the effect of decentralization on public expenditure efficiency is not driven by outliers. Regarding the health sector, the decentralization effect remains positive for advanced economies, and negative for emerging markets and developing economies, corroborating the baseline findings. These effects are also robust when the decentralization ratio is narrowed (columns 4-5). If one considers the education sector, the same

result of negative decentralization effect is observed for emerging markets and developing economies (columns 8 and 10), with a slight difference in the magnitude.

### **5.6.2. Fiscal decentralization and public service delivery: changing the dependent variable**

We pursue the robustness analysis by changing the dependent variable in two ways. First, we measure the efficiencies using Jondrow *et al.* (1982) approach. Then, these efficiencies are used as dependent variables. In addition, we take into account the sample heterogeneity and heteroskedasticity while predicting the efficiencies.

Table 5.9 below details estimation results with alternative dependent variables. We directly test the robustness of the impact of political and institutional variables in the relationship between decentralization and public expenditure efficiency, as shown earlier in tables 5.6 and 5.7.

First, we strengthen our former findings that the effect of fiscal decentralization on the efficiency of public expenditure depends on the political and institutional environment. Analyzing the health sector, estimates using the Jondrow *et al.* (1982) method (columns 1-4) show that corruption phenomenon worsens the negative effect of decentralization. On the contrary, the negative effect is significantly mitigated in countries operating under a parliamentary regime.

In addition, more democratic institutions, as well as the existence of autonomous regions help reducing the negative effect. These non-linearities are persistent when the sample heterogeneity is taken into consideration in predicting the efficiencies (columns 5-8), though the parliamentary system variable loses its statistical significance.

Regarding the education sector, we remark that corruption amplifies the negative effect of decentralization, while the existence of autonomous regions strengthens the benefits of decentralization. These results hold when focusing on the Jondrow *et al.* (1982) measure of efficiencies (columns 9-12), as well as the use of heterogenous efficiencies as dependent variable (columns 13-16).

**Table 5.9: 2SLS estimates of the effect of FD on public expenditure efficiency: the Jondrow et al. (1982) approach, and the case of heterogeneous efficiencies***Dependent variable: estimated efficiencies*

|  | <u>Health</u>                           |                    |                              |                              |                               |                              |                              |                              | <u>Education</u>                        |                    |                             |                    |                              |                    |                             |                            |
|--|---|--------------------|------------------------------|------------------------------|-------------------------------|------------------------------|------------------------------|------------------------------|---|--------------------|-----------------------------|--------------------|------------------------------|--------------------|-----------------------------|----------------------------|
|  | Efficiencies with Jondrow et al. (1982) |                    |                              |                              | Heterogeneous efficiencies    |                              |                              |                              | Efficiencies with Jondrow et al. (1982) |                    |                             |                    | Heterogeneous efficiencies   |                    |                             |                            |
|  | (1)                                     | (2)                | (3)                          | (4)                          | (5)                           | (6)                          | (7)                          | (8)                          | (9)                                     | (10)               | (11)                        | (12)               | (13)                         | (14)               | (15)                        | (16)                       |
| FD <sub>(t-1)</sub>                                    | -0.56<br>(-1.556)                       | -0.866<br>(-1.142) | <b>-1.392***</b><br>(-2.711) | <b>-0.781***</b><br>(-3.181) | <b>-0.488***</b><br>(-2.962)  | -0.389<br>(-1.424)           | <b>-0.552***</b><br>(-2.770) | <b>-0.546***</b><br>(-2.665) | <b>-1.087*</b><br>(-1.780)              | -0.174<br>(-0.220) | <b>-0.774*</b><br>(-1.897)  | -0.702<br>(-1.277) | <b>-1.726**</b><br>(-2.319)  | -0.694<br>(-0.632) | <b>-1.254**</b><br>(-2.074) | <b>-1.327*</b><br>(-1.798) |
| FD × Corruption <sub>(t-1)</sub>                       | <b>-0.518***</b><br>(-3.284)            |                    |                              |                              | <b>-0.110**</b><br>(-2.543)   |                              |                              |                              | <b>-0.612***</b><br>(-2.738)            |                    |                             |                    | <b>-0.778***</b><br>(-2.873) |                    |                             |                            |
| FD × Parliamentary <sub>(t-1)</sub>                    | <b>4.663**</b><br>(2.208)               |                    |                              |                              | 0.979<br>(1.508)              |                              |                              |                              | 1.161<br>(0.833)                        |                    |                             |                    | 1.777<br>(0.872)             |                    |                             |                            |
| FD × Regime <sub>(t-1)</sub>                           | <b>0.035***</b><br>(2.970)              |                    |                              |                              | <b>0.010**</b><br>(2.052)     |                              |                              |                              | 0.013<br>(1.477)                        |                    |                             |                    | 0.0184<br>(1.451)            |                    |                             |                            |
| FD × Autonomy <sub>(t-1)</sub>                         | <b>2.199***</b><br>(5.504)              |                    |                              |                              | <b>1.069***</b><br>(2.732)    |                              |                              |                              | <b>1.965***</b><br>(2.939)              |                    |                             |                    | <b>3.121***</b><br>(3.243)   |                    |                             |                            |
| Real GDP pc <sub>(t-1)</sub>                           | -0.0415<br>(-1.516)                     | -0.13<br>(-1.596)  | <b>-0.125***</b><br>(-2.825) | 0.014<br>(1.182)             | <b>-0.100***</b><br>(-11.046) | <b>-0.112***</b><br>(-4.312) | <b>-0.132***</b><br>(-5.617) | <b>-0.084***</b><br>(-7.668) | <b>-0.131**</b><br>(-2.377)             | -0.044<br>(-0.922) | <b>-0.072**</b><br>(-2.256) | -0.020<br>(-1.136) | -0.089<br>(-1.306)           | 0.023<br>(0.322)   | -0.036<br>(-0.732)          | 0.053**<br>(2.185)         |
| Obs. (countries)                                       | 810 (51)                                | 875 (55)           | 874 (55)                     | 875 (55)                     | 719 (51)                      | 778 (55)                     | 777 (55)                     | 778 (55)                     | 639 (49)                                | 690 (53)           | 689 (53)                    | 690 (53)           | 639 (49)                     | 690 (53)           | 689 (53)                    | 690 (53)                   |
| Fisher ( <i>p-value</i> )                              | 0.006                                   | 0.095              | 0.001                        | 0.000                        | 0.000                         | 0.000                        | 0.000                        | 0.000                        | 0.029                                   | 0.695              | 0.239                       | 0.06               | 0.001                        | 0.011              | 0.001                       | 0.000                      |
| Hansen OID ( <i>p-value</i> )                          | 0.398                                   | 0.871              | 0.437                        | 0.136                        | 0.009                         | 0.154                        | 0.085                        | 0.246                        | 0.901                                   | 0.012              | 0.004                       | 0.141              | 0.722                        | 0.028              | 0.033                       | 0.425                      |
| KP-under   | 0.04                                    | 0.175              | 0.013                        | 0.001                        | 0.000                         | 0.013                        | 0.000                        | 0.000                        | 0.076                                   | 0.134              | 0.067                       | 0.092              | 0.076                        | 0.134              | 0.067                       | 0.092                      |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.000                                   | 0.000              | 0.000                        | 0.000                        | 0.000                         | 0.000                        | 0.000                        | 0.000                        | 0.038                                   | 0.229              | 0.014                       | 0.047              | 0.038                        | 0.229              | 0.014                       | 0.047                      |
| FD × I <sub>(t-1)</sub> instrument. ( <i>p-value</i> ) | 0.058                                   | 0.226              | 0.000                        | 0.000                        | 0.000                         | 0.039                        | 0.000                        | 0.000                        | 0.161                                   | 0.115              | 0.000                       | 0.000              | 0.161                        | 0.115              | 0.000                       | 0.000                      |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.



### 5.6.3. Fiscal decentralization and public service delivery: absorbing short term fluctuations

Instead of assuming annual variations in the evolution of fiscal decentralization and public expenditure efficiency, one can make the hypothesis that decentralization ratio changes slowly over time, and affects public expenditure efficiency with delay. Therefore, we compute the efficiency scores using four-year average. Consequently, all right-hand-side variables are time-averaged, including the fiscal decentralization variable, and introduced with one period lag. As an alternative robustness check, this specification allows us to rather focus on medium-term impact of fiscal decentralization, ignoring short term fluctuations. Estimates are detailed in table 5.10 below.

**Table 5.10: 2SLS estimates of the effect of FD on public expenditure efficiency: absorbing short-term fluctuations**

*Dependent variables: 4-year average of estimated efficiencies*

|                                     | Health              |                            |                    |                        | Education                |                    |                    |                            |                        |                              |                    |                    |
|-------------------------------------|---------------------|----------------------------|--------------------|------------------------|--------------------------|--------------------|--------------------|----------------------------|------------------------|------------------------------|--------------------|--------------------|
|                                     | All                 | Advanced                   | EME and DC         | Political interactions |                          | All                | Advanced           | EME and DC                 | Political interactions |                              |                    |                    |
|                                     | (1)                 | (2)                        | (3)                | (4)                    | (5)                      | (6)                | (7)                | (8)                        | (9)                    | (10)                         | (11)               | (12)               |
| FD <sub>(t-1)</sub>                 | -0.091<br>(-0.362)  | <b>0.294***</b><br>(3.091) | -0.759<br>(-1.514) | -0.350<br>(-1.198)     | -0.313<br>(-0.512)       | -1.637<br>(-1.506) | -0.001<br>(-0.001) | <b>0.482***</b><br>(3.636) | -0.460<br>(-0.642)     | -0.550<br>(-1.179)           | -3.718<br>(-1.139) | 0.18<br>(0.136)    |
| FD × Corruption <sub>(t-1)</sub>    |                     |                            |                    | -0.136<br>(-1.539)     |                          |                    |                    |                            |                        | <b>-0.343***</b><br>(-2.654) |                    |                    |
| FD × Parliamentary <sub>(t-1)</sub> |                     |                            |                    |                        | <b>1.977*</b><br>(1.689) |                    |                    |                            |                        |                              | 4.912<br>(1.148)   |                    |
| FD × Autonomy <sub>(t-1)</sub>      |                     |                            |                    |                        |                          | 1.455<br>(1.607)   |                    |                            |                        |                              |                    | 0.074<br>(0.068)   |
| Real GDP pc <sub>(t-1)</sub>        | 0.033***<br>(3.484) | 0.013<br>(0.698)           | 0.028<br>(1.400)   | 0.003<br>(0.109)       | -0.049<br>(-0.868)       | 0.020<br>(0.832)   | -0.012<br>(-0.414) | -0.124***<br>(-3.991)      | 0.007<br>(0.217)       | -0.047<br>(-1.187)           | -0.155<br>(-0.969) | -0.011<br>(-0.268) |
| Obs. (countries)                    | 221 (55)            | 63 (14)                    | 158 (41)           | 203 (51)               | 221 (55)                 | 221 (55)           | 199 (52)           | 61 (14)                    | 138 (38)               | 184 (48)                     | 199 (52)           | 199 (52)           |
| Fisher ( <i>p-value</i> )           | 0.002               | 0.002                      | 0.016              | 0.011                  | 0.231                    | 0.218              | 0.909              | 0.001                      | 0.815                  | 0.078                        | 0.83               | 0.996              |
| Hansen OID ( <i>p-value</i> )       | 0.012               | 0.219                      | 0.318              | 0.422                  | 0.674                    | 0.691              | 0.065              | 0.059                      | 0.045                  | 0.267                        | 0.899              | 0.087              |
| KP-under                            | 0.522               | 0.107                      | 0.698              | 0.361                  | 0.569                    | 0.717              | 0.507              | 0.134                      | 0.667                  | 0.255                        | 0.646              | 0.704              |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

Taking the four-year averages leaves us with 226 observations, but with the same number of countries as in the baseline specifications. Results displayed in table 5.10 support our baseline findings that fiscal decentralization affects significantly public expenditure efficiency, even if we consider medium term fluctuations. As shown in columns (2) and (8) decentralization increases the efficiency of public expenditure for advanced economies. The

estimates strengthen once again the negative effect of decentralization for emerging markets and developing economies, though not statistically significant. Estimates of the interaction between fiscal decentralization variable and political/institutional variables are displayed in columns (4)-(6) for health sector and (10)-(12) for education sector. The negative effect of corruption phenomenon holds even in the medium-term. Likewise the impact of a parliamentary system in guaranteeing positive outcomes of fiscal decentralization persists.

#### **5.6.4. Fiscal decentralization and public service delivery: additional political and institutional interactions**

We continue exploring the effect of political and institutional variables in the decentralization-efficiency nexus, including additional political/institutional interactions. It's worth mentioning that the positive effect formerly observed for parliamentary regime in mitigating the downside of fiscal decentralization is supported in table 5.11.

First, we notice that when the executive is assembly-elected, then decentralization has positive effect. On the contrary, when the regime is presidential, the effect of decentralization on public expenditure efficiency turns negative. These variables, taken as a whole, show that the political regime has a notable influence when it comes to implementing fiscal decentralization. Presidential regime, in giving more discretion to the executive may hamper fiscal decentralization. Presidential regime also gives room for executive to constraint sub-national government in defining and implementing local policies better tailored to local citizens' needs. As a comparison, assembly-elected regime and parliamentary regimes as well may be more binding in reducing the discretion of the executive, and making them more willing to share public expenditure with the sub-national levels, to guarantee efficiency in public service delivery.

In addition, table 5.11 shows that the control of relevant houses by the executive can be beneficial while implementing fiscal decentralization. Having this control confers the executive the necessary room to cope with the risks sometimes associated with fiscal decentralization, strengthening the control and increasing accountability. In this line, checks and balances system, should be strengthened, as shown in column (6), to mitigate the negative effect of decentralization. Although the statistical significance matters, table

5.11 also shows that political stability affects positively the way that decentralization impacts public expenditure efficiency. As a consequence, authorities should act in lowering the likelihood to be destabilized or overthrown by unconstitutional means.

**Table 5.11: 2SLS estimates of the effect of FD on public expenditure efficiency: additional political/institutional interactions**

|  | <u>Health</u>              |                              |                              |                    |                              |                    | <u>Education</u>   |                              |                       |                    |                    |                    |
|--|----------------------------|------------------------------|------------------------------|--------------------|------------------------------|--------------------|--------------------|------------------------------|-----------------------|--------------------|--------------------|--------------------|
|  | (1)                        | (2)                          | (3)                          | (4)                | (5)                          | (6)                | (7)                | (8)                          | (9)                   | (10)               | (11)               | (12)               |
| FD <sub>(t-1)</sub>                                    | <b>-0.486*</b><br>(-1.838) | <b>0.953***</b><br>(3.609)   | <b>-0.597***</b><br>(-3.131) | -1.408<br>(-1.513) | <b>-0.480***</b><br>(-2.741) | -0.022<br>(-0.061) | -0.001<br>(-0.003) | <b>0.786**</b><br>(2.143)    | -0.409<br>(-1.382)    | -0.811<br>(-1.310) | 0.565<br>(1.519)   | -0.014<br>(-0.008) |
| FD × Assembly elec. <sub>(t-1)</sub>                   |                            | <b>3.672***</b><br>(3.093)   |                              |                    |                              |                    | 5.499<br>(0.525)   |                              |                       |                    |                    |                    |
| FD × Presidential <sub>(t-1)</sub>                     |                            | <b>-1.737***</b><br>(-4.999) |                              |                    |                              |                    |                    | <b>-1.410***</b><br>(-2.583) |                       |                    |                    |                    |
| FD × All house <sub>(t-1)</sub>                        |                            |                              | <b>0.541***</b><br>(3.846)   |                    |                              |                    |                    |                              | 0.13<br>(1.452)       |                    |                    |                    |
| FD × Bureaucracy <sub>(t-1)</sub>                      |                            |                              |                              | 0.379<br>(0.953)   |                              |                    |                    |                              |                       | 0.16<br>(0.644)    |                    |                    |
| FD × Political stab. <sub>(t-1)</sub>                  |                            |                              |                              |                    | 0.102<br>(0.781)             |                    |                    |                              |                       |                    | 0.459<br>(1.394)   |                    |
| FD × Checks and balances <sub>(t-1)</sub>              |                            |                              |                              |                    |                              | 0.141<br>(0.924)   |                    |                              |                       |                    |                    | -1.032<br>(-1.216) |
| Real GDP pc <sub>(t-1)</sub>                           | 0.054***<br>(5.817)        | 0.002<br>(0.169)             | 0.004<br>(0.394)             | -0.008<br>(-0.282) | 0.006<br>(0.412)             | 0.010<br>(0.540)   | 0.023<br>(0.786)   | -0.034**<br>(-2.319)         | -0.027***<br>(-2.715) | -0.032<br>(-1.541) | -0.022<br>(-1.065) | 0.080<br>(0.910)   |
| Additional controls                                    | <i>Yes</i>                 | <i>Yes</i>                   | <i>Yes</i>                   | <i>Yes</i>         | <i>Yes</i>                   | <i>Yes</i>         | <i>Yes</i>         | <i>Yes</i>                   | <i>Yes</i>            | <i>Yes</i>         | <i>Yes</i>         | <i>Yes</i>         |
| Obs. (countries)                                       | 875 (55)                   | 875 (55)                     | 844 (54)                     | 807 (51)           | 602 (55)                     | 868 (55)           | 690 (53)           | 690 (53)                     | 664 (51)              | 639 (49)           | 482 (51)           | 684 (53)           |
| Fisher ( <i>p-value</i> )                              | 0.00                       | 0.00                         | 0.00                         | 0.00               | 0.00                         | 0.60               | 0.53               | 0.02                         | 0.00                  | 0.07               | 0.04               | 0.81               |
| Hansen OID ( <i>p-value</i> )                          | 0.01                       | 0.63                         | 0.00                         | 0.00               | 0.00                         | 0.01               | 0.60               | 0.01                         | 0.00                  | 0.00               | 0.09               | 0.48               |
| KP-under   | 0.01                       | 0.00                         | 0.00                         | 0.13               | 0.02                         | 0.43               | 0.87               | 0.11                         | 0.06                  | 0.26               | 0.01               | 0.86               |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.00                       | 0.00                         | 0.00                         | 0.00               | 0.00                         | 0.00               | 0.30               | 0.02                         | 0.03                  | 0.06               | 0.04               | 0.07               |
| FD × I <sub>(t-1)</sub> instrument. ( <i>p-value</i> ) | 0.04                       | 0.00                         | 0.00                         | 0.00               | 0.14                         | 0.622              | 0.26               | 0.23                         | 0.00                  | 0.38               | 0.06               | 0.94               |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

### 5.6.5. Fiscal decentralization and public service delivery: the revenue side

We take the sensitivity check a step further and build a decentralization index using the revenue instead of the expenditure. The interest variable used here is then the share of sub-national government revenue over the general government revenue. As in the baseline model, we test the extent to which fiscal decentralization affects the efficiency of public expenditure. Results of table 5.12 show robust positive impact of decentralization, even if we consider the revenue side (columns 1 and 6). However, one can notice that revenue decentralization seems more beneficial, compared to expenditure decentralization. Jiménez-Rubio (2011) finds earlier that decentralization can impact positively the infant mortality only if a substantial degree of autonomy in the sources of revenue is devolved to local governments. Regarding the health sector, it can be shown that, on average, one standard deviation increase in the revenue decentralization leads to 15.5% improve in public expenditure efficiency, relative to the mean (82.2%). This efficiency improvement is greater in absolute term in advanced economies, compared to emerging markets and developing economies. These results are in line with Kavosi *et al.* (2013) whom indicated that decentralization in provincial revenue had a positive impact on under-five mortality rate.

When considering the education sector, we observe a 34.9% improvement in public expenditure efficiency, following a standard deviation increase in the share of sub-national government revenue. Turning to political interactions, estimates of table 5.12 support that political and institutional environment has a say in this story. It appears that corruption phenomenon influences negatively the relationship between decentralization and the efficiency of public expenditure, while sub-national government's autonomy mitigates the downside of decentralization. Additionally, table 5.15 shows that the health sector seems more sensitive to the political and institutional environment. Statistical significance vanishes when considering education sector.

**Table 5.12: 2SLS estimates of the effect of FD on public expenditure efficiency: the revenue side***Dependent variable: estimated efficiencies*

|  | <u>Health</u>   |                 |                 |                        |                 | <u>Education</u> |           |               |                        |          |
|--|-----------------|-----------------|-----------------|------------------------|-----------------|------------------|-----------|---------------|------------------------|----------|
|  | All             | Advanced        | EME and DC      | Political interactions |                 | All              | Advanced  | EME and DC    | Political interactions |          |
|  | (1)             | (2)             | (3)             | (4)                    | (5)             | (6)              | (7)       | (8)           | (9)                    | (10)     |
| FD Revenue <sub>(t-1)</sub>                            | <b>0.568***</b> | <b>0.670***</b> | <b>0.445***</b> | -1.948                 | <b>-1.364*</b>  | <b>1.275**</b>   | 0.094     | <b>1.292*</b> | 2.000                  | 5.087    |
|  | (4.334)         | (8.023)         | (3.252)         | (-0.904)               | (-1.828)        | (2.524)          | (0.680)   | (1.803)       | (0.730)                | (0.815)  |
| FDR × Corruption <sub>(t-1)</sub>                      |                 |                 |                 | -1.245                 |                 |                  |           |               | 0.184                  |          |
|  |                 |                 |                 | (-1.333)               |                 |                  |           |               | (0.219)                |          |
| FDR × Autonomy <sub>(t-1)</sub>                        |                 |                 |                 |                        | <b>3.681***</b> |                  |           |               |                        | -5.777   |
|  |                 |                 |                 |                        | (2.953)         |                  |           |               |                        | (-0.598) |
| Real GDP pc <sub>(t-1)</sub>                           | 0.048***        | 0.041***        | 0.046***        | -0.146                 | -0.013          | 0.038            | -0.082*** | 0.065**       | 0.072                  | 0.147    |
|  | (5.778)         | (3.057)         | (5.070)         | (-1.102)               | (-0.585)        | (1.640)          | (-5.654)  | (2.029)       | (0.310)                | (0.762)  |
| Obs. (countries)                                       | 904 (55)        | 269 (14)        | 635 (41)        | 808 (51)               | 872 (55)        | 714 (53)         | 213 (14)  | 501 (39)      | 637 (49)               | 687 (53) |
| Fisher ( <i>p-value</i> )                              | 0.000           | 0.000           | 0.000           | 0.403                  | 0.000           | 0.042            | 0.000     | 0.102         | 0.231                  | 0.799    |
| Hansen OID ( <i>p-value</i> )                          | 0.000           | 0.040           | 0.000           | 0.781                  | 0.024           | 0.033            | 0.000     | 0.009         | 0.231                  | 0.857    |
| KP-under   | 0.000           | 0.000           | 0.000           | 0.786                  | 0.285           | 0.011            | 0.004     | 0.037         | 0.925                  | 0.826    |
| FD <sub>(t-1)</sub> instrumentation ( <i>p-value</i> ) | 0.000           | 0.000           | 0.000           | 0.000                  | 0.000           | 0.012            | 0.000     | 0.035         | 0.020                  | 0.002    |
| FD × I <sub>(t-1)</sub> instrument. ( <i>p-value</i> ) |                 |                 |                 | 0.057                  | 0.000           |                  |           |               | 0.155                  | 0.000    |

Note. Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. Same as in Table 5.4.

## 5.7. Conclusion

The question we raised so far is whether the drive towards fiscal decentralization leads to an improvement in public expenditure efficiency, considering the health and education sectors. One argument, among others, in favor of fiscal decentralization is that central government becomes more responsive by re-directing public priorities to areas of greatest needs. Besides, devolving more responsibilities to local authorities make the public service delivery more efficient, since local authorities can better target local citizens' needs. We conduct our analysis in a panel of advanced and developing economies over the two last decades. Using appropriate econometric techniques, we develop a two-stage approach, measuring first the efficiency of public expenditure. Then, we investigate the effect of decentralization on the estimated efficiency scores, with decentralization measured as the share of sub-national government expenditure over general government expenditure. This chapter concludes that expenditure decentralization influences significantly the efficiency of public expenditure, depending on the level of development. First, we estimate a 35.7% decentralization threshold above which decentralization improves public expenditure efficiency. Below that threshold, decentralization becomes unprofitable, and may affect negatively the efficiency. Second our results highlight the importance of political and institutional aspects for countries aiming at implementing decentralization reform. While corruption phenomenon may considerably

hamper the process, advanced degree of democracy, as well as greater autonomy for sub-national governments are key aspects in favor of successful decentralization.

Building on these evidences, two main policy implications can be drawn. On the one hand, decentralization process should be conducted in due time, especially when central government has the necessary room to share at least one third of the expenditure to the sub-national level. On the other hand, political and institutional environment should be taken as key features when it comes to shift towards decentralization. Authorities should act in reducing corruption, while at the same time democracy should be strengthened to guarantee positive outcomes from the decentralization process. Likewise, greater autonomy in the choice of local priority needs should be transferred to the local governments while implementing decentralization.

## Appendices E

## Appendix E.1: countries, data coverage and sources

| Countries                | coverage  | sources       | Countries                  | coverage  | Sources       |
|--------------------------|-----------|---------------|----------------------------|-----------|---------------|
| Argentina                | 1993-2004 | GFS, WEO      | Korea                      | 2000-2012 | OECD database |
| Australia <sup>R,E</sup> | 1990-2011 | OECD database | Latvia                     | 1995-2012 | Eurostat      |
| Austria                  | 1990-2012 | Eurostat      | Lesotho                    | 1990-2008 | GFS, WEO      |
| Bahrain <sup>T</sup>     | 1990-2004 | GFS, WEO      | Lithuania                  | 1995-2012 | Eurostat      |
| Belarus                  | 2001-2010 | GFS, WEO      | Luxembourg                 | 1990-2012 | Eurostat      |
| Belgium                  | 1990-2012 | Eurostat      | Maldives                   | 1990-2011 | GFS, WEO      |
| Bhutan                   | 1990-2009 | GFS, WEO      | Malta                      | 1995-2012 | Eurostat      |
| Bolivia                  | 1990-2007 | GFS, WEO      | Mauritius                  | 2000-2011 | GFS, WEO      |
| Brazil                   | 1997-2012 | GFS, WEO      | Mexico                     | 1990-2012 | GFS, WEO      |
| Bulgaria                 | 1995-2012 | Eurostat      | Mongolia                   | 1992-2012 | GFS, WEO      |
| Canada                   | 1990-2010 | OECD database | Netherlands                | 1990-2012 | Eurostat      |
| Chile                    | 1990-2012 | GFS, WEO      | New Zealand <sup>R,E</sup> | 1990-2012 | OECD database |
| Croatia                  | 2002-2012 | Eurostat      | Norway                     | 1990-2012 | Eurostat      |
| Cyprus                   | 1995-2012 | Eurostat      | Pakistan                   | 1990-2007 | GFS, WEO      |
| Czech Republic           | 1995-2012 | Eurostat      | Peru                       | 1995-2012 | GFS, WEO      |
| Denmark                  | 1990-2012 | Eurostat      | Poland                     | 1995-2012 | Eurostat      |
| Egypt                    | 2002-2012 | GFS, WEO      | Portugal                   | 1990-2012 | Eurostat      |
| Estonia                  | 1995-2012 | Eurostat      | Romania                    | 1995-2012 | Eurostat      |
| Finland                  | 1990-2012 | Eurostat      | Seychelles                 | 1993-2012 | GFS, WEO      |
| France                   | 1990-2012 | Eurostat      | Singapore                  | 1990-2012 | GFS, WEO      |
| Georgia                  | 1997-2012 | GFS, WEO      | Slovak Republic            | 1995-2012 | Eurostat      |
| Germany                  | 1990-2012 | Eurostat      | Slovenia                   | 1995-2012 | Eurostat      |
| Greece                   | 1995-2012 | Eurostat      | South Africa               | 1990-2012 | GFS, WEO      |
| Hungary                  | 1995-2012 | Eurostat      | Spain                      | 1995-2012 | Eurostat      |
| Iceland                  | 1995-2012 | Eurostat      | Sweden                     | 1993-2012 | Eurostat      |
| India                    | 1990-2012 | GFS, WEO      | Switzerland                | 1990-2012 | Eurostat      |
| Indonesia                | 1990-2004 | GFS, WEO      | Tunisia                    | 1990-2012 | GFS, WEO      |
| Iran                     | 1990-2009 | GFS, WEO      | Turkey <sup>R,E</sup>      | 1990-2012 | OECD database |
| Ireland                  | 1990-2012 | Eurostat      | United Kingdom             | 1990-2012 | Eurostat      |
| Israel                   | 1995-2012 | OECD database | United States              | 1990-2012 | OECD database |
| Italy                    | 1990-2012 | Eurostat      | Uruguay                    | 1999-2012 | GFS, WEO      |
| Japan <sup>R,E</sup>     | 1990-2012 | OECD database | Venezuela                  | 1990-2005 | GFS, WEO      |

**R,E** indicate that country has no disaggregated data on revenue, expenditure or taxes respectively.



**Appendix E.2: variables definition and data sources**

|                              | Description  | Sources                             |
|------------------------------|--|-------------------------------------|
| <b>Variables</b>             |  |                                     |
| expenditure decentralization | Fiscal decentralization - Expenditure side   | Eurostat, GFS,                      |
| revenue decentralization     | Fiscal decentralization - Revenue side   | OECD and WEO                        |
| IMR                          | Mortality rate, infant (per 1,000 live births)   |                                     |
| UMR                          | Mortality rate, under-5 (per 1,000 live births)  |                                     |
| Primary education            | Primary education, duration (years)  |                                     |
| Secondary education          | Secondary education, duration (years)  | World Bank,                         |
| Average year of schooling    | Average year of primary and secondary schooling  | World                               |
| Total population             | Measures the size of the population  | Development                         |
| Density                      | Population density (people per sq. km of land area)  | Indicators 2014                     |
| Real GDP pc                  | GDP per capita, PPP (constant 2011 international)  |                                     |
| Natural resources (% GDP)    | Natural resource rents   |                                     |
| Health exp.                  | Health expenditure, public (% of GDP)  | OECD and                            |
| primary enrolment            | Gross enrolment ratio, primary, both sexes (%)   | UNESCO                              |
| secondary enrolment          | Gross enrolment ratio, secondary, both sexes (%)   | databases                           |
| Education exp.               | Government expenditure on education as % of GDP (%)  |                                     |
| Political stability          | Political stability measures the likelihood that the government will be destabilized by unconstitutional or violent means. | The WGI, 2013 Update                |
| Government fractionalization | Probability that two deputies randomly picked from the government parties will be of different parties.                    |                                     |
| Fractionalization            | The probability that two deputies picked from the legislature will be of different parties.                                | DPI2012                             |
| Parliamentary                | Dummy variable that takes value 1 if the political system is parliamentary   | Database of Political Institutions: |
| Democracy                    | Variable recording the strength of the democracy   |                                     |
| Autonomy                     | Dummy variable taking value 1 with the existence of autonomous region  |                                     |
| Corruption                   | Assessment of corruption within the political system.  | ICRG database                       |

Expenditure and Revenue decentralization for European and OECD countries are taken respectively from Eurostat and OECD databases. For emerging and developing, we report data from GFS and WEO. IMR (UMR) is infant (under-five) mortality rate.

**Appendix E.3: Detailed descriptive statistics**

| Variables                       | Obs. | Mean   | Advanced | EME and DC | Std. Dev. | Minimum | Maximum |
|---------------------------------|------|--------|----------|------------|-----------|---------|---------|
| FD expenditure (%)              | 1086 | 29.55  | 38.97    | 25.42      | 21.31     | 0.00    | 98.44   |
| FD revenue (%)                  | 1129 | 27.37  | 36.81    | 23.45      | 19.81     | 0.00    | 73.60   |
| Infant mortality rate           | 1472 | 17.34  | 5.34     | 22.41      | 20.06     | 1.70    | 105.90  |
| Under-five mortality rate       | 1472 | 21.97  | 6.45     | 28.53      | 27.24     | 2.20    | 138.40  |
| Secondary education (years)     | 1472 | 6.49   | 5.77     | 5.50       | 0.99      | 4.00    | 9.00    |
| Primary education (years)       | 1471 | 5.58   | 6.64     | 6.43       | 0.96      | 3.00    | 8.00    |
| Average year of schooling       | 1472 | 6.04   | 6.21     | 5.97       | 0.35      | 5.00    | 8.00    |
| Population size (in millions)   | 1472 | 48.64  | 43.31    | 50.89      | 138.70    | 0.07    | 1236.70 |
| Density                         | 1452 | 252.43 | 446.68   | 168.79     | 777.31    | 1.41    | 7589.14 |
| Real GDP pc (in thousands)      | 1467 | 22.65  | 34.67    | 17.55      | 15.74     | 1.31    | 97.41   |
| Natural res. rents (% GDP)      | 1467 | 4.54   | 1.88     | 5.67       | 8.08      | 0.00    | 63.98   |
| Health exp. (% of GDP)          | 1357 | 4.72   | 6.19     | 4.06       | 2.07      | 0.27    | 9.93    |
| Primary enrolment rate (%)      | 1330 | 102.67 | 101.44   | 103.19     | 8.39      | 50.72   | 147.51  |
| Secondary enrolment rate (%)    | 1271 | 92.70  | 104.93   | 87.23      | 21.45     | 21.19   | 160.62  |
| Education exp. (% of GDP)       | 1168 | 4.97   | 5.49     | 4.77       | 1.90      | 1.00    | 21.06   |
| Political stability             | 896  | 0.38   | 0.80     | 0.21       | 0.85      | -2.81   | 1.67    |
| Government fractionalization    | 1381 | 0.29   | 0.29     | 0.29       | 0.29      | 0.00    | 1.00    |
| Fractionalization               | 1361 | 0.65   | 0.65     | 0.64       | 0.20      | 0.00    | 1.00    |
| Parliamentary                   | 1433 | 0.57   | 0.87     | 0.44       | 0.49      | 0.00    | 1.00    |
| Democracy                       | 1425 | 30.06  | 51.01    | 20.88      | 26.39     | 1.00    | 82.00   |
| Autonomy                        | 1427 | 0.20   | 0.26     | 0.17       | 0.40      | 0.00    | 1.00    |
| Corruption                      | 1280 | -2.72  | -3.52    | -2.32      | 1.31      | -5.00   | 0.67    |
| Vertical fiscal imbalance (VFI) | 953  | 1.43   | 1.16     | 1.57       | 3.03      | 0.00    | 64.76   |

VFI is the ratio between expenditure decentralization and revenue decentralization.

**Appendix E.4: Stochastic frontier estimates**

| <i>Dependent variables:</i>        | <u>Infant mort. rate</u> |                      | <u>Enrolment rate</u> |                      |
|------------------------------------|--------------------------|----------------------|-----------------------|----------------------|
|                                    | (1)                      | (2)                  | (3)                   | (4)                  |
| PE <sub>(t-1)</sub>                | -0.308***<br>(-3.24)     | -0.403***<br>(-3.76) | 0.013<br>(0.20)       | 0.056<br>(1.60)      |
| Real GDP pc <sub>(t-1)</sub>       | -0.906***<br>(-14.89)    | -0.625***<br>(-4.11) | 0.214***<br>(6.28)    | 0.124***<br>(5.70)   |
| Pop. size <sub>(t-1)</sub>         | 0.034<br>(1.34)          | 0.055*<br>(1.90)     | -0.015<br>(-1.64)     | -0.016*<br>(-1.87)   |
| Density <sub>(t-1)</sub>           | -0.05**<br>(-2.07)       | -0.046**<br>(-2.04)  | -0.023*<br>(-1.84)    | -0.015<br>(-1.49)    |
| Average schooling <sub>(t-1)</sub> | 0.105<br>(0.15)          | 0.189<br>(0.28)      |                       |                      |
| Constant                           | 11.02***<br>(8.30)       | 10.23***<br>(6.65)   | 2.765***<br>(10.12)   | 3.554***<br>(22.98)  |
| M                                  | -38.71***<br>(-18.35)    | -30.78***<br>(-5.52) | -42.88***<br>(-13.19) | -0.382<br>(-0.39)    |
| U-sigma                            |                          | 0.822***<br>(32.86)  |                       | -0.927***<br>(-5.68) |
| V-sigma                            |                          | -0.199<br>(-0.87)    |                       | 1.421**<br>(2.02)    |
| Constant                           | -2.364***<br>(-11.60)    | -0.482<br>(-0.21)    | -4.881***<br>(-20.30) | -19.26***<br>(-2.75) |
| Observations (countries)           | 1278 (74)                | 1078 (74)            | 1008 (62)             | 1008 (62)            |
| Wald ( <i>p-value</i> )            | 0.00                     | 0.00                 | 0.00                  | 0.00                 |
| Log Likelihood                     | -545.38                  | -313.81              | 473.78                | 527.40               |
| $\sigma_\mu$                       | 2.91                     |                      | 2.47                  |                      |
| $\sigma_v$                         | 0.31                     |                      | 0.09                  |                      |

Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust standard errors given in brackets. Maximum likelihood estimations are performed, assuming a truncated normal distribution. Based on these estimates, the efficiencies are predicted using the Battese and Coelli (1988) and Jondrow *et al.* (1982) approaches.

## Appendix E.5: First-step regressions

*Dependent variable: fiscal decentralization*

|                                      | <u>Expenditure</u>   |                     |                      | <u>Revenue</u>       |                     |                      |
|--------------------------------------|----------------------|---------------------|----------------------|----------------------|---------------------|----------------------|
|                                      | (1)                  | (2)                 | (3)                  | (4)                  | (5)                 | (6)                  |
| Real GDP pc <sub>(t-1)</sub>         | -0.017<br>(-1.32)    | 0.035**<br>(2.16)   | -0.029*<br>(-1.95)   | -0.035***<br>(-3.19) | -0.016<br>(-0.92)   | -0.043***<br>(-3.22) |
| NR rents <sub>(t-1)</sub>            | -0.010***<br>(-3.53) | -0.002<br>(-0.96)   | -0.025***<br>(-4.95) | -0.005**<br>(-2.59)  | -0.002<br>(-1.18)   | -0.010**<br>(-2.58)  |
| Government fract. <sub>(t-1)</sub>   | -0.033***<br>(-2.66) | -0.054***<br>(-3.5) | -0.035**<br>(-2.37)  | -0.019*<br>(-1.84)   | -0.026<br>(-1.54)   | -0.013<br>(-1.04)    |
| Fractionalization <sub>(t-1)</sub>   | -0.023<br>(-0.51)    | -0.180**<br>(-2.5)  | 0.010<br>(0.23)      | -0.001<br>(-0.05)    | -0.172**<br>(-2.74) | 0.014<br>(0.62)      |
| Population <sub>(t-1)</sub>          | 0.026<br>(0.61)      | 0.179***<br>(3.6)   | -0.029<br>(-0.55)    | 0.108**<br>(2.76)    | 0.153**<br>(2.89)   | 0.105**<br>(2.24)    |
| Observations                         | 875                  | 269                 | 606                  | 714                  | 213                 | 501                  |
| Countries                            | 55                   | 14                  | 41                   | 55                   | 14                  | 41                   |
| Join significance test               | 5.66                 | 11.04               | 5.35                 | 4.04                 | 5.11                | 3.01                 |
| F ( <i>p</i> -value)                 | 0.00                 | 0.00                | 0.00                 | 0.00                 | 0.00                | 0.01                 |
| R-squared                            | 0.03                 | 0.24                | 0.06                 | 0.05                 | 0.15                | 0.05                 |
| F- test for excluded inst. (p-value) | 0.00                 | 0.00                | 0.00                 | 0.01                 | 0.00                | 0.03                 |
| KP under-identification (p-value)    | 0.00                 | 0.00                | 0.00                 | 0.01                 | 0.00                | 0.04                 |

*Note.* Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. NR stands for natural resources. The GMM specification has been used in all specifications. Fixed effects are taken into consideration to control for all time-invariant characteristics and exploit within country variations. The endogenous variable is the fiscal decentralization ratio and the instrumental variables are: the size of the country measured by the total population, natural resource rents, and two measures of fractionalization. The instrumental variables are significantly correlated with the endogenous regressor in almost all cases (the *p*-values associated with the F-test for excluded instruments are < 0.05). Additionally, using the Kleibergen-Paap's (KP) *p* values, we reject, at 5% level, the null hypothesis that equations are under-identified. The instrumental variables used are relevant i.e. correlated with the endogenous regressor.

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## **CHAPTER 6:**

# **Fiscal Decentralization and Fiscal Policy Performance**

### **Abstract**

This chapter explores the cyclical reaction of fiscal policy and the response of structural fiscal balance to fiscal decentralization and vertical fiscal imbalance. Using a sample of advanced and developing economies, with appropriate panel estimators, we find that fiscal decentralization reduces the counter-cyclicality of fiscal policy. This destabilizing effect is country-specific and depends on the position of the economy vis-à-vis the business cycle. Second, we find that promoting decentralization strengthens general government's structural fiscal position, conditional to the level of economic development. Finally, this chapter shows that vertical imbalance, which is measured through the gap between expenditure assignments and revenue capacities, hurts the structural fiscal position, although the statistical evidence is weaker, compared to the impact of decentralization.

**Keywords:** Fiscal decentralization, structural fiscal balance, vertical fiscal imbalance, instrumental variable estimations.

## 6.1. Introduction

The recent decades have witnessed a wide spread of fiscal decentralization reform.<sup>96</sup> Decentralization, understood as the process of assigning expenditure and/or shifting revenue collection responsibilities to local governments is expected to improve public financial management. Following the onset of the financial crisis, with the concern of public debt sustainability back to the foreground, fiscal decentralization issue is increasingly gaining prominence.

The proponents push forth the idea, assuming that fiscal decentralization may help strengthening the general government's fiscal position. The backdrop of such a hypothesis is that decentralization provides efficiency gains in public service delivery. With their relative closeness, sub-national governments are better suited to provide cost-effective public service that match local preferences. In addition, fiscal decentralization may enhance tax collection performance, thanks to increasing (local) tax bargaining power. Combining the foreseen positive outcomes from the expenditure and revenue sides, decentralization is expected to strengthen the general government structural fiscal position. On the contrary, the critics argue that the expected benefits of fiscal decentralization may be hypothetical if the economies of scale of providing public goods and services are large. Competences of local administrations might also be worth considering, when it comes to shifting tax collection responsibilities to sub-national levels.<sup>97</sup>

This chapter contributes to the growing literature on fiscal decentralization in three aspects. First, we analyze the impacts of fiscal decentralization on the cyclical reaction of fiscal policy and emphasize the stabilizing property of fiscal decentralization. Next, this chapter brings empirical light to the relationship between decentralization and the government fiscal stance, ascertaining thus the disciplinary effect of decentralization. Furthermore, we explore the extent to which vertical fiscal imbalances affect the structural fiscal balance.

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<sup>96</sup> Kenya, Mali, Moldova, Romania, Rwanda and South Africa, among others stepped towards higher level of decentralization over the last two decades.

<sup>97</sup> Subnational levels or governments include state, local or regional governments.



We perform an econometric analysis on a panel of advanced and developing countries, including emerging market economies, over the last two decades. This chapter takes stock of existing empirical developments and proceeds with different approaches. Regarding the stabilizing effect, we adopt a two step methodology. First, we assess the cyclical reaction of fiscal policy using the Aghion and Marinescu (2007) technique. Then, we analyze the extent to which fiscal decentralization affects the pro- or counter-cyclicality of fiscal policy. Fiscal decentralization is considered to have destabilizing effect, when it significantly reduces the counter-cyclicality of fiscal policy. Our second concern, the disciplinary effect, is investigated via two channels. In the first channel, fiscal decentralization variable is considered as the main interest variable, while the second channel focuses rather on the impact of vertical fiscal imbalances on the structural fiscal balance. Vertical fiscal imbalances in this context reflect the level of transfer dependency, which arises when the ratio of expenditure decentralization is higher than the revenue capacity of local governments. We resort upon the two-stage least squares techniques to estimate the stabilizing and the disciplinary effects. The suitability of this method is justified in the sense that it allows mitigating the reverse causality problem, and obtaining bias-corrected estimates of the impact of fiscal decentralization and vertical fiscal imbalances, respectively on the cyclicality of fiscal policy and the structural fiscal balance. Three main findings emerge from this chapter.

After confirming the counter-cyclicality of fiscal policy, we find clear evidence that fiscal decentralization significantly reduces the counter-cyclicality of fiscal policy. In other words, fiscal decentralization reduces the scope for central government to implement counter-cyclical fiscal measures. In addition, we notice that the destabilizing effect is more pronounced in advanced economies, than in emerging market and developing economies. Besides, the effect operates only in time of recession. There is no evidence of destabilizing effect in time of expansion. We then argue that the destabilizing effect is country-specific, and depends on the position of the economy vis-à-vis the business cycle.

Second, our results unveil a strong relationship between fiscal decentralization and the structural fiscal balance. The causality runs from decentralization to the structural balance, meaning that promoting fiscal decentralization strengthens the structural fiscal position of the

general government. It's worth noting that this disciplinary effect also depends on the level of economic development.

Third, this chapter provides evidences that vertical fiscal imbalances, generated by the gap between expenditure assignments and revenue capacities, and bridged through the transfers from the central to the local levels hurt the structural fiscal position.

The rest of the chapter is structured as follow. Section 2 discusses briefly the literature, while section 3 details the data used throughout. The following section 4 develops a model testing the relationship between fiscal decentralization, vertical fiscal imbalances and the structural balance. Estimation results of the disciplinary effect are discussed thereafter. Section 5 further presents the econometric method and discusses the results relative to the stabilizing effect. Sensitivity analysis is conducted in section 6. Section 7 ends up with the concluding remarks and policy discussion.

## **6.2. Literature and theoretical background**

The effects of fiscal decentralization on the performance of fiscal policy have not reached consensus yet. The advocates push forth the merits of decentralization and support the arguments that, fiscal decentralization, by guarantying productive efficiency strengthens governments' fiscal instance. In addition, fiscal decentralization can foster competition among jurisdictions to limit tax burden by widening their tax base. Moreover, fiscal decentralization may force local governments to improve efficiency of (fiscal) management (Tiebout, 1956).

The critics, on the other hand, highlight the downsides such as the common pool problem, arising with fiscal decentralization. In some cases, local policymakers fail to fully internalize the cost of local spending when they can finance their marginal expenditure with central transfers or revenue that are funded by taxpayers in other jurisdictions. In such cases, the marginal costs of additional spending would exceed the marginal benefits. This behavior leads to overspending, relaxation of tax collection, and deficit bias (Oates, 2006). An additional concern is that the central government may not be able to enforce consistent hard budget constraints on sub-national governments over time (Afonso and Hauptmeier, 2009).

Moral hazard problem induces soft budget constraint in the sense that, sub-national governments expect the bailing-out of the central authorities when the local deficit becomes unsustainable (Rodden *et al.* 2003).

Another important consequence of fiscal decentralization is that macroeconomic stabilization can be significantly jeopardized. In fact, the conduct of counter-cyclical policy could be undermined if a large share of taxes and spending is shifted towards sub-national governments as the central government would not have sufficient policy lever. Even with similar amount of resources, decentralization can impede central governments from changing the composition of revenue and expenditure to address shocks. Besides, policy priorities across government levels often differ (Ter-Minassian, 1997; Tanzi, 1995).

Existing literature also argues that fiscal policy in sub-national levels tends to be pro-cyclical, due to dissimilar incentive structure (Rodden and Wibbles, 2009). Competition among local governments does not allow savings during good times or raise taxes in recession (Norregaard, 1997). Besides, local governments have limited information and incentives to address general governments' economic cycle; their primary concerns are the delivery of local—instead of general—public service, and their short-term—instead of long-term—budget.

It's worth noting that the benefits of fiscal decentralization come with risks. Decentralization can be significantly damaging in case of high dependency on transfers from central government. Transfer dependency, particularly without debt limits, worsens overall fiscal balance (Rodden 2002). Transfers may also become a vicious cycle, with higher transfer dependency leading to larger local governments' deficits and requiring larger transfers (De Mello, 2007). Last but not least, local authorities may lack the capacity to effectively manage the budget and provide public services (IMF, 2009). Fiscal decentralization can lead to misuse of public funds (Prud'homme, 1995).

### **6.3. Data**

Our sample covers 64 countries, over the last two decades, up to 2012. We differentiate between advanced and developing countries, following the IMF's world economic outlook

(WEO) income-based classification. The emerging markets economies are grouped with developing countries. We collect data from the IMF's Government Finance Statistics and the WEO, the World Bank's World Development Indicators, Eurostat and OCED databases, among others. Full sample and variable definition are detailed in appendices F.1 and F.2.

In this chapter, we consider two dependent variables alternatively. On the one hand, the stabilizing effect of decentralization is apprehended, using the cyclical response of fiscal policy as dependent variable. On the other hand, to explore the disciplinary effect of fiscal variable, we rather utilize the structural fiscal balance as left-hand-side variable.

Our main focus here, among the right-hand-side variables, is the fiscal decentralization variable, computed as the share of sub-national fiscal variables (expenditure, revenue) over the general government fiscal variables as in Davoodi and Zoo (1998), Davoodi *et al.* (1999), Thornton (2007), Ahmad *et al.* (2008), Dziobek *et al.* (2011), and Escolano *et al.* (2012). Our baseline estimates are performed using the expenditure side of fiscal decentralization. In other words we calculate the share of sub-national expenditure over general government expenditure.<sup>98</sup> Besides the fiscal decentralization variable, we also compute a measure of vertical imbalance as the ratio of expenditure decentralization over revenue decentralization. The idea is to see how insufficient level of decentralization and asymmetries in the decentralization process affect the structural balance.

While estimating the stabilizing and the disciplinary effects, we control for the GDP growth rate and the public debt as percentage of GDP. Omitting these two critical variables, which affect the size, but also the dynamic of the structural fiscal balance would lead to a severe upward bias. We also isolate the effects of other macroeconomic and external variables (current account balance, trade openness, both measured in percent of GDP, and the inflation rate) that could affect the structural balance, and the cyclicity of fiscal policy. In addition,

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<sup>98</sup> Due to the difficulties in obtaining data from local and regional governments, our fiscal decentralization index is obtained as the inverse of the ratio of central government share of expenditure over the total general government expenditure –which measures *fiscal centralization*-. We are aware of the fact that decentralization may not be considered as the perfect inverse of centralization, however, our figures describe to the best possible the actual level of fiscal decentralization. The effect of the revenue side of fiscal decentralization is further investigated in terms of robustness.

political and institutional aspects are taken into account. We especially focus on the level of corruption and the strength of the democracy. Detailed descriptive statistics are presented in appendix F.3. The next section details the dependent and control variables, presents the empirical models and discusses the estimation strategies.

#### 6.4. Fiscal decentralization and the structural fiscal balance: Is there a disciplinary effect?

We raise two different questions to test the disciplinary effect. First, we measure the impact of decentralization on the structural fiscal balance. Second, we explore the effect of transfer dependency through the vertical fiscal imbalances.

##### 6.4.1. Empirical models and estimation method

The following equations are specified to measure the effect of fiscal decentralization (equation 6.1) and vertical fiscal imbalance (equation 6.2) on the structural fiscal balance:

$$SFB_{it} = \alpha + \delta fd_{it-1} + \varphi GDPgr_{it-1} + \nu PD_{it-1} + \sum_{k=1}^K \rho_k X_{it-1} + \varepsilon_{it} \quad (6.1)$$

$$SFB_{it} = \alpha + \delta vfi_{it-1} + \varphi GDPgr_{it-1} + \nu PD_{it-1} + \sum_{k=1}^K \rho_k X_{it-1} + \varepsilon_{it} \quad (6.2)$$

The dependent variable in equations (6.1) and (6.2) is the structural fiscal balance,  $SFB_{it}$ , with  $i$  and  $t$  denoting respectively the panel and time dimensions. An advantage of using the structural aspect of the fiscal balance, rather than the overall fiscal balance for instance, is that the structural dimension measures discretionary actions of fiscal authorities and purges out any cyclical effects from the actions of the authorities. Structural balance also allows to mitigate the effects of automatic stabilizers. We consider two variables of interest. Equation (6.1) measures the impact of fiscal decentralization ( $fd_{it-1}$ ) on the structural fiscal balance, while equation (6.2) explores the effect of vertical fiscal imbalance,  $vfi_{it-1}$ . This phenomenon is captured using the ratio of expenditure decentralization over revenue decentralization. Greater ratio of vertical imbalance means greater reliance of local governments to the central

level, in terms of transfers. Vertical imbalance is therefore used as a proxy of transfer dependency.

We focus on the coefficient  $\delta$  in equations (6.1) and (6.2). While we expect a positive impact of fiscal decentralization ( $fd_{it-1}$ ) on the structural balance,  $\delta > 0$  (equation 6.1), the vertical imbalance ( $vfi_{it-1}$ ) is expected to hamper the general government's fiscal stance,  $\delta < 0$  (equation 6.2).

Our models control for the effect of output growth ( $GDPgr_{it-1}$ ) and the outstanding debt stock ( $PD_{it-1}$ ) on the structural balance. Matrix  $X_{k,it-1}$  is a set of additional controls, including political and external factors.  $\varepsilon_{it}$  is a composite error term, including country specific characteristics that do not vary over time, and the stochastic component.

Potential endogeneity of fiscal decentralization variable is overcome as follow. A first attempt consists of introducing all right hand side variables, including fiscal decentralization with one time lag. In addition, we use the two-stage least squares (2SLS) instrumental variable technique to properly deal with the endogeneity problem.<sup>99</sup> The instruments proposed are: the population size and government fractionalization. The main hypothesis is that these variables affect the structural balance, but indirectly through the decentralization process.<sup>100</sup> One could assume that there is no link between the size of the population size of a given country, and its structural fiscal balance. However, empirical evidences have shown that decentralization decision is significantly linked with the population size. Jiménez-Rubio (2011) and Escolano *et al.* (2012) argued that decentralization incentives are more pronounced in countries with larger population size. Besides, the degree of fractionalization in the government might not be directly linked with the structural balance, but can affect the decentralization process. Highly fractionalized governments may easily push for decentralization due to pressures coming from outside the central government. On the other

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<sup>99</sup> One might think that the standard errors of the second step coefficients are not valid. We present in our robustness tests the estimated coefficients with bootstrapped standard errors.

<sup>100</sup> We restrict the discussion to the fiscal decentralization process, since the vertical fiscal imbalance is derived from fiscal decentralization variable. Therefore, an instrumental variable that is assumed to affect fiscal decentralization variable is also expected to influence our measure of vertical fiscal imbalance accordingly.

side, fractionalization of the government may hamper the process of decentralization, due to political rigidities. This identification strategy will allow deriving causal relationship between fiscal decentralization and the structural balance. Next section presents the estimation results.

#### **6.4.2. Estimations**

Table 6.1 presents the results of the impact of decentralization on the structural fiscal balance. In columns 1 to 4, we alternatively include additional variables in the baseline specification, controlling for macroeconomic, external, and political and institutional factors.

The positive coefficient of decentralization variable indicates that fiscal decentralization has disciplinary effect by strengthening the structural fiscal position of the general government. Increasing the decentralization ratio helps government generating structural surplus or reducing the deficit. This disciplinary effect is statistically significant and is robust to the inclusion of control variables, meaning that this finding is not driven by omitted variable bias.

Economic arguments of the disciplinary effect can be thought as follow. Assume that fiscal decentralization increases the efficiency of public service delivery. These efficiency gains manifest since local governments, compared to central government, have lower cost of provision of local public goods and services. The reduction in public expenditure following the efficiency gains has positive impact on the structural balance. On the revenue side, tax collection is assumed to gain effectiveness, with the decentralization process taking place. Decentralization allows better identification of tax payers and reduction in tax avoidance. In addition, the relative closeness with local citizens may facilitate tax bargaining and improve tax compliance, optimizing therefore revenue collection. The expected revenue increase impacts positively the fiscal balance, all else equal. Taking either the expenditure or the revenue side, fiscal decentralization, when effective, affects positively the structural balance. In addition, an effective decentralization would prevent the central government from transferring resources to other subnational jurisdictions to overcome the soft budget constraint.

**Table 6.1: Fiscal decentralization and the structural balance***Dependent variable: structural fiscal balance (% GDP)*

|                               | All countries  |                 |                |                 | Advanced      | EME and DC   |
|-------------------------------|----------------|-----------------|----------------|-----------------|---------------|--------------|
|                               | (1)            | (2)             | (3)            | (4)             | (5)           | (6)          |
| <b>FD<sub>(t-1)</sub></b>     | <b>21.07**</b> | <b>25.60***</b> | <b>20.77**</b> | <b>24.26***</b> | <b>14.11*</b> | <b>30.23</b> |
|                               | (2.244)        | (2.600)         | (2.532)        | (2.608)         | (1.939)       | (1.222)      |
| Public debt <sub>(t-1)</sub>  | 2.089***       | 1.654***        | 2.188***       | 1.403**         | -0.13         | 1.504**      |
|                               | (4.655)        | (3.503)         | (4.370)        | (2.550)         | (-0.218)      | (2.087)      |
| GDP gr <sub>(t-1)</sub>       | 0.169***       | 0.181***        | 0.180***       | 0.190***        | 0.284***      | 0.154**      |
|                               | (3.864)        | (3.895)         | (3.748)        | (3.562)         | (4.747)       | (1.991)      |
| CAB <sub>(t-1)</sub>          |                | 0.186***        |                | 0.258***        | 0.252***      | 0.306***     |
|                               |                | (4.706)         |                | (5.043)         | (4.454)       | (3.599)      |
| Inflation <sub>(t-1)</sub>    |                | 0.148*          |                | 0.145**         | -0.973***     | 0.185**      |
|                               |                | (1.919)         |                | (2.035)         | (-2.603)      | (2.361)      |
| Openness <sub>(t-1)</sub>     |                | -1.386*         |                | -0.067          | 2.324*        | -1.903       |
|                               |                | (-1.901)        |                | (-0.071)        | (1.689)       | (-1.273)     |
| Corruption <sub>(t-1)</sub>   |                |                 | -0.751***      | -0.812***       | -1.018**      | -0.388       |
|                               |                |                 | (-2.905)       | (-2.799)        | (-2.431)      | (-1.033)     |
| Polity 2 <sub>(t-1)</sub>     |                |                 | -0.604         | -0.844**        | -0.137        | -1.322**     |
|                               |                |                 | (-1.466)       | (-2.025)        | (-0.297)      | (-2.422)     |
| Observations                  | 705            | 702             | 627            | 624             | 251           | 373          |
| Countries                     | 46             | 46              | 40             | 40              | 14            | 26           |
| Fisher ( <i>p-value</i> )     | 0.000          | 0.000           | 0.000          | 0.000           | 0.000         | 0.000        |
| Hansen OID ( <i>p-value</i> ) | 0.075          | 0.315           | 0.137          | 0.095           | 0.045         | 0.174        |
| KP-under                      | 0.000          | 0.000           | 0.000          | 0.000           | 0.000         | 0.004        |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets. Fiscal decentralization (FD) is considered to be endogenous. Instruments proposed are fractionalization of the government and legislating system, and the population size. In addition, all right-hand-side variables are one time lagged, including the FD variable. The Hansen's robust (*to heteroskedasticity and autocorrelation*) p-values validate the over-identification restrictions. Beside, with the Kleibergen-Paap's p values, we reject, at 5% level, the null hypothesis that equations are under-identified.

Table 6.1 displays additional important findings. We find that GDP growth rate affects positively the structural balance, with higher growth rate increasing (lowering) the surplus (deficit). This effect is persistent throughout. Interestingly, we notice that increasing the level of public debt help governments strengthening their fiscal position. This finding seems interesting in the sense that it can be used to proxy the sustainability of fiscal policy. A positive reaction of fiscal policy to the public debt might be interpreted as a sign of “sustainable” fiscal policy. However, this result should be taken cautiously. It could be driven by our sample composition, since the reaction of fiscal policy to the public debt is specific to each group of countries.



In the following table 6.2, we present the estimation results of the impact of vertical fiscal imbalance,  $vfi_{it-1}$  (equation 6.2). We remind that the vertical imbalance is obtained as the ratio of expenditure decentralization over revenue decentralization. Then, a high ratio means that expenditure decentralization is higher than revenue decentralization, and high transfer-dependency of local governments to the central authorities. This transfer dependency is induced by the fact that expenditure assignments, following the decentralization may not be fully covered by the local government's own resources.

**Table 6.2: Vertical fiscal imbalance and the structural balance**

|                               | All countries |               |               |                | Advanced        | EME and DC    |
|-------------------------------|---------------|---------------|---------------|----------------|-----------------|---------------|
|                               | (1)           | (2)           | (3)           | (4)            | (5)             | (6)           |
| <b>VFI<sub>(t-1)</sub></b>    | <b>-1.140</b> | <b>-2.327</b> | <b>-1.399</b> | <b>-3.771*</b> | <b>-5.958**</b> | <b>-0.006</b> |
|                               | (-0.536)      | (-0.856)      | (-0.977)      | (-1.792)       | (-2.425)        | (-0.007)      |
| Public debt <sub>(t-1)</sub>  | 1.094**       | 0.135         | 1.269***      | -0.326         | -1.409**        | 1.339**       |
|                               | (2.327)       | (0.183)       | (2.884)       | (-0.496)       | (-2.034)        | (2.219)       |
| GDP gr <sub>(t-1)</sub>       | 0.189***      | 0.224***      | 0.164***      | 0.181***       | 0.223**         | 0.171***      |
|                               | (4.588)       | (5.342)       | (3.767)       | (3.955)        | (2.285)         | (3.054)       |
| CAB <sub>(t-1)</sub>          |               | 0.244***      |               | 0.298***       | 0.405***        | 0.231***      |
|                               |               | (4.017)       |               | (4.903)        | (5.158)         | (3.674)       |
| Inflation <sub>(t-1)</sub>    |               | 0.143         |               | 0.133*         | -1.747**        | 0.187**       |
|                               |               | (1.607)       |               | (1.707)        | (-2.171)        | (2.546)       |
| Openness <sub>(t-1)</sub>     |               | -0.787        |               | 0.702          | 1.036           | -0.85         |
|                               |               | (-1.015)      |               | (0.773)        | (0.799)         | (-0.932)      |
| Corruption <sub>(t-1)</sub>   |               |               | -0.498**      | -0.639**       | -0.669**        | -0.413        |
|                               |               |               | (-2.259)      | (-2.396)       | (-2.146)        | (-1.358)      |
| Polity 2 <sub>(t-1)</sub>     |               |               | -0.048        | -0.054         | -0.665          | -0.620        |
|                               |               |               | (-0.099)      | (-0.104)       | (-1.243)        | (-1.624)      |
| Observations                  | 659           | 656           | 598           | 595            | 240             | 355           |
| Countries                     | 44            | 44            | 39            | 39             | 14              | 25            |
| Fisher ( <i>p-value</i> )     | 0.000         | 0.000         | 0.000         | 0.000          | 0.000           | 0.000         |
| Hansen OID ( <i>p-value</i> ) | 0.001         | 0.004         | 0.004         | 0.002          | 0.773           | 0.033         |
| KP-under                      | 0.258         | 0.409         | 0.165         | 0.230          | 0.104           | 0.615         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets. Same as in table 2.

Results displayed in table 6.2 show that control variables come out with the statistical significance and expected signs. While higher GDP growth rate strengthens the structural fiscal balance, growing share of public debt, as percent of GDP increases the fiscal surplus,

or reduces the deficit. In the same line, current account surplus is positively linked with the structural fiscal balance. We also notice that reducing corruption mitigates its perverse effect on the structural balance. On the other side, while the effect of inflation appears mitigated, trade openness, as well as the political regime affects negatively the structural balance. The evidences remain statistically weak for these latter variables.

Turning to the impact of vertical imbalance, the first four columns pool all the country together, regardless of the level of development, and introduce sequentially additional controls. Coefficients attached with the estimates of the vertical imbalance variable are negative throughout. As expected, transfer dependency, through high vertical imbalance (expenditure decentralization overweighing revenue decentralization) weakens the structural balance (see column 4). The negative effect of transfer dependency can be explained by a moral hazard problem. In fact, local governments, sometimes, may have the full information that the central government will bail them out when the deficit become unsustainable. In such situation, they face soft budget constraint, and can implement loose “local” fiscal policy. The local government budget is not fully constrained by the market access or debt sustainability concerns, since the (local) deficit could be transferred to the central level. Transferring the local deficit to the central level deteriorates the general government fiscal position.

Table 6.2 also shows that the magnitude of the estimated coefficients of vertical imbalance changes strongly. When splitting the sample, we notice that the negative effect of vertical imbalance is mainly borne by advanced economies. Column 5, referring to these latters, shows that the vertical fiscal imbalance has negative impact on the structural fiscal stance. When considering emerging market and developing economies (column 6), the coefficient is considerably lower in magnitude and the statistical significance vanishes, though the negative effect persists. Again, this finding evidences that the effect of vertical imbalance is country specific.

## 6.5. Fiscal decentralization and the cyclical policy: testing a (de)stabilizing effect?

### 6.5.1. The model

In investigating the (de)stabilizing effect, we proceed with a two step approach. First, we estimate the cyclical policy, using the Aghion and Marinescu (2007) method. The dependent variable is the general government final consumption expenditure,  $G_{it}$ . The choice of government expenditure as policy variable, instead of the overall/primary balance stemmed from the criticisms of Kaminsky *et al.* (2004), arguing that this latter is not a policy tool, but rather an outcome of the discretionary actions of fiscal authorities. Rather, the policy tools that authorities resort on to implement fiscal policy and influence economic activity are mainly the public expenditure and tax rates. To capture the discretionary actions of the authorities, we use the first difference of log transformed government expenditure over GDP<sup>101</sup> as dependent variable in equation (6.3) below.

$$G_{it} = \alpha_{it} + \gamma_{it} Y_{it}^* + \varepsilon_{it} \quad (6.3)$$

With  $\varepsilon_{it} \rightarrow N(0, \sigma^2 / \omega_t(\tau))$  and  $\omega_t(\tau) = \frac{1}{\sigma \sqrt{2\pi}} \exp\left(-\frac{(\tau - t)^2}{2\sigma^2}\right)$

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<sup>101</sup> Given the difficulty to obtain accurate data on tax rates, we resort only upon the expenditure side of fiscal policy. Our dependent variable government expenditure is GDP-weighted, to facilitate cross-country comparison. We tentatively overcome the potential criticism that changes in the government expenditure-to-GDP ratio could be driven mainly by changes in the denominator –*the GDP*– by including GDP growth rate as a control variable, while specifying the empirical model.

$Y_{it}^*$  is the year-to-year output gap, or the business cycle, measured as the difference between the real and potential GDP. Potential GDP is obtained from Hodrick-Prescott filter.<sup>102</sup> The method of Aghion and Marinescu (2007) used to estimate equation (6.3) has the main advantage of generating country-specific and time-varying coefficients of the reaction of fiscal policy to the business cycle. Equation (6.3) then assesses whether fiscal policy is pro-cyclical or counter-cyclical, on a county-specific and yearly basis.

Second, after gauging the cyclicity of fiscal policy, we measure the extent to which fiscal decentralization and vertical fiscal imbalance affect the cyclicity of fiscal policy. The following specifications are used.

$$\hat{\gamma}_{it} = \alpha + \beta fd_{it-1} + \sum_{k=1}^K \rho_k X_{kit-1} + \nu_{it} \quad (6.4)$$

$$\hat{\gamma}_{it} = \alpha + \beta vfi_{it-1} + \sum_{k=1}^K \rho_k X_{kit-1} + \nu_{it} \quad (6.5)$$

$\hat{\gamma}_{it}$  represents the estimates of the cyclicity of fiscal policy which varies across countries and over time. The variables of interest are fiscal decentralization  $fd_{it-1}$  (equation 6.4) and vertical fiscal imbalance  $vfi_{it-1}$  (equation 6.5). As usual,  $X_{k,it}$  is a set of additional controls affecting the cyclicity of fiscal policy. To strongly mitigate the potential bias and capture a causal relationship running from fiscal decentralization (vertical fiscal imbalance) to the cyclicity of fiscal policy, we adopt the same identification strategy and use the 2SLS estimators as discussed earlier.

### 6.5.2. Estimation results

First, table 6.3 details the results of the estimation of equation (6.3), which gives the yearly estimates of the cyclicity of fiscal policy. In line with the existing literature, the negative mean estimated cyclicity coefficients tell us that fiscal policy is, on average, counter-

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<sup>102</sup> The usage of the HP filter is subject to several criticisms especially due the arbitrary choice of the smoothing parameter and the fact that it disregards the structural breakdowns. Moreover, literature points out the instability of the filter due to its symmetric design. Despite these criticisms, the HP filter remains the most commonly used throughout the literature (Agénor *et al.* 1999 and Talvi and Végh, 2005). The alternatives methods (Band-Pass filter for example) are not spared from criticisms.

cyclical (Talvi and Vegh, 2005; Aghion and Marinescu, 2007; Thornton, 2009; Kaminsky *et al.* 2005). This negative sign can be interpreted saying that, in situations where real GDP is above its potential (i.e. output gap is positive), then authorities reduce government consumption expenditure. In downturns, they raise the public expenditure to boost private demand and support economic activity. Columns (2) and (3) re-estimate the cyclicity coefficient, disentangling between advanced and developing economies, and columns (4)-(5) use alternative estimation methods that will be detailed further in our robustness section. We notice that the magnitude of counter-cyclicity is slightly lower in advanced economies, compared to emerging market and developing economies. This finding could be driven by the recent evolution of fiscal policy in these latter countries. Frankel *et al.* (2013) have shown that developing countries graduated from pro-cyclical to counter-cyclical fiscal policy. We will not go deeper in interpreting these results. Our main interest is the impact of fiscal decentralization on the estimated cyclicity coefficients, which is displayed in table 6.4.

**Table 6.3: Cyclicity of fiscal policy using the LGWOLS method**

|                               | All countries | Advanced      | EME and DC    |               |               |
|-------------------------------|---------------|---------------|---------------|---------------|---------------|
|                               | (1)           | (2)           | (3)           | (4)           | (5)           |
| Mean estimates (of cyclicity) | <b>-0.102</b> | <b>-0.088</b> | <b>-0.108</b> | <b>-0.202</b> | <b>-0.153</b> |
| Standard deviations           | 0.369         | 0.256         | 0.411         | 0.469         | 0.761         |
| Minimum                       | -3.692        | -1.502        | -3.692        | -4.622        | -10.858       |
| Maximum                       | 1.295         | 0.541         | 1.295         | 1.439         | 1.705         |

Note: We use the Aghion and Marinescu (2007)'s *Local Gaussian Weighted Ordinary Least Squares* (LGWOLS) method to estimate the time-varying and country-specific standard errors. The year-to-year cyclicity coefficients are computed using all available observations for each country  $i$ , and performing a regression for each period  $t$ , with observations weighted by a Gaussian centered at the considered period  $t$ . Following these authors, we chose a value of 5 for  $\sigma$  (See equation 6.3 above). This value is subject to sensitivity checks.

We notice first that our instrumental variables are significantly correlated with the endogenous regressor in almost all cases (the associated p-values are  $< 0.05$ ). Besides, using the Kleibergen-Paap's p values, we reject, at 5% level, the null hypothesis that equations are under-identified. In addition, the Hansen's over identification tests mostly do not reject the null hypothesis that the proposed instrumental variables are exogenous, and not correlated with the error term, comforting the validity of our instruments.<sup>103</sup>

<sup>103</sup> First-step regressions of the instrumentation procedure are given in the appendix F.4.

Table 6.4 shows that fiscal decentralization is positively associated with the cyclicity coefficient. As mentioned earlier, fiscal policy is found to be counter-cyclical, with a negative association between output gap and government expenditure. Given that the cyclicity coefficient is negative, then an increase in this coefficient will correspond to an increase in pro-cyclicality (or a reduction in counter-cyclicality). Therefore, the positive coefficient of decentralization (column 1) means that increasing decentralization ratio increases pro-cyclicality, or reduces the magnitude of counter-cyclicality. Taken differently, fiscal decentralization has destabilizing effect on fiscal policy. This baseline result holds once we control for macroeconomic and external variables, and further persists to the inclusion of political and institutional controls (columns 2-4).

**Table 6.4: Fiscal decentralization and the cyclicity of fiscal policy**

*Dependent variable: cyclicity of fiscal policy*

|                               | All countries  |                |                 |                | Advanced       | EME and DC    |
|-------------------------------|----------------|----------------|-----------------|----------------|----------------|---------------|
|                               | (1)            | (2)            | (3)             | (4)            | (5)            | (6)           |
| <b>FD<sub>(t-1)</sub></b>     | <b>1.908**</b> | <b>1.375**</b> | <b>1.600***</b> | <b>0.952**</b> | <b>0.555**</b> | <b>-2.323</b> |
|                               | (2.393)        | (2.142)        | (2.837)         | (2.029)        | (2.071)        | (-1.594)      |
| Public debt <sub>(t-1)</sub>  | 0.054*         | 0.067**        | 0.053**         | 0.064***       | 0.042          | 0.039         |
|                               | (1.808)        | (2.467)        | (2.141)         | (2.684)        | (1.009)        | (1.260)       |
| CAB <sub>(t-1)</sub>          |                | -0.006***      |                 | -0.006***      | -0.012***      | -0.001        |
|                               |                | (-3.458)       |                 | (-2.788)       | (-3.214)       | (-0.486)      |
| Inflation <sub>(t-1)</sub>    |                | -0.001         |                 | 0.0001         | 0.047**        | -0.0001       |
|                               |                | (-0.161)       |                 | (0.032)        | (2.422)        | (-0.030)      |
| Openness <sub>(t-1)</sub>     |                | -0.189***      |                 | -0.257***      | -0.131         | -0.211***     |
|                               |                | (-3.493)       |                 | (-5.469)       | (-1.638)       | (-3.457)      |
| Corruption <sub>(t-1)</sub>   |                |                | -0.001          | 0.018*         | -0.052**       | 0.018         |
|                               |                |                | (-0.113)        | (1.671)        | (-2.174)       | (0.999)       |
| Polity 2 <sub>(t-1)</sub>     |                |                | -0.003          | 0.0002         | -0.036**       | 0.006         |
|                               |                |                | (-0.508)        | (0.040)        | (-2.057)       | (0.868)       |
| Observations                  | 902            | 892            | 801             | 794            | 268            | 526           |
| Countries                     | 57             | 57             | 50              | 50             | 14             | 36            |
| Fisher ( <i>p-value</i> )     | 0.020          | 0.000          | 0.028           | 0.000          | 0.000          | 0.000         |
| Hansen OID ( <i>p-value</i> ) | 0.009          | 0.215          | 0.006           | 0.159          | 0.013          | 0.050         |
| KP underid. Test              | 0.000          | 0.000          | 0.000           | 0.000          | 0.000          | 0.058         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

The last columns (5) and (6) disentangle between advanced and emerging market and developing countries. It appears that the destabilizing effect is country-specific and only

observed in advanced economies. This result could be driven, to some extent, by the level of decentralization which differs significantly across the two groups.

The rationales of this destabilizing effect can be discussed as follows. First, as a consequence of shifting large share of spending to the local governments, central governments will have less maneuver to conduct counter-cyclical fiscal measures. Second, this reduction in counter-cyclicality, namely this destabilizing effect might be attributable to the tendency of local governments to conduct pro-cyclical fiscal measures. Competition among local jurisdictions ends up creating pro-cyclical bias, i.e. preventing them from savings during good times or raising deficits in recession. Raising tax rates or cutting expenditure might be more costly for local governments, due to their relative closeness to local citizens.

Table 6.5 reports the results relative to the impact of vertical fiscal imbalance on the cyclical aspect of fiscal policy. Before diving into the estimation results, we remind that the rule-of-thumb in interpreting the coefficients is that, a positive sign reflects a destabilizing effect, i.e. an increase (reduction) in pro-cyclicality (counter-cyclicality). At first sight, we notice that none of the coefficients of the vertical imbalance variable is statistically significant. However, in some cases, the coefficients are positive (columns 1, 2 and 4). This can be interpreted saying that, the higher the vertical fiscal imbalance, the lower the magnitude of counter-cyclicality. In other words, an increasing asymmetry in expenditure and revenue decentralization, fueling the need for transfers to the local levels, will reduce the room for central authorities to conduct counter-cyclical fiscal measures. Statistical significance matters though. Besides, this destabilizing effect is not robust to re-sampling (columns 5-6).

**Table 6.5: Vertical fiscal imbalance and the cyclicity of fiscal policy***Dependent variable: cyclicity of fiscal policy*

|                               | All countries |              |               |              | Advanced      | EME and DC    |
|-------------------------------|---------------|--------------|---------------|--------------|---------------|---------------|
|                               | (1)           | (2)          | (3)           | (4)          | (5)           | (6)           |
| <b>VFI<sub>(t-1)</sub></b>    | <b>0.036</b>  | <b>0.071</b> | <b>-0.042</b> | <b>0.064</b> | <b>-0.160</b> | <b>-0.049</b> |
|                               | (0.276)       | (0.556)      | (-0.450)      | (0.822)      | (-1.010)      | (-0.689)      |
| Public debt <sub>(t-1)</sub>  | 0.049         | 0.101*       | 0.027         | 0.087*       | 0.037         | 0.034         |
|                               | (0.892)       | (1.673)      | (0.610)       | (1.846)      | (0.881)       | (0.668)       |
| CAB <sub>(t-1)</sub>          |               | -0.012*      |               | -0.009*      | -0.007        | 0.001         |
|                               |               | (-1.936)     |               | (-1.807)     | (-1.422)      | (0.127)       |
| Inflation <sub>(t-1)</sub>    |               | -0.005       |               | -0.001       | 0.029         | -0.0002       |
|                               |               | (-0.979)     |               | (-0.136)     | (0.693)       | (-0.058)      |
| Openness <sub>(t-1)</sub>     |               | -0.234***    |               | -0.314***    | -0.181**      | -0.249***     |
|                               |               | (-4.128)     |               | (-4.680)     | (-2.182)      | (-3.447)      |
| Corruption <sub>(t-1)</sub>   |               |              | 0.001         | 0.036*       | -0.017        | 0.021         |
|                               |               |              | (0.071)       | (1.691)      | (-0.993)      | (0.953)       |
| Polity 2 <sub>(t-1)</sub>     |               |              | 0.005         | 0.001        | -0.034**      | 0.010         |
|                               |               |              | (0.331)       | (0.114)      | (-2.039)      | (0.626)       |
| Observations                  | 832           | 822          | 753           | 746          | 257           | 489           |
| Countries                     | 54            | 54           | 48            | 48           | 14            | 34            |
| Fisher ( <i>p-value</i> )     | 0.651         | 0.000        | 0.647         | 0.000        | 0.000         | 0.003         |
| Hansen OID ( <i>p-value</i> ) | 0.043         | 0.556        | 0.002         | 0.100        | 0.117         | 0.320         |
| KP underid. Test              | 0.536         | 0.565        | 0.566         | 0.587        | 0.097         | 0.508         |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

## 6.6. Robustness analysis

We start with challenging our finding of disciplinary effect, by adopting an alternative measure of the fiscal policy stance. Then, we test whether our findings of destabilizing effect are robust to changes in either the estimation method or the technique of measuring the business cycle.

### 6.6.1. The case of the disciplinary effect

We recall equation (6.2) and reassess the impact of fiscal decentralization and vertical fiscal imbalance on the fiscal policy stance, changing the measurement of the fiscal balance. Instead of using the structural fiscal balance, we follow Escolano *et al.* (2012) and utilize the cyclically-adjusted-primary fiscal balance (CAPB). This latter has the advantage of



eliminating the legacy of former governments, i.e. the debt service payments, and precludes the cyclical effects from the government fiscal stance in assessing the government's fiscal stance. We build upon the standard approach of estimating the CAPB via the following fiscal reaction function:

$$PFB_{it} = \alpha + \beta PFB_{it-1} + \gamma OGap_{it} + \phi Inflation_{it} + \tau Trend + \nu_{it} \quad (6.6)$$

In reference to Fatas and Mihov (2003), this fiscal reaction function allows us to estimate the primary fiscal balance, abstracting from the inertia effect ( $PFB_{it-1}$ ), the cyclical effects (output gap) and other factors that could influence the fiscal balance such as the monetary policy actions (inflation). Equation (6.6) also controls for the deviations that are purely driven by the trend evolution of the primary fiscal balance beyond the control of fiscal authorities. Abstracting from all these effects, the residual of equation (6.6),  $\hat{\nu}_{it}$  captures the changes in the primary balance purely driven by the discretionary actions of the government. This cyclically-adjusted primary fiscal balance is used as dependent variable in equation (6.7):

$$\hat{\nu}_{it} = \alpha + \beta fd_{it-1} [vfi_{it-1}] + \sum_{k=1}^K \rho_k X_{k,it-1} + \xi_{it} \quad (6.7)$$

Our interest in equation (6.7) lies in the coefficient  $\beta B$ , which captures the effect of fiscal decentralization (vertical fiscal imbalance)  $fd_{it-1}(vfi_{it-1})$  on the cyclically adjusted primary balance  $\hat{\nu}_{it}$ .  $X_{k,it-1}$  is a set of controls as specified in equations 6.1-6.2, and  $\xi_{it}$  is the composite error term, including country specific characteristics and a stochastic component. Equation (6.7) is estimated via 2SLS, with all right-hand-side variables introduced with one-time lag. Estimation results are presented in tables 6.6 and 6.7.

We notice that the disciplinary effect of fiscal decentralization persists throughout (table 6.6), although the evidence seems stronger when controlling for time dummies. Undertaking decentralization process may help strengthening the cyclically-adjusted primary balance. Additionally, columns (3) and (4) show that the disciplinary effect is sensitive to the country classification. Although the positive association between fiscal decentralization and the

cyclically-adjusted primary balance remains, the effect is stronger (in magnitude) in EME and DC, than in advanced economies.

**Table 6.6: Fiscal decentralization and the cyclically adjusted primary balance**

*Dependent variable: CAPB (% of GDP)*

|                               | Baseline<br>(1)     | Time dummies<br>(2) | Advanced<br>(3)     | EME and DC<br>(4)   |
|-------------------------------|---------------------|---------------------|---------------------|---------------------|
| $FD_{(t-1)}$                  | 10.55*<br>(1.643)   | 14.68***<br>(2.730) | 6.05<br>(1.541)     | 31.84*<br>(1.772)   |
| Public debt $_{(t-1)}$        | 1.952***<br>(5.837) | 1.901***<br>(5.901) | 1.743***<br>(2.903) | 1.816***<br>(3.618) |
| GDP gr $_{(t-1)}$             | 0.124***<br>(4.532) | 0.0639*<br>(1.754)  | 0.145**<br>(2.383)  | 0.0806<br>(1.117)   |
| CAB $_{(t-1)}$                | 0.092***<br>(2.946) | 0.047<br>(1.576)    | 0.135***<br>(3.191) | 0.0173<br>(0.361)   |
| Inflation $_{(t-1)}$          | 0.103<br>(1.545)    | 0.116*<br>(1.808)   | -0.151<br>(-0.527)  | 0.122*<br>(1.842)   |
| Openness $_{(t-1)}$           | -0.581<br>(-1.071)  | 0.726<br>(0.920)    | 1.332<br>(0.837)    | -0.010<br>(-0.008)  |
| Corruption $_{(t-1)}$         | -0.012<br>(-0.091)  | -0.186<br>(-1.186)  | -0.413<br>(-1.485)  | 0.223<br>(0.821)    |
| Polity 2 $_{(t-1)}$           | 0.017<br>(0.285)    | -0.028<br>(-0.418)  | -0.23<br>(-0.610)   | -0.101<br>(-1.316)  |
| Observations                  | 788                 | 788                 | 269                 | 519                 |
| Countries                     | 50                  | 50                  | 14                  | 36                  |
| Fisher ( <i>p-value</i> )     | 0.000               | 0.000               | 0.000               | 0.000               |
| Hansen OID ( <i>p-value</i> ) | 0.120               | 0.020               | 0.002               | 0.344               |
| KP-under                      | 0.000               | 0.000               | 0.000               | 0.013               |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

In pursuing the sensitivity checks, table 6.7 reveals important findings. The perverse effect of vertical imbalance is effective only in advanced economies. High level of transfers from the central to local governments weakens the cyclically adjusted primary balance. On the contrary, the cyclically-adjusted primary balance in EME and DC reacts differently to changes in the transfer dependency ratio. Indeed the positive association between vertical imbalance and government's fiscal stance in EME and DC is somewhat counterintuitive. A tentative explanation is the (low) level of decentralization in this group of countries, compared to advanced economies. Decentralization in its early stage needs to be accompanied with transfers coming from the central level. These transfers will help the sub-national governments building capacities to endorse the responsibilities devolved thus far,

and gaining autonomy (in levying local taxes and defining local fiscal policy in accordance with local needs) progressively.

**Table 6.7: Vertical fiscal imbalance and the cyclically adjusted primary balance**

*Dependent variable: CAPB (% of GDP)*

|                               | Baseline<br>(1)     | Time dummies<br>(2) | Advanced<br>(3)      | EME and DC<br>(4)   |
|-------------------------------|---------------------|---------------------|----------------------|---------------------|
| VFI <sub>(t-1)</sub>          | 1.187<br>(1.185)    | 1.846<br>(1.564)    | -4.498**<br>(-2.099) | 1.349*<br>(1.958)   |
| Public debt <sub>(t-1)</sub>  | 2.294***<br>(3.775) | 2.494***<br>(2.978) | 0.677<br>(1.063)     | 2.273***<br>(3.015) |
| GDP gr <sub>(t-1)</sub>       | 0.120***<br>(3.746) | 0.049<br>(0.774)    | -0.0542<br>(-0.395)  | 0.00653<br>(0.128)  |
| CAB <sub>(t-1)</sub>          | 0.036<br>(0.551)    | -0.059<br>(-0.907)  | 0.281***<br>(4.357)  | -0.057<br>(-1.214)  |
| Inflation <sub>(t-1)</sub>    | 0.034<br>(0.610)    | 0.030<br>(0.486)    | -1.038<br>(-1.636)   | 0.062<br>(1.335)    |
| Openness <sub>(t-1)</sub>     | -1.245*<br>(-1.746) | -0.831<br>(-0.578)  | -2.374<br>(-1.341)   | 0.0271<br>(0.020)   |
| Corruption <sub>(t-1)</sub>   | 0.354<br>(1.257)    | 0.488<br>(1.549)    | -0.347<br>(-1.371)   | 0.336<br>(1.368)    |
| Polity 2 <sub>(t-1)</sub>     | 0.158<br>(1.077)    | 0.050<br>(0.253)    | -0.808**<br>(-2.112) | -0.018<br>(-0.113)  |
| Observations                  | 740                 | 740                 | 258                  | 482                 |
| Countries                     | 48                  | 48                  | 14                   | 34                  |
| Fisher ( <i>p-value</i> )     | 0.000               | 0.000               | 0.000                | 0.000               |
| Hansen OID ( <i>p-value</i> ) | 0.715               | 0.924               | 0.170                | 0.604               |
| KP-under                      | 0.569               | 0.421               | 0.162                | 0.362               |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

### 6.6.2. Testing the (sensitivity of the) destabilizing effect

Table 6.8 displays estimation results of baseline models testing respectively the impact decentralization (equation 6.4) and vertical imbalance (equation 6.5); but includes time dummies (columns 1 and 4). Despite changes in magnitude, our finding of destabilizing effect of decentralization is persistent when controlling for time dummies. We further decompose the business cycle into expansion and recession episodes and test whether the effect of fiscal decentralization is linear vis-à-vis the business cycle. We further disentangle between expansion and recession episodes (columns 2-3 and 5-6). Recessions (expansions) correspond to periods of negative (positive) output gap, meaning that the real output is below (above) its potential level. Table 6.8 unveils two important results. First, the destabilizing effect depends on the position of the economy vis-à-vis the business cycle. The fact that

fiscal decentralization reduces the counter-cyclicality of fiscal policy is effective only in expansionary episodes. Second the impact of vertical fiscal imbalance seems sensitive to the decomposition of the business cycle. This non linearity can be intuitively understood in the sense that the magnitude of counter-cyclicality is stronger in expansionary periods. Authorities have greater maneuver to reduce counter-cyclicality in these episodes than they do in recessions. Reducing counter-cyclicality of fiscal policy in time of recessions may have even worse impact on the economy, given the need to re-boost demand and economic activity. Absent those actions, the prolonged decline of the economy can raise debt sustainability concerns.

**Table 6.8: The destabilizing effect: expansion vs. recession and time dummies**

|                               | Fiscal decentralization   |                            |                           | Vertical imbalance      |                           |                         |
|-------------------------------|---------------------------|----------------------------|---------------------------|-------------------------|---------------------------|-------------------------|
|                               | Time dummies              | Expansion                  | Recession                 | Time dummies            | Expansion                 | Recession               |
|                               | (1)                       | (2)                        | (3)                       | (4)                     | (5)                       | (6)                     |
| <b>FD<sub>(t-1)</sub></b>     | <b>0.816**</b><br>(2.214) | <b>1.177***</b><br>(2.612) | <b>-0.336</b><br>(-0.354) |                         |                           |                         |
| <b>VFI<sub>(t-1)</sub></b>    |                           |                            |                           | <b>0.071</b><br>(1.167) | <b>-0.057</b><br>(-0.740) | <b>0.005</b><br>(0.073) |
| Public debt <sub>(t-1)</sub>  | 0.072***<br>(2.935)       | 0.015<br>(0.417)           | 0.066<br>(1.418)          | 0.106**<br>(2.492)      | 0.184*<br>(1.926)         | 0.073*<br>(1.672)       |
| CAB <sub>(t-1)</sub>          | -0.005**<br>(-2.426)      | -0.002<br>(-0.542)         | -0.007***<br>(-2.907)     | -0.008**<br>(-2.148)    | 0.003<br>(0.720)          | -0.006***<br>(-2.576)   |
| Inflation <sub>(t-1)</sub>    | -0.001<br>(-0.327)        | 0.001<br>(0.146)           | 0.008<br>(1.201)          | -0.002<br>(-0.418)      | -0.002<br>(-0.193)        | 0.009<br>(1.179)        |
| Openness <sub>(t-1)</sub>     | -0.280***<br>(-4.025)     | -0.342***<br>(-4.201)      | -0.233***<br>(-4.618)     | -0.380***<br>(-4.290)   | -0.419***<br>(-4.076)     | -0.243***<br>(-4.692)   |
| Corruption <sub>(t-1)</sub>   | 0.016<br>(1.359)          | 0.021<br>(1.162)           | 0.030**<br>(2.409)        | 0.036**<br>(2.077)      | 0.051**<br>(1.985)        | 0.021<br>(1.545)        |
| Polity 2 <sub>(t-1)</sub>     | 0.002<br>(0.396)          | -0.003<br>(-0.487)         | -0.002<br>(-0.316)        | 0.005<br>(0.387)        | 0.044<br>(1.075)          | -0.005<br>(-0.495)      |
| Observations                  | 794                       | 368                        | 426                       | 746                     | 345                       | 401                     |
| Countries                     | 50                        | 50                         | 50                        | 48                      | 48                        | 48                      |
| Fisher ( <i>p-value</i> )     | 0.000                     | 0.000                      | 0.000                     | 0.000                   | 0.013                     | 0.000                   |
| Hansen OID ( <i>p-value</i> ) | 0.157                     | 0.060                      | 0.501                     | 0.121                   | 0.029                     | 0.388                   |
| KP underid. Test              | 0.000                     | 0.000                      | 0.071                     | 0.458                   | 0.168                     | 0.350                   |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

The next step in checking the sensitivity of our findings consists of amending the LGWOLS techniques and adding a set of control variables while estimating the cyclicity of fiscal policy (column 2). Then, we reevaluate the cyclicity of fiscal policy, changing the smoothing parameter ( $\lambda$ ) of the Hodrick-Prescott filter used to measure the output gap. In

column (3),  $\lambda$  is assigned the value 100, in comparison with the standard value of 6.25 provided by Ravn and Uhlig (2002). In columns 4-5, we pursue with the LGWOLS method and allow arbitrary changes in the smoothing window ( $\sigma$ ).

Column (1) of table 6.9 refreshes our baseline finding of destabilizing effect of fiscal decentralization. Despite a change in the magnitude, the effect persists to the change in the method of measuring the cyclicity of fiscal policy (column 2). Furthermore, columns 3 and 5 show that the destabilizing effect is robust to the length of the smoothing window used to construct the year-to-year coefficients of cyclicity. As a result, table 6.9 shows that the destabilizing effect of decentralization is neither driven by omitted variable bias, nor is this finding sensitive to noises that could pollute the estimations of the cyclicity of coefficients. The destabilizing effect also persists in column (4), although the statistical significance matters.

**Table 6.9: Fiscal decentralization and the cyclicity of fiscal policy: amending the LGWOLS**

*Dependent variable: cyclicity of fiscal policy*

|                               | Baseline       | Controls        | $\lambda = 100$ | $\sigma = 3$ | $\sigma = 7$    |
|-------------------------------|----------------|-----------------|-----------------|--------------|-----------------|
|                               | (1)            | (2)             | (3)             | (4)          | (5)             |
| <b>FD<sub>(t-1)</sub></b>     | <b>0.952**</b> | <b>3.429***</b> | <b>0.925***</b> | <b>0.040</b> | <b>0.989***</b> |
|                               | (2.029)        | (4.849)         | (2.788)         | (0.049)      | (2.857)         |
| Public debt <sub>(t-1)</sub>  | 0.064***       | 0.036           | 0.073***        | 0.125***     | 0.034*          |
|                               | (2.684)        | (1.341)         | (4.425)         | (3.384)      | (1.913)         |
| CAB <sub>(t-1)</sub>          | -0.006***      | -0.000          | -0.001          | -0.013***    | -0.003*         |
|                               | (-2.788)       | (-0.010)        | (-0.949)        | (-4.032)     | (-1.835)        |
| Inflation <sub>(t-1)</sub>    | 0.000          | 0.001           | -0.002          | -0.000       | -0.001          |
|                               | (0.032)        | (0.226)         | (-0.937)        | (-0.036)     | (-0.238)        |
| Openness <sub>(t-1)</sub>     | -0.257***      | -0.1            | -0.084**        | -0.299***    | -0.178***       |
|                               | (-5.469)       | (-1.592)        | (-2.306)        | (-3.811)     | (-5.006)        |
| Corruption <sub>(t-1)</sub>   | 0.018*         | -0.036**        | -0.001          | 0.036**      | 0.013           |
|                               | (1.671)        | (-2.446)        | (-0.145)        | (2.045)      | (1.579)         |
| Polity 2 <sub>(t-1)</sub>     | 0.000          | -0.013          | 0.002           | 0.013        | -0.001          |
|                               | (0.040)        | (-1.475)        | (0.627)         | (0.830)      | (-0.483)        |
| Observations                  | 794            | 794             | 794             | 794          | 794             |
| Countries                     | 50             | 50              | 50              | 50           | 50              |
| Fisher ( <i>p-value</i> )     | 0.000          | 0.000           | 0.000           | 0.000        | 0.000           |
| Hansen OID ( <i>p-value</i> ) | 0.159          | 0.186           | 0.223           | 0.562        | 0.022           |
| KP underid. Test              | 0.000          | 0.000           | 0.000           | 0.000        | 0.000           |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

If one refers to table 6.10, it can be seen that evidences of destabilizing effect of vertical fiscal imbalance are less clear-cut on a statistical ground, although the estimated results display the expected positive sign.

**Table 6.10: vertical imbalance and the cyclical policy: amending the LGWOLS**

*Dependent variable: cyclical policy*

|                               | Baseline<br>(1)         | Controls<br>(2)         | $\lambda = 100$<br>(3)  | $\sigma = 3$<br>(4)       | $\sigma = 7$<br>(5)     |
|-------------------------------|-------------------------|-------------------------|-------------------------|---------------------------|-------------------------|
| <b>VFI<sub>(t-1)</sub></b>    | <b>0.064</b><br>(0.822) | <b>0.229</b><br>(1.447) | <b>0.091</b><br>(1.125) | <b>-0.109</b><br>(-0.696) | <b>0.035</b><br>(0.510) |
| Public debt <sub>(t-1)</sub>  | 0.087*<br>(1.846)       | 0.212***<br>(2.697)     | 0.126***<br>(3.009)     | 0.077<br>(0.905)          | 0.056<br>(1.481)        |
| CAB <sub>(t-1)</sub>          | -0.009*<br>(-1.807)     | -0.012**<br>(-2.072)    | -0.008*<br>(-1.821)     | -0.006<br>(-0.674)        | -0.006<br>(-1.542)      |
| Inflation <sub>(t-1)</sub>    | -0.001<br>(-0.136)      | -0.010**<br>(-2.085)    | -0.006*<br>(-1.820)     | 0.003<br>(0.357)          | -0.003<br>(-0.904)      |
| Openness <sub>(t-1)</sub>     | -0.314***<br>(-4.680)   | -0.339***<br>(-4.166)   | -0.194***<br>(-3.542)   | -0.248*<br>(-1.826)       | -0.258***<br>(-5.426)   |
| Corruption <sub>(t-1)</sub>   | 0.036*<br>(1.691)       | 0.068*<br>(1.927)       | 0.035**<br>(1.992)      | 0.003<br>(0.066)          | 0.038**<br>(2.327)      |
| Polity 2 <sub>(t-1)</sub>     | 0.001<br>(0.114)        | 0.019<br>(0.871)        | 0.015<br>(1.271)        | 0.017<br>(0.572)          | 0.012<br>(1.274)        |
| Observations                  | 746                     | 746                     | 746                     | 746                       | 746                     |
| Countries                     | 48                      | 48                      | 48                      | 48                        | 48                      |
| Fisher ( <i>p-value</i> )     | 0.000                   | 0.001                   | 0.001                   | 0.007                     | 0.000                   |
| Hansen OID ( <i>p-value</i> ) | 0.100                   | 0.002                   | 0.069                   | 0.861                     | 0.067                   |
| KP underid. Test              | 0.587                   | 0.587                   | 0.587                   | 0.587                     | 0.587                   |

Significance: \* 10%; \*\* 5% and \*\*\* 1%. T-statistics based on robust standard errors are reported in brackets.

## 6.7. Conclusion

This chapter explored the effect of fiscal decentralization and vertical fiscal imbalances on two aspects of fiscal policy performance: the stabilizing effect, and the disciplinary effect. The stabilizing (disciplinary) effect is apprehended using the cyclical policy (structural fiscal balance) as dependent variable. Using a panel of advanced and developing countries, including emerging market economies, over the last two decades, with the appropriate estimation techniques, three main results emerge.

We find that fiscal decentralization has destabilizing effect on fiscal policy. Put differently, fiscal decentralization reduces significantly the room for counter-cyclical fiscal maneuvers. Further, we notice that this destabilizing effect is country-specific (advanced vs. developing

economies) and depends on the position of the economy vis-à-vis the business cycle (expansion vs. recession). The destabilizing effect is effective in advanced economies, and operates only in time of expansion. Additionally vertical imbalances have destabilizing effect, but the effect is less clear-cut.

Second, this study unveils a robust relationship between fiscal decentralization, vertical imbalances and the structural fiscal balance. Our results show that higher level of decentralization helps strengthening the structural fiscal balance. This impact operates through the efficiency gains (in public expenditure) following the decentralization process. On the revenue side, decentralization is expected to enhance the tax collection procedure and increases public revenue. Finally, we illustrate that transfer dependency, measured through the vertical fiscal imbalances have significant negative impact on the structural fiscal stance. High vertical imbalances, resulting from high asymmetries between expenditure decentralization and revenue decentralization deteriorate the structural balance. Our results show that this effect is country-specific.

Knowing that fiscal decentralization has significant destabilizing effect on fiscal policy, local fiscal rules, which can reduce the moral hazard incentives, can be envisaged as mitigating measures of the destabilizing effect. Besides, reducing transfer-dependency, and, by the same token, its perverse effect would require the authorities to promote expenditure decentralization, in line with the revenue capacity of the local governments. Otherwise, fiscal decentralization will compromise the sustainability of public finances.

## Appendices F

## Appendix F.1: countries, data coverage and sources

| Countries                | coverage  | sources       | Countries                  | coverage  | Sources       |
|--------------------------|-----------|---------------|----------------------------|-----------|---------------|
| Argentina                | 1993-2004 | GFS, WEO      | Korea                      | 2000-2012 | OECD database |
| Australia <sup>R,E</sup> | 1990-2011 | OECD database | Latvia                     | 1995-2012 | Eurostat      |
| Austria                  | 1990-2012 | Eurostat      | Lesotho                    | 1990-2008 | GFS, WEO      |
| Bahrain <sup>T</sup>     | 1990-2004 | GFS, WEO      | Lithuania                  | 1995-2012 | Eurostat      |
| Belarus                  | 2001-2010 | GFS, WEO      | Luxembourg                 | 1990-2012 | Eurostat      |
| Belgium                  | 1990-2012 | Eurostat      | Maldives                   | 1990-2011 | GFS, WEO      |
| Bhutan                   | 1990-2009 | GFS, WEO      | Malta                      | 1995-2012 | Eurostat      |
| Bolivia                  | 1990-2007 | GFS, WEO      | Mauritius                  | 2000-2011 | GFS, WEO      |
| Brazil                   | 1997-2012 | GFS, WEO      | Mexico                     | 1990-2012 | GFS, WEO      |
| Bulgaria                 | 1995-2012 | Eurostat      | Mongolia                   | 1992-2012 | GFS, WEO      |
| Canada                   | 1990-2010 | OECD database | Netherlands                | 1990-2012 | Eurostat      |
| Chile                    | 1990-2012 | GFS, WEO      | New Zealand <sup>R,E</sup> | 1990-2012 | OECD database |
| Croatia                  | 2002-2012 | Eurostat      | Norway                     | 1990-2012 | Eurostat      |
| Cyprus                   | 1995-2012 | Eurostat      | Pakistan                   | 1990-2007 | GFS, WEO      |
| Czech Republic           | 1995-2012 | Eurostat      | Peru                       | 1995-2012 | GFS, WEO      |
| Denmark                  | 1990-2012 | Eurostat      | Poland                     | 1995-2012 | Eurostat      |
| Egypt                    | 2002-2012 | GFS, WEO      | Portugal                   | 1990-2012 | Eurostat      |
| Estonia                  | 1995-2012 | Eurostat      | Romania                    | 1995-2012 | Eurostat      |
| Finland                  | 1990-2012 | Eurostat      | Seychelles                 | 1993-2012 | GFS, WEO      |
| France                   | 1990-2012 | Eurostat      | Singapore                  | 1990-2012 | GFS, WEO      |
| Georgia                  | 1997-2012 | GFS, WEO      | Slovak Republic            | 1995-2012 | Eurostat      |
| Germany                  | 1990-2012 | Eurostat      | Slovenia                   | 1995-2012 | Eurostat      |
| Greece                   | 1995-2012 | Eurostat      | South Africa               | 1990-2012 | GFS, WEO      |
| Hungary                  | 1995-2012 | Eurostat      | Spain                      | 1995-2012 | Eurostat      |
| Iceland                  | 1995-2012 | Eurostat      | Sweden                     | 1993-2012 | Eurostat      |
| India                    | 1990-2012 | GFS, WEO      | Switzerland                | 1990-2012 | Eurostat      |
| Indonesia                | 1990-2004 | GFS, WEO      | Tunisia                    | 1990-2012 | GFS, WEO      |
| Iran                     | 1990-2009 | GFS, WEO      | Turkey <sup>R,E</sup>      | 1990-2012 | OECD database |
| Ireland                  | 1990-2012 | Eurostat      | United Kingdom             | 1990-2012 | Eurostat      |
| Israel                   | 1995-2012 | OECD database | United States              | 1990-2012 | OECD database |
| Italy                    | 1990-2012 | Eurostat      | Uruguay                    | 1999-2012 | GFS, WEO      |
| Japan <sup>R,E</sup>     | 1990-2012 | OECD database | Venezuela                  | 1990-2005 | GFS, WEO      |

<sup>R,E</sup> indicate that country has no disaggregated data on revenue, expenditure or taxes respectively.



**Appendix F.2: variables definition and data sources**

| Variables                    | Description   | Sources                                       |
|------------------------------|---|---|
| expenditure decentralization | Fiscal decentralization - Expenditure side  | Eurostat, GFS, OECD and WEO                   |
| revenue decentralization     | Fiscal decentralization - Revenue side  |   |
| Inflation                    | Changes in consumer price index   |   |
| CAB                          | Current account balance   |   |
| Openness                     | Sum of exports and imports in percent of GDP  |   |
| GDP growth                   | Growth rate of the GDP  |   |
| PFB                          | Primary fiscal balance is the difference between total revenues and total expenditures excluding interest payment | World Bank, World Development Indicators 2014 |
| Structural FB                | Structural fiscal balance excludes the cyclical and conjuncture effects from the fiscal balance                   |   |
| Total population             | Measures the size of the population   |   |
| Real GDP pc                  | GDP per capita, PPP (constant 2011 international)   |   |
| Public debt                  | Public debt in percent of GDP   | WEO and Ali Abbas database                    |
| Government fractionalization | Probability that two deputies randomly picked from the government parties will be of different parties.           | DPI2012 Database of Political Institutions:   |
| Fractionalization            | The probability that two deputies picked from the legislature will be of different parties.                       |   |
| Corruption                   | Assessment of corruption within the political system.   | ICRG database                                 |

Expenditure and Revenue decentralization for European and OECD countries are taken respectively from Eurostat and OECD databases. For emerging and developing, we report data from GFS and WEO.

**Appendix F.3: Detailed descriptive statistics**

| Variable                              | Obs. | Mean  | Advanced | EME   | Std. Dev. | Min     | Max     |
|---------------------------------------|------|-------|----------|-------|-----------|---------|---------|
| FD expenditure (%)                    | 1086 | 29.55 | 38.97    | 25.42 | 21.31     | 0.00    | 98.44   |
| FD revenue (%)                        | 1129 | 27.37 | 36.81    | 23.45 | 19.81     | 0.00    | 0.74    |
| Population size (in millions)         | 1472 | 48.64 | 43.31    | 50.89 | 138.70    | 0.07    | 1236.69 |
| Government fractionalization          | 1381 | 0.29  | 0.29     | 0.29  | 0.29      | 0.00    | 1.00    |
| Inflation                             | 1430 | 0.75  | 0.60     | 0.82  | 1.11      | -16.86  | 16.38   |
| Openness                              | 1454 | 88.54 | 81.58    | 91.52 | 58.49     | 13.75   | 439.66  |
| Corruption                            | 1280 | -2.72 | -3.52    | -2.32 | 1.31      | -5.00   | 0.67    |
| Polity 2                              | 1341 | 7.08  | 9.05     | 6.28  | 5.24      | -10.00  | 10.00   |
| Current account balance               | 1432 | -1.63 | 0.97     | -2.74 | 7.47      | -42.09  | 26.33   |
| GDP growth                            | 1461 | 3.10  | 2.50     | 3.36  | 4.55      | -44.90  | 19.59   |
| Public debt (in % of GDP)             | 1332 | 55.29 | 59.33    | 53.45 | 33.49     | 3.69    | 289.55  |
| Primary fiscal balance                | 1365 | 0.07  | 0.42     | -0.09 | 4.16      | -27.93  | 19.90   |
| Structural fiscal balance             | 907  | -0.19 | -0.18    | -0.19 | 3.70      | -17.70  | 30.41   |
| Vertical Imbalance                    | 953  | 1.43  | 1.16     | 1.57  | 3.03      | 0.00    | 64.76   |
| GDP                                   | 1467 | 545   | 1420     | 174   | 1560      | 0.22    | 16200   |
| Output gap                            | 1446 | -0.01 | 0.00     | -0.01 | 0.08      | -0.58   | 0.25    |
| Output gap ( $\lambda=100$ )          | 1446 | -0.01 | -0.01    | -0.01 | 0.13      | -0.76   | 0.46    |
| Cyclicalities of FP                   | 1342 | 6.37  | 14.16    | 2.91  | 21.64     | -49.04  | 159.33  |
| Cyclicalities of FP ( $\lambda=100$ ) | 1342 | 0.34  | 1.51     | -0.18 | 13.11     | -50.35  | 119.09  |
| Cyclicalities of FP ( $\sigma=3$ )    | 1342 | 7.34  | 15.07    | 3.91  | 25.20     | -114.03 | 182.74  |
| Cyclicalities of FP ( $\sigma=7$ )    | 1342 | 5.97  | 13.85    | 2.47  | 20.91     | -46.21  | 150.84  |

VFI is the ratio between expenditure decentralization and revenue decentralization.

**Appendix F.4: First-step regressions***Dependent variable: fiscal decentralization*

|   | All countries<br>(1) | Advanced<br>(2)      | EME<br>(3)        |
|---|----------------------|----------------------|-------------------|
| Real GDP pc <sub>(t-1)</sub>                  | -0.001<br>(-1.14)    | -0.001<br>(-0.76)    | -0.000<br>(-0.47) |
| Public debt <sub>(t-1)</sub>                  | -0.016*<br>(-1.79)   | -0.063***<br>(-3.53) | 0.004<br>(0.48)   |
| CAB <sub>t-1</sub>                            | -0.001<br>(-1.17)    | 0.001<br>(0.48)      | -0.001<br>(-1.45) |
| Inflation <sub>(t-1)</sub>                    | 0.000<br>(0.55)      | 0.005<br>(0.49)      | 0.000<br>(0.04)   |
| Trade <sub>(t-1)</sub>                        | 0.052**<br>(2.91)    | -0.023<br>(-0.62)    | 0.047**<br>(2.48) |
| Corruption <sub>(t-1)</sub>                   | 0.015***<br>(3.71)   | 0.050***<br>(4.85)   | -0.000<br>(-0.05) |
| Polity 2 <sub>(t-1)</sub>                     | 0.003<br>(0.73)      | -0.028**<br>(-2.15)  | 0.013**<br>(2.56) |
| Government fract. <sub>(t-1)</sub>            | -0.088***<br>(-4.87) | -0.107***<br>(-4.07) | -0.067<br>(-2.73) |
| Fractionalization <sub>(t-1)</sub>            | 0.054<br>(1.14)      | -0.053<br>(-0.53)    | 0.036<br>(0.69)   |
| Population size <sub>(t-1)</sub>              | -0.394***<br>(-3.74) | -0.587***<br>(-3.56) | -0.116<br>(-1.33) |
| Observ.                                       | 624                  | 251                  | 373               |
| Countries                                     | 40                   | 14                   | 26                |
| Join significance test                        | 6.56                 | 6.42                 | 2.59              |
| F ( <i>p-value</i> )                          | 0.00                 | 0.00                 | 0.00              |
| R-squared                                     | 0.14                 | 0.28                 | 0.13              |
| F- test for excluded inst. ( <i>p-value</i> ) | 0.00                 | 0.00                 | 0.01              |
| KP under-identification ( <i>p-value</i> )    | 0.00                 | 0.00                 | 0.00              |

*Note.* Significance: \* 10%, \*\* 5% and \*\*\* 1% with robust *T*-statistics in parentheses. NR stands for natural resources. Fixed effects are taken into consideration to control for all time-invariant characteristics and exploit within country variations. The endogenous variable is the fiscal decentralization ratio and the instrumental variables are: the population size, and two measures of fractionalization. The instrumental variables are significantly correlated with the endogenous regressor in almost all cases (the *p*-values associated with the F-test for excluded instruments are < 0.05). Additionally, using the Kleibergen-Paap's (KP) *p* values, we reject, at 5% level, the null hypothesis that equations are under-identified. The instrumental variables used are relevant i.e. correlated with the endogenous regressor.

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## Main findings of Part II

Part two of this thesis focused mainly on fiscal policy, with three chapters giving emphasis to the relationship between fiscal policy, public debt, fiscal rules and fiscal decentralization. First, we analyzed the cyclical reaction of fiscal policy to the public debt, and the role of fiscal rules. Using appropriate estimation techniques, we highlighted that a high public debt-to-GDP ratio decreases the counter-cyclical property of fiscal policy. This detrimental effect, in other words, the destabilizing effect of high debt ratio is strengthened with endogenous threshold estimates *à la* Hansen (1999). We established an upper-bound of 117% of debt-to-GDP ratio beyond which fiscal policy loses its counter-cyclical property. Having this said, we thought of a possible remedy to this detrimental effect of high public debt, related to the presence of fiscal rules. We showed that the presence of fiscal rules strongly mitigates the negative effect of high public debt on the cyclical property of fiscal policy, though with remarkable heterogeneities among the different types of rules. The disciplinary effect of fiscal rules operates only via the deficit rules, while rules with escape clause seem to have worsening effects. Golden rules and national rules also show their superiority when compared with other type of rules.

Finally, chapters five and six addressed fiscal decentralization issues. Decentralization is measured as the share of sub-national expenditure (revenue) over the general government expenditure (revenue). As first evidences, we showed that greater ratio of fiscal decentralization, within well-functioning political and institutional environment, improves significantly the efficiency of public service delivery. Analyzing the education and health sectors, we found that devolving more responsibilities to local authorities lead to efficiency gains, since local authorities are better positioned to target local citizens' needs. It's worth emphasizing that, to be effective, fiscal decentralization needs to reach a threshold estimated at 35.7%. Otherwise, the expected positive outcomes become questionable, or even inexistent. In the final chapter six, we explored two aspects of fiscal decentralization, namely the destabilizing effect and the disciplinary effect. Our first evidences revealed a destabilizing effect of fiscal decentralization, through a reduction in the room for counter-cyclical fiscal maneuver. Notice that this destabilizing effect is found to be country-specific, and sensitive to the position of the economy vis-à-vis the business cycle. We took the chapter

step further and found a robust relationship between fiscal decentralization and the structural fiscal balance. Assigning more expenditure to the sub-national authorities and/or shifting revenue responsibilities to local administrations strengthens the general government structural stance. This positive effect comes from efficiency gains realized on the expenditure side, and increasing effectiveness in revenue collection. It is worth noting, however, that transfer dependency, measured through the vertical fiscal imbalances, has significant negative impact on the structural fiscal stance. Higher vertical fiscal imbalances, resulting from asymmetries between expenditure assignments and (local) revenue capacities, typically weaken the general government structural fiscal position.

## General Conclusion and Policy Lessons

This thesis explored, in two parts, the macroeconomic impacts of exchange rate regimes, as well as the recent developments in fiscal policy and fiscal decentralization. Part one is concerned with the impact of exchange rate regimes and comprises three chapters. Chapter 1 starts with analyzing the potential stabilizing effect of exchange rate regimes, within a panel of developing countries. Our results first confirm the pro-cyclicality of fiscal policy in these countries. Using the IMF's classification of exchange rate regime, we show that fixed exchange rate regimes help stabilizing fiscal policy. In other words, the magnitude of pro-cyclicality is reduced for countries under pegged regimes, compared to those with flexible ones. We also found that the stabilizing effect strongly depends on the fiscal policy indicator as well as the exchange rate regime classification. A step further, we noticed that, within the pegged regimes, the stabilizing effect is solely observable for countries with a conventional peg arrangement. The rationale of such stabilizing mechanism is supported by the thinking that countries under pegged regimes reduce their incentives to overspend during booms in order to avoid excessive money growth, and rising inflation pressures that could end-up threatening the peg. In addition, such (constraining) regimes do not offer sufficient room for debt monetization.

In our second chapter, when assessing the vulnerability of alternative exchange rate regimes to banking or financial, currency and debt crises, we vigorously broke down the bipolar view, suggesting that the corner regimes *–to peg or to float–* are safer than intermediate regimes. There is no clear link between crisis vulnerability and the exchange rate regime at place, but the fundamentals (*fiscal, financial and monetary variables*) do matter when it comes to gauging the crisis proneness of different types of exchange rate regimes.

The remaining chapter three of part one explored the link between exchange rate and tax policy. Our findings unveil a significant link between exchange rate regimes and tax policy. Countries with pegged exchange rate regimes tend to collect more VAT revenue, compared to those with intermediate or floating regimes. This result is economically supported by the substitution and the composition effects. The former hypothesis argues that fiscal authorities try to offset the resource loss entailed by the early-90s trade liberalization process, either by

mobilizing more seigniorage revenue or operating tax transition with a greater reliance on domestic taxation. Since countries with a pegged regime cannot use the seigniorage as an offsetting mechanism, their alternative would be to undertake tax transition process, using the VAT channel for instance. The competitiveness effect assumes that countries within a pegged arrangement implement less border taxation to promote cross-border trade. Giving-up border taxation leads the policymakers to increase their reliance on domestic taxation. Further, we find that, in developing countries, the more the exchange rate regime is restrictive and the stronger is the link between exchange rate regimes and tax policy.

Part two of this thesis focused mainly on fiscal policy, with three chapters giving emphasis to the relationship between fiscal policy, public debt, fiscal rules and fiscal decentralization. We first analyzed the cyclical reaction of fiscal policy to the public debt, and the role of fiscal rules. Using appropriate estimation techniques, we highlighted that a high public debt-to-GDP ratio decreases the counter-cyclical property of fiscal policy. This detrimental effect, in other words, the destabilizing effect of high debt ratio is strengthened with endogenous threshold estimates *à la* Hansen (1999). We established an upper-bound of 117% of debt-to-GDP ratio beyond which fiscal policy loses its counter-cyclical property. Having this said, we thought of possible remedy to this detrimental effect of high public debt. We then showed that the presence of fiscal rules strongly mitigates the negative effect of high public debt on the cyclical property of fiscal policy, though with remarkable heterogeneities among the different types of rules under consideration. The disciplining effect of fiscal rules operates only via the deficit rules, while rules with escape clause seem to have worsening effects. Golden rules and national rules also show their superiority when compared with other type of rules.

Finally, chapters five and six addressed the issues of fiscal decentralization, defined as the share of sub-national expenditure (revenue) over the general government expenditure (revenue). As first evidences, we showed that greater ratio of fiscal decentralization, within well-functioning political and institutional environment, improves significantly the efficiency of public service delivery. Analyzing the education and health sectors, we found that devolving more responsibilities to local authorities lead to efficiency gains, since local authorities are better positioned to target local citizens' needs. It's worth emphasizing that, to be effective, fiscal decentralization needs to reach a threshold estimated at 35.7%. Otherwise,



the expected positive outcomes become questionable, or even unprofitable. In the final chapter six, we explored two aspects of fiscal decentralization, namely the destabilizing effect and the disciplinary effect. Our first evidences revealed a destabilizing effect of fiscal decentralization, through a reduction in the room for counter-cyclical fiscal maneuvers. This destabilizing effect is found to be country-specific, and sensitive to the position of the economy vis-à-vis the business cycle. We took the chapter step further and found a robust relationship between fiscal decentralization and the structural fiscal balance. Assigning more expenditure to the sub-national authorities and/or shifting revenue responsibilities to local administrations strengthens the general government structural stance. This positive effect comes from efficiency gains realized on the expenditure side, and increasing effectiveness in revenue collection. However, it is worth noting that transfer dependency, measured through the vertical fiscal imbalance, has significant negative impact on the structural fiscal stance. Higher vertical fiscal imbalance, resulting from asymmetry between expenditure assignments and (local) revenue capacities, typically weakens the general government structural fiscal position.

### **Policy Lessons**

On the one hand, this thesis has reconsidered the role of exchange rate regimes and its interplay with fiscal, monetary and tax policy. On the other hand it has documented the cyclical reaction of fiscal policy in high debt context and studied the impact of fiscal decentralization on various indicators of fiscal policy performance. Relevant policy lessons can be drawn.

First, the thesis suggested that exchange rate regimes can be thought as a credible policy tool, when it comes to stabilizing fiscal policy. This policy advice, however, should be taken cautiously since the stabilizing effect is not automatic, but rather conditional upon the inter-temporal distribution of the costs of loose fiscal policy among the alternative regimes. Authorities should also strike the right balance between the trade-offs associated with the choice of constraining regimes such as the pegged arrangements, and the disciplinary effect induced by these types of monetary frameworks.

Our second policy lesson is concerned with the choice of the appropriate exchange rate regime to reduce the probability of banking/financial, currency and debt crises. In fact, our results have shown that the mere adoption of any exchange rate regimes cannot be viewed as a guarantee against crises. Thus, in addition to a careful choice of the appropriate monetary regime, it's worth safeguarding against crises-conducting behaviors, such as reckless private credit expansion, implementation of loose fiscal policy and unsustainable public debt path. A tight monitoring of these fundamentals would help reducing the vulnerability to crises, or at least mitigate their effects once they come out.

This thesis has also provided another understanding of the link between exchange rate regime and tax policy, stating that tax policy reforms should be implemented in accordance with the ruling monetary framework.

In turn, building on the evidences of our last three chapters (four to six), one can derive policy recommendations that would help guarantying sound fiscal policy. Chapter four has shown that high public debt may seriously reduce the maneuvers of fiscal authorities when it comes to implementing counter-cyclical fiscal measures. Thus, our first policy advice is concerned with the monitoring of the public debt path. In this regard, a thoughtful supervision is needed, so as to avoid the public debt ratio reaching unreasonable levels. In the same line, chapter four's results push strongly towards the adoption of fiscal rules. The disciplinary effect of fiscal rules is expected to impose restrictions on policymakers to running excessive deficits and accumulating unsustainable debt levels. An important consideration should be given to the design and implementation of the chosen rule(s), since the expected disciplinary effect of fiscal rules does not thrive from all type of rules. Besides, deficit rules, national and golden rules stood out of the crowd, among others, as effective rules that could help preserving the counter-cyclicity of fiscal policy in time of high debt.

Finally, chapters five and six guided those countries aiming at undertaking decentralization reform. We remind that decentralization is expected to produce efficiency gains in the provision of public goods and services. Among those elements that need to be taken into consideration while decentralizing, is the effectiveness of the political and institutional environment. While the stability of governments with sufficient autonomy to sub-national

levels are key aspects for decentralization to deliver positive outcomes, corruption phenomenon and lack of accountability rather lead to perverse effects of fiscal decentralization. In a more formal way, when it comes to implementing decentralization, central government needs to share at least one third of its resources with the sub-national levels. Such level of decentralization is expected to allow local authorities sufficient room to match their expenditure assignments with their revenue capacities.

Moreover, fiscal decentralization should also be worth considering, following the onset of the financial crisis, which has revived debt sustainability issues. Chapter six highlighted that fiscal decentralization can help strengthening the general government's structural balance, thanks to the efficiency gains on the expenditure side and more effective tax collection administrations. However, authorities might bear in mind the downsides of decentralization which can seriously weaken the fiscal position of the general government. Governments should limit the transfer dependency induced by the vertical imbalance phenomenon. Reducing the transfer dependency would require the central government to share expenditure responsibilities, in line with the revenue capacities of local governments. Besides, shifting expenditure responsibilities or revenue collection capacities could have destabilizing effect, reducing the room for counter-cyclical fiscal measures. Implementation of fiscal rules, especially at the local level, can be foreseen as a remedy. One advantage of local fiscal rules lies in their capacity of enforcing a full budget constraint to the sub-national governments, in comparison with the soft budget constraint that prevailed in the context of asymmetric decentralization.

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## Summary of the thesis

This thesis explored, in two parts, the macroeconomic impacts of exchange rate regimes (ERR), as well as the recent developments in fiscal policy and fiscal decentralization. **Part I** has reconsidered the role of ERR and its interplay with fiscal, monetary and tax policy. The first result that emerges (**Chapter 1**) is that fixed ERR can serve as a credible policy tool for stabilizing fiscal policy. However, this stabilizing effect is conditional upon the inter-temporal distribution of the costs of loose fiscal policy. In assessing the linkage between ERR and crises (banking/financial, currency and debt), **Chapter 2** evidenced that the bipolar view is no longer valid, and that, crisis proneness rather depends on the macroeconomic fundamentals (the volatility of private sector credit, the deficit-financing mechanism, and the debt-to-GDP ratio). In **Chapter 3**, we unveiled a strong relationship between ERR and tax policy. Countries with pegged regimes have greater reliance on domestic taxation -such as the VAT- to make up for the loss of seigniorage revenue (substitution effect). Moreover, *peggers* tend to collect more VAT revenue to offset the shortfall in cross border taxes following the trade liberalization reform (competitiveness effect). **Part II** discussed the cyclical response of fiscal policy in high debt periods, and focused on fiscal decentralization issues. In **Chapter 4**, we showed that the reaction of fiscal policy to the business cycle is non-linear and conditional to the level of public debt. When the debt-to-GDP ratio goes beyond a certain threshold (87%), fiscal policy loses its counter-cyclical properties. Further, we highlighted that carefully-designed fiscal rules help maintaining counter-cyclicality through an *ex ante* disciplinary effect. Chapters 5 and 6 analyzed the impact of fiscal decentralization on the efficiency of public service delivery and fiscal policy performance, respectively. **Chapter 5** revealed that a sufficient level of expenditure decentralization, coupled with revenue decentralization, improves the efficiency of public service delivery. However, the political and institutional environment is critical for reaping decentralization-led benefits. Lastly, **Chapter 6** concluded that fiscal decentralization has destabilizing effect by reducing the counter-cyclicality of fiscal policy. In addition, we found that decentralization strengthens the structural fiscal balance; however, vertical fiscal imbalances reduce the benefits of decentralization. It is therefore critical to limit asymmetries between expenditure and revenue decentralization, so as to reduce the transfer-dependency of local governments to the central level, and thus prevent decentralization from weakening the fiscal stance at the general government level.

*Keywords:* Developing Countries, Duration Analysis, Economic Crises, Exchange Rate Regimes, Fiscal Decentralization, Fiscal Discipline, Fiscal Policy, Fiscal Rules, Instrumental Variables Method, Non Linear Effects, Panel Data, Public Debt, Stochastic Frontier Analysis, Tax Policy.

## Résumé de la thèse

Cette thèse s'intéresse d'une part aux effets macroéconomiques des régimes de change, et d'autre part, aux récentes évolutions sur la politique budgétaire et la décentralisation. La **partie I** met essentiellement l'accent sur l'interaction entre les régimes de change (RC) et la politique budgétaire, monétaire et fiscale. Tout d'abord, nous mettons en évidence que les RC peuvent avoir un effet stabilisateur sur la politique budgétaire (**chapitre 1**). Cependant, cet effet stabilisateur des RC n'est pas automatique mais dépendrait plutôt des conséquences d'une politique budgétaire laxiste. Le **chapitre 2** s'intéresse quant à lui à la causalité entre RC et crises (bancaire/financière, de change et de dette) et remet en cause la vision bipolaire qui prétendait que les RC intermédiaires sont plus vulnérables aux crises que les solutions en coin (RC fixes/flexibles). Il ressort de notre analyse que les fondamentaux macroéconomiques (la volatilité du crédit au secteur privé, le financement du déficit, et le ratio dette sur PIB) jouent un rôle considérable. Le **chapitre 3** met en évidence un lien entre les RC et la politique fiscale. Les pays à RC fixes montrent une plus grande dépendance aux recettes domestiques -telles que la TVA-, comparativement aux pays en change intermédiaires/flexibles pour compenser les pertes de recettes de seigneurage (effet de substitution). De plus, ces pays avec RC fixes collectent plus de recettes domestiques en compensation de la perte de recettes douanières, suite à la libéralisation commerciale (effet de compétitivité). Dans les trois derniers chapitres (**partie II**), nous mettons le focus sur la politique budgétaire et les effets de la décentralisation. Le **chapitre 4** révèle une relation non-linéaire entre la politique budgétaire et le cycle économique, qui dépend du niveau de la dette publique. Lorsque celle-ci dépasse un certain seuil (87%), la politique budgétaire perd toute propriété contra-cyclique. Nous montrons par ailleurs que l'effet disciplinaire *ex-ante* des règles budgétaires aide à restaurer la contra-cyclicité de la politique budgétaire. A travers le **chapitre 5**, nous montrons que la décentralisation budgétaire, dans un cadre politico-institutionnel sain et dépourvu de corruption, améliore l'offre de biens et services publics. Le **chapitre 6** conclut que la décentralisation impacte positivement le solde structurel. Cependant une asymétrie entre la décentralisation des dépenses et celle des recettes accroît la dépendance des gouvernements locaux vis-à-vis du gouvernement central en termes de transferts, et amoindrirait considérablement à l'effet positif de la décentralisation.

*Mots clés:* Crises économiques, régimes de change, décentralisation budgétaire, discipline budgétaire, politique budgétaire et fiscale, règles budgétaires, dette publique, pays en développement, modèles de durée, variables instrumentales, données de panel, effets non linéaires, modèles de frontières stochastiques.