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Exchange Rate Adjustment**

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# Short- and Long-Term Growth Effects of Exchange Rate Adjustment

Evžen Kočenda<sup>a</sup>, Mathilde Maurel<sup>b</sup>, Gunther Schnabl<sup>c</sup>

## Abstract

The European sovereign debt crisis revived the discussion concerning pros and cons of exchange rate adjustment in the face of asymmetric shocks. In the spirit of Keynes, exit from the euro area is to regain rapidly international competitiveness. In the spirit of Schumpeter, exchange rate stability with structural reforms would be beneficial towards the long-run growth performance. Previous literature has estimated the average growth of countries with different degrees of exchange rate flexibility. We augment this literature by analyzing short- and long-term growth effects of exchange rate flexibility in a panel-cointegration framework for a sample of 60 countries clustered in five country groups. The estimations show that countries with a high degree of exchange rate stability exhibit a higher long-term growth performance. In line with Mundell (1961) we show that the degree of business cycle synchronization with the (potential) anchor country matters for the impact of exchange rate flexibility on growth.

JEL Classification number(s): C54; E32; E42; F32; F33; N20.

Keywords: Exchange rate regime; crisis; shock adjustment; theory of optimum currency areas; Mundell; Schumpeter; Hayek; cointegration.

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## 1. Introduction

The recent wave of financial, balance of payments and sovereign debt crises has revived the discussion about the appropriate adjustment strategy in the face of asymmetric shocks. In most crisis events such as the 1997/1998 Asian crisis, the 1998 Japanese financial crisis, the 1998 Russian flu, the 2001 collapse of the Argentine currency board and even the US subprime market crisis, the crisis countries embarked on monetary expansion and depreciation as crisis solution strategies. In contrast, originating in growing intra-European current account imbalances (Argyrou and Chortareas, 2008), during the most recent European sovereign debt crisis a set of European crisis countries opted for staying in the Economic and Monetary Union (EMU; the EMU crisis countries) or maintaining tight exchange rate pegs to the euro (the Baltic countries and Bulgaria). The consequence was a strong pressure to curtail government expenditure and to cut wages.

The different adjustment strategies in the face of crisis based on inflation or deflation are embedded into different theoretical frameworks. Keynes (1936) and Mundell (1961) favoured monetary expansion and depreciation to provide a quick fix for missing international competitiveness and high unemployment. In contrast, Schumpeter (1911) and Hayek (1937) stressed the role of wage and price cuts to boost long-term growth via an increasing marginal efficiency of private investment. In the context of the choice of the exchange rate regime, based on Friedman (1953), Mundell (1961) modelled the benefits of exchange rate adjustment in the face of asymmetric shocks to stimulate (short-term) growth (Tavlas, 2009). In contrast, McKinnon (1963) highlighted the role of fixed exchange rates for macroeconomic stabilization and therefore as a tool for preserving the (long-term) growth performance.

Empirical studies on the impact of the exchange rate regime on growth have come to mixed results. For instance, Levy-Yeyati and Sturzenegger (2002) who examine the impact of the exchange rate regime on growth for a sample of 183 countries in the post-Bretton-Woods era (1974-2000) based on a pooled regression framework find a negative impact of exchange rate stability on growth for emerging market economies. In contrast, Maurel and Schnabl's (2012) static and dynamic panel estimations find a positive impact of exchange rate stability on growth for a set of 60 mostly emerging market economies.

We aim to augment this literature by isolating the long-term and short-term growth effects of exchange rate stability / flexibility based on a cointegration framework. This research allows us to reconcile Mundell's (1961) and McKinnon's (1963) view on the impact of exchange rate flexibility / stability on growth in the face of asymmetric shocks.

## **2. Short- and Long-Term Growth Effects of (Non-) Exchange Rate Adjustment**

From 2008 to 2012 the European debt crisis revealed the different adjustment strategies to asymmetric shocks and crisis. When many European periphery countries were hit by bursting bubbles, the reversal of capital inflows and (near to) unsustainable debt levels, the EMU membership barred the way towards depreciation as a quick fix for the adjustment of unit labour costs to regain international competitiveness.

The loss of independent monetary policy and the exchange rate as adjustment tools to asymmetric shocks made price and wage adjustments necessary, which amplified the crisis and triggered different policy responses. Whereas Ireland (like the Baltic countries and Bulgaria) embarked on doughty adjustment measures in the private and public sector, in Greece political resistance retarded reforms. The delayed reforms in Greece were reflected in substantial rescue packages and rising imbalances in the ECB's TARGET2 mechanism, which both provided a substitute for pre-crisis private capital inflows as financing mechanism for persistent current account deficits.

The issue of the appropriate adjustment mechanism for unsustainable current account deficits within the EMU is reminiscent of a discussion during world economic crisis in the 1930s. Whereas Keynes (1936) called for monetary expansion and depreciation to provide a short-term growth impulse, Hayek (1937) - in the spirit of Schumpeter (1911) - stressed the need of price and wage adjustment. The controversy between Keynes (1936) and Hayek (1937) reflected different attitudes concerning the role of the government for macroeconomic stabilization. Whereas Keynes (1936) stressed the need for a timely anti-cyclical public macroeconomic impulse, Hayek (1937) believed in the self-healing forces of the market.

The real exchange rate adjustment, which is required to rebalance the current account position of crisis countries, is framed by the theory of optimum currency areas. Building upon Friedman's (1953) advocacy of flexible exchange rates, Mundell (1961) assumed that countries with a high probability of asymmetric shocks better preserve the exchange rate as an adjustment mechanism to stabilize growth, if labour markets are rigid. This reflects the Keynesian assumption of (short-term) price and wage rigidity and the crucial role of the government for macroeconomic stabilization. In contrast, McKinnon (1963) argued that in small and open economies a fixed exchange rate serves as a macroeconomic stabilizer by absorbing nominal shocks to promote growth. To maintain a fixed exchange rate, sufficient price and wage flexibility is necessary, which is line with Hayek's (1937) and Schumpeter's

(1911) notion that declining prices and wages are the prerequisite for a robust recovery after crisis.<sup>1</sup>

The growth effects of the crisis adjustment strategies based on exchange rate or wage adjustment have a goods market and a capital market perspective. Keynes (1936) stressed the short-term dimension with a focus on goods markets. In his view depreciation in the case of crisis helps to “jumpstart” the economy as real depreciation restores instantaneously the international competitiveness. Real wages decline without cumbersome wage negotiations as inflation increases.

Hawtrey (1919), who dedicated his academic work to the deflationary consequences of the return to the gold standard, pioneered the financial market based arguments in favour a monetary expansion during crisis. He assumed that low-cost credit during crisis helps to prevent a credit crunch (which is triggered by increasing risk perception in the private banking sector) and a dismantling of investment projects. New investment is encouraged which speeding up the recovery. As a fundamental restructuring process in the economy is circumvented, dire wage cuts become dispensable, and this helps to maintain economic activity via the consumption channel.

In contrast, Hayek (1937) and Schumpeter (1911) help to understand the negative long-term growth effects of crisis therapy via monetary expansion and depreciation as restructuring is postponed. In Schumpeter’s (1911: 350) real overinvestment theory the recession is a process of uncertainty and disorder, which forces a reallocation of resources on the enterprise sector (“cleansing effect”). The reallocation is a pre-requisite for long-term growth as speculative investment is abandoned, inefficient enterprises leave the market, the efficiency of the remaining enterprises is strengthened and new enterprises, products and production processes emerge. Exchange rate depreciation during crisis is an impediment to long-term growth as the “*unadapted and unlivable*” persists (Schumpeter 1911: 367).<sup>2</sup> In this context the

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<sup>1</sup> Although the Keynesian notion of discretionary policy making is matched here with the need for exchange rate flexibility and Hayek’s belief in price and wage adjustment as crisis solution strategy is linked to exchange rate stability, this does not exclude that both authors made different policy propositions concerning the choice of exchange rate regime. Keynes’ (1980) Bancor was equivalent to a fixed exchange rate regime, whereas Hayek’s (1937) denationalization of money implies a flexible exchange rate regime. In detail Hayek (1937) embraced fixed exchange rates for a gold standard, but not for a fiat money-based international monetary system. As Kindleberger (1985: 1) puts it the “*dichotomy is not between any particular views of those great economists. It is rather more general, between one school worried about inflation and deflation of prices and the quantity of money, and the other about output and employment.*”

<sup>2</sup> Schumpeter’s (1911) argument, which has been designed for the private enterprise sector, can be applied for the government sector as well. A strong recession will trigger only structural reforms if there are restrictions on fiscal and monetary expansion in place.

exchange rate regime matters, as a fixed exchange rate (or membership in a monetary union) imposes the need for structural reforms.

The monetary overinvestment theory of Hayek (1937) allows approaching the long-term growth effects of monetary expansion and depreciation from a capital market perspective. During the upswing low interest rates set by the central bank encourage investment with declining marginal efficiency. When rising inflation urges the central bank to lift interest rates again, investment projects with low marginal return have to be dismantled. The resulting cleansing effect is the prerequisite for a sustained recovery, as only dynamic investment persists. If, however, the central bank responds to the crisis by decisive interest rate cuts, investment projects with low marginal returns, i.e. a distorted production structure, are conserved. A structurally declining interest rate level deprives the interest rate of its allocation function (which separates high-return investment from low-return investment) thereby putting a drag on long-term growth (Schnabl, 2009).

Furthermore, as stressed by Mundell (1961) the question of if the exchange rate regime has a positive or negative effect on the growth performance of countries – within an asymmetric world monetary system – hinges on the degree of business cycle synchronization with the anchor country. Because of underdeveloped goods and capital markets small and open economies have an inherent incentive to stabilize the exchange rate versus the currency of a large anchor country -- usually the dollar or the euro (Calvo and Reinhart, 2002). If business cycles are synchronized with the anchor country, the monetary policy of the anchor country will be in line with the macroeconomic needs of the small open economy. If, however, business cycles are idiosyncratic, there is a larger need to stabilize growth via exchange rate adjustment. The recent contributions of the exchange rate regime literature in the wake of the financial crisis are reviewed by Beckman et al., (2012).

Previous papers have tested for the overall average growth effects of exchange rate flexibility, partially contingent on business cycle synchronization. We augment this literature by separating between the long-term and short-term growth effects of exchange rate flexibility based on a sample of 60 small open emerging market economies with the help of an error correction framework.

### **3. Data, Flexibility Measures and Business Cycle Correlation**

To trace the short-term and long-term impact of exchange rate flexibility on growth, we choose five country groups for which the choice of the appropriate exchange rate regime has been high on the political agenda. These country groups are the EU15, Emerging Europe, East

Asia, South America and the Commonwealth of Independent States (CIS). In the EU15 as well as in Central, Eastern and Southeastern Europe (Emerging Europe) the discussion about membership in the EMU and/or the optimum degree of exchange rate stability against the euro continues to be discussed controversially.<sup>3</sup> The discussion about the pro and cons of EMU membership was revived during the most recent crisis.

In East Asia and South America the optimum degree of exchange rate stability against the dollar continues to be discussed, in particular since the Asian crisis and drastic US interest rate cuts following the subprime crisis. Most recently, Japan, China and Brazil have been involved in a discussion on “currency wars” and competitive interest rate cuts. In the Commonwealth of Independent States, Russia’s move towards a currency basket and the depreciation of the CIS currencies during the recent crisis have revived the question about the optimum exchange rate policy. In this context, the choice of the anchor currency and the degree of business cycle synchronization with the anchor country play an important role.

The five country groups include all countries of the respective region excluding microstates – which may bias the sample towards a very high positive effect of exchange rate stability on growth (Frenkel and Rose, 2002) – and excluding countries with insufficient data. This brings us to a sample size of 60 countries. Table 1 provides an overview of all countries under research, grouped into regions. We also list the prevalent anchor currencies and thereby the reference countries for measuring business cycle correlation. For the countries in East Asia, South America and the CIS the dollar has been the prevailing target of exchange rate stabilization. Business cycle correlation is measured versus the US.

For the European countries before the introduction of the euro in 1999, the German mark has been the dominant anchor currency (Gros and Thygesen, 1999). Since then, the euro has become the natural anchor for the European non-EMU countries. Exchange rate flexibility is measured in terms of exchange rate fluctuations against the German mark before 1999 and against the euro after 1999. Once a country has entered the EMU the proxy for exchange rate flexibility is set to zero. Business cycle correlation in Europe is measured versus Germany, which is the largest European economy (and therefore a country with a high degree of business cycle correlation with the euro area). For Germany, France as the second largest European economy is used as a reference country to measure business cycle correlation.

The data source is the International Financial Statistics. Missing or inconsistent data were completed and cross-checked with national statistics, mainly by national central banks. Series

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<sup>3</sup> Kočenda and Poghosyan (2009) show that new EU members should promote nominal and real convergence with the core EU members since both real and nominal factors impact the variability of their exchange rate risk.



used in estimations are at quarterly frequencies and are seasonally adjusted. Quarterly real GDP growth rates and inflation rates are calculated as year-over-year quarterly growth rates to filter out the seasonal pattern and lower the volatility of the transformed series ( $x_{it} = \ln X_{it} - \ln X_{it-4}$ ). The sample period starts in January 1994 for two reasons. First, to exclude the beginning of the 1990s, which for most of the Central, Eastern and Southeastern European and CIS countries implied high economic volatility and data uncertainty linked to the transition process. Second, to have a balanced sample the observations for all other countries start in 1994 as well. The time series end in 2010. We compute quarterly measures for trade integration as exports plus imports over GDP. Finally, we include the interest rate of the potential exchange rate anchor country as indicated in Table 1 as a proxy for external monetary conditions, which have been an important determinant of growth in emerging market economies (Maurel and Schnabl, 2012).

We use de facto exchange rate flexibility measures, because de jure flexibility measures are likely to be flawed by fear of floating.<sup>4</sup> Quarterly de facto exchange rate flexibility is measured by the standard deviation of monthly percent exchange rate changes of the respective quarter ( $\sigma$ ) and the quarterly arithmetic average of monthly percent exchange rate changes ( $\mu$ ). Both measures are summarized by the z-score ( $z = \sqrt{\sigma^2 + \mu^2}$ ) as in Schnabl (2009) and Maurel and Schnabl (2012). All three variables are calculated against the euro or the dollar, depending of the respective anchor currency as listed in Table 1.

Finally, as we aim to analyze the impact of exchange rate flexibility on growth contingent on business cycles synchronization we construct a dummy for business cycle synchronization (*Dbcc*) for every country based on the five country groups defined earlier. If business cycle correlation of specific countries with the reference country is lower than the country group average the dummy is set equal to one. The dummy is zero if the degree of business cycle correlation is above average.

#### 4. Empirical Analysis

Given the different time dimensions of economic theories concerning the impact of exchange rate flexibility/stability on growth, the issue is an empirical one. The foregoing empirical analysis aims to disentangle the long-term and short-term effect of exchange rate flexibility

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<sup>4</sup> Calvo and Reinhart (2002) show that the official (de jure) classifications of the exchange rate regime by the IMF are not necessarily in line with the practiced (de facto) exchange rate strategies of countries. Therefore, following De Grauwe and Schnabl (2008) we assume that exchange rate volatility is high in case of full exchange rate flexibility. This implies that low exchange rate volatility indicates exchange rate stabilization efforts by central banks.

on growth, which may, possibly, reconcile both strands of the literature as presented in section 2 by attributing a time dimension to them. Our model below is not derived from a standard neo-classical analysis of growth. Rather, by relying upon Schnabl (2009) or Maurel and Schnabl (2012) it principally correlates quarterly growth rates and exchange rate flexibility.

#### 4.1. Model Specification and Estimation Procedure

We model changes in economic growth ( $w_{it}$ ) as a function of exchange rate flexibility / volatility (ERF), inflation (INF), interest rate (IR), trade openness (TO) and trend (T) proxies for changes in technology. Equation (1) is our benchmark specification:

$$w_{it} = \alpha_{0i} + \alpha_{1i}ERF_{it} + \alpha_{2i}INF_{it} + \alpha_{3i}IR_{it} + \alpha_{4i}TO_{it} + \alpha_{5i}T_t + \varepsilon_{it}, \quad (1)$$

where subscripts  $i$  and  $t$  represent country and time period indices, respectively, and  $\alpha_{0i}$  and  $\varepsilon_{it}$  are country-specific intercepts and error terms. The dependent variable  $w_{it}$  represents the quarterly real growth rates from 1994 to 2010. Exchange rate flexibility ( $ERF_{it}$ ) is to account for the long-run effect of exchange rate policy. We use three different measures of exchange rate flexibility / volatility as described above: standard deviation, mean of percent exchange rate changes against the anchor currency, and z-score. Further, we employ theoretically motivated explanatory variables that affect economic growth via direct or indirect channels. Inflation ( $INF_{it}$ ) serves as a control variable for macroeconomic instability. The interest rate of the anchor country ( $IR_{it}$ ) accounts for the influence of the price of money with respect to growth. Finally, we include trade openness ( $TO_{it}$ ) to account for the extent of the international economic integration, and a time trend ( $T_t$ ) to reflect unobserved technological change.

We assume that the latter variables have an impact on the long-term economic performance while they do not matter in the short-term. There is a large number of other potential explanatory variables like investment, government spending, schooling, etc. which could increase the fit of the model. However, these variables would also generate endogeneity (for instance between investment and growth) and multicollinearity (for instance between government spending and inflation) as argued by De Grauwe and Schnabl (2008). Therefore, we opt for a parsimonious specification, restricted to the variables mentioned above.

As a next step we modify our benchmark model into specification (2) in order to account for the effect of asymmetric countries:

$$w_{it} = \alpha_{0i} + \alpha_{1i}ERF_{it} + \alpha_{2i}ERF_{it}^{asm} + \alpha_{3i}INF_{it} + \alpha_{4i}IR_{it} + \alpha_{5i}TO_{it} + \alpha_{6i}T_t + u_{it} \quad (2)$$

In specification (2), we control for the fact that countries with asymmetric business cycles face bigger constraints to achieve the same growth when compared to countries without

asymmetries. To do so we include additional variable  $ERF_{it}^{asm}$  that is constructed as  $ERF_{it}$  multiplied by the dummy variable  $Dbcc$  capturing asymmetric business cycle (defined in section 3). Hence, the variable  $ERF_{it}^{asm}$  takes the value of the specific flexibility measure only for countries characterized by relative asymmetric business cycles, and does not enter estimation for countries that do not exhibit asymmetric business cycles. The inclusion of the interaction term ( $ERF_{it}^{asm}$ ) aims to capture the short-term nature of asymmetric shocks.

Prior to estimation we test for the stationarity of the employed variables by several panel unit root tests (results not reported; available upon request). We find that the quarterly growth rate, inflation, and three measures of exchange rate flexibility are stationary, whereas trade openness, interest rate and by construction a trend, are integrated of order one. While the explained variable is stationary, the panel of explanatory variables combines stationary and nonstationary variables. This leaves open the possibility for the estimated specifications to be embedded in a dynamic error-correction model (ECM).

Similarly as in Elbadawi et al. (2012) we estimate an ECM version of the specifications (1) and (2) for our panel of 60 countries over the period 1994-2010. The details on the dynamic specifications ARDL are given in the Tables 2-4. Three econometric estimation frameworks are chosen for the ECM for panel data: pooled mean group, mean group, and dynamic fixed-effects estimators. The most restrictive is the dynamic fixed-effects estimator that assumes that all parameters are constant across countries, except for the intercept, which is allowed to vary across countries. The pooled mean group estimator is more general than the dynamic fixed-effects estimator as it imposes the restriction that all countries share the long-term coefficients. The mean group estimator is even more general as it assumes that economies differ in their short-term and long-term parameters.

The choice between the three estimators entails a tradeoff between consistency and efficiency. The dynamic fixed-effects estimator dominates the other two in terms of efficiency if the restrictions are valid. If they are not valid, the dynamic fixed effects will generate inconsistent estimates and is dominated by the pooled mean group and mean group estimates. The pooled mean group estimator can be assumed to offer the best compromise between consistency and efficiency, because one would expect the long-term growth path to be driven by a similar process across countries while the short-term dynamics around the long-term equilibrium path differ because of idiosyncratic news and shocks to fundamentals. Following the above arguments we perform formal Hausman tests of the implied restrictions.

By estimating both specifications (1) and (2) our objective is threefold: to highlight the impact of exchange rate flexibility on growth, to disentangle the short-term versus long-term

effect of exchange rate flexibility on growth, and to quantify the weight of countries with asymmetric business cycles (which we call asymmetric countries) in this impact. Our prior is that the impact of exchange rate flexibility should be positive in the short term, especially for asymmetric countries, but negative in the long term.

#### *4.2. Estimation Results*

The econometric estimation results are presented in Tables 2 to 4. The results are organized in a way that columns labeled as 1 contain an overall effect via coefficients from specification (1), while columns labeled as 2 show the effects from specification (2) where we account for asymmetry in business cycle correlation. The null hypothesis of equality of coefficients between pooled mean group and mean group is in most cases rejected at 1 % level. The Hausman test favors the mean group model (Table 2) against the pooled mean group estimator (Table 3).<sup>5</sup> The dynamic fixed effects estimates are presented in Table 4. All estimates support our main assumptions regarding the long- versus short-run impact of exchange rate flexibility on growth and the more specific case of asymmetric countries.

The mean group results as presented in Table 2 suggest a negative effect of exchange rate flexibility on growth in the long term and a positive effect of exchange rate flexibility on growth in the short term. For all three flexibility measures (standard deviation, average yearly change, and z-score) exchange rate flexibility has a highly significant negative effect on growth in the long term, when controlling for interest rates in the anchor country, trade openness, and inflation. Both trade openness and the interest rate in the large reference country have the expected signs and are highly significant. Open economies grow faster and the gradual decline of the interest rate level in the large anchor countries (US, euro area, Germany) seems to have boosted growth in the emerging market economies. In the long term higher growth levels are linked to higher inflation levels.<sup>6</sup> The coefficient of the interaction term is significant for the z-score measure and insignificant for the other two flexibility measures. Negative coefficients for the interaction term indicate an additional negative effect of exchange flexibility for asymmetric countries in the long run.

In the short-run there is a positive effect of exchange rate flexibility (volatility) on growth for average change as flexibility measure, significant at 1% percent. In all other cases (five

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<sup>5</sup> The mean group estimator of Pesaran and Smith (1995) is consistent but not a good estimator when either N or T is small. Hence, we consider results of the pooled mean group estimator on par with those of the mean group estimator.

<sup>6</sup> Due to the lack of convergence during the estimation the inflation term is dropped from the equation in the specification with standard deviation as a proxy for exchange rate flexibility.

out of six), the overall coefficients of the short-term impact of exchange rate flexibility on growth are positive but not significant. Coefficients of the interaction term in the short run are positive but statistically insignificant. This indicates that positive impact of exchange flexibility is magnified for asymmetric countries in the short-run but statistical insignificance prevents us to draw a firm inference. In the short-run equation there is mostly no evidence for a significant positive impact of inflation on growth.

The results of our preferred estimates, obtained through the pooled mean group estimation, are presented in Table 3. They are mainly in line with the mean group estimation and therefore can be regarded as evidence for the robustness of the results. The long-run effect of exchange rate flexibility on growth is clearly negative, significant at the 1% level for all flexibility measures. For countries with asymmetric business cycles there is an additional, even larger negative effect of exchange rate flexibility on growth. In the pooled mean group estimations inflation has no significant positive long-run impact on growth. Openness and declining interest rates in the reference country are clearly associated with higher growth.

In contrast, in the short run exchange rate flexibility mostly seems to be positively linked to higher growth, with average exchange rate changes being significant at 1% level and standard deviations at 5% level.<sup>7</sup> The interaction term identifies an additional and positive effect of exchange rate flexibility on growth for asymmetric countries in two out of three cases (standard deviation and z-score), suggesting that the effect of exchange rate flexibility on short-run growth is driven by the asymmetric countries. In contrast to the long-term coefficient a statistically significant positive link between inflation and growth is revealed.

The results of the dynamic fixed effects estimation are reported in Table 4. The negative long-term effect of exchange rate flexibility on growth remains highly significant for all three flexibility measures. There is no statistically significant long-term impact of inflation on growth. The highly significant impact of trade openness and interest rates changes in the anchor country on growth in our sample is confirmed. For countries with asymmetric business cycles an additional negative effect of exchange rate flexibility on growth is suggested. In the short-run a highly significant positive impact of exchange rate flexibility on growth is revealed. The estimates based on average change confirm that this positive impact is imputable to the presence of asymmetric countries. For the other two estimates, the positive effect of exchange rate flexibility on short-run growth applies to countries with or without

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<sup>7</sup> Bubák et al. (2011) show that exchange rate volatility increases in medium-term for some new EU countries with troubled financial sector development. Hanousek and Kočenda (2011) document capital market spillovers on the same set of countries.

comparatively synchronized business cycles. The dynamic fixed effects estimation does not reveal any significant short-term link between inflation and growth.

All in all, the estimations provide evidence in favor of the hypothesis that in the short-run exchange rate flexibility helps to smooth the business cycle, in particular for countries with idiosyncratic business cycles. In contrast, in the long-run the impact of exchange rate flexibility on growth is clearly negative. The positive impact of exchange rate flexibility on growth in the short-term supports the policy propositions of Keynes (1936), Hawtrey (1919), and Mundell (1961), whereas negative long-run impact of exchange rate flexibility on growth is in line with Hayek (1937), Schumpeter (1911), and McKinnon (1963). Finally, positive impact of the short-run exchange flexibility is magnified for asymmetric countries and helps to smooth out asymmetric shocks in the short run.

#### *4.3. Diagnostic checking*

We complement our analysis by diagnostic checking; results are in Table 5. We perform panel-unit root tests designed by Choi (2001) and a battery of Westerlund (2007) tests for cointegration. The results show that the residuals are stationary for both estimated specifications (with or without accounting for the business cycle asymmetry). Further, no matter what exchange rate flexibility measure is used (standard deviation, average, or z-score) the results show that the variables are cointegrated; in all cases, two out of the four statistics proposed by Westerlund (2007) reject the null of no cointegration. Finally, it should be noted that Pesaran et al. (1999) show that pooled mean group estimation does not require pretesting for unit roots and cointegration, and that pooled mean group estimation provides consistent and efficient estimates of parameters in a long-run relationship between stationary and integrated variables.

### **5. Conclusion**

With the European sovereign debt crisis a controversial discussion concerning the appropriate monetary policy and exchange rate strategy to asymmetric shocks and crisis has reemerged. We have aimed to derive from our econometrical exercise for a panel of 60 countries a policy recommendation for crisis countries. Our estimation results provide evidence that exchange rate adjustment stimulates growth in the short-term, but puts a drag on the long-term growth performance. As the overall effect is negative, the policy implication is to keep exchange rates stable to promote long-term growth via price and wage flexibility, in the spirit of Schumpeter (1911), Hayek (1937), and McKinnon (1963).

In line with Schnabl (2009) and based on our findings we recommend the crisis countries to proceed with structural reforms and real wage cuts. Painful restructuring and declining output today are likely to be rewarded with a robust economic recovery and rising income in the future. In contrast, monetary expansion and depreciation as a crisis solution strategy can be expected to provide short-term relief, but long-term pain. Mutual monetary expansion would lead into a wave of competitive depreciations and competitive interest rate cuts, and therefore global financial and economic instability. This would be an antidote of the coordinated structural reforms.

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**Table 1**  
**Groups of countries**

<b>Country group</b>	<b>Anchor currency Reference country</b>	<b>Countries</b>
EU15	Euro/DM Germany	Austria, Belgium, Denmark, Finland, France, Germany*, Greece, Ireland, Italy, Luxemburg, Netherlands, Portugal, Spain, Sweden, UK
Emerging Europe	Euro/DM Germany	Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Macedonia, Latvia, Lithuania, Poland, Romania, Serbia, Slovak Republic, Slovenia, Turkey
CIS	Dollar US	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Ukraine
East Asia	Dollar US	China, Hong Kong, Indonesia, Japan, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand
Latin America	Dollar US	Argentina, Bolivia, Brazil, Chile, Columbia, Ecuador, Paraguay, Peru, Uruguay, Venezuela

\* France, as the second largest country of the European Union, is used as a reference country for Germany.

Table 2 The Short- and Long-Run Effects on the aggregate output growth (mean group estimator)

Variable	Exchange Rate Flexibility Measures					
	Average change		Standard deviation		z-score	
	1	2	1	2	1	2
<i>Long-run coefficients</i>						
ER flexibility	-0.7350 <sup>a</sup> (0.2702)	-0.3668 (0.2478)	-0.8099 <sup>a</sup> (0.2833)	-1.1610 <sup>b</sup> (0.5552)	-0.6116 <sup>a</sup> (0.2625)	-1.1808 <sup>b</sup> (0.5107)
ER flexibility for asymmetric countries		-0.7934 (1.8618)		1.1930 (0.8224)		-1.3587 <sup>b</sup> (0.5899)
Inflation	0.3236 <sup>b</sup> (0.1415)	0.2796 <sup>b</sup> (0.1292)			0.3112 <sup>a</sup> (0.1146)	0.2924 <sup>b</sup> (0.1221)
Interest rate	-1.3806 <sup>a</sup> (0.4788)	-1.2928 <sup>a</sup> (0.4333)	-1.1143 <sup>a</sup> (0.3531)	-1.2209 <sup>a</sup> (0.3793)	-1.2629 <sup>a</sup> (0.4173)	-1.3436 <sup>a</sup> (0.4338)
Trade openness	0.2916 <sup>a</sup> (0.0925)	0.3075 <sup>a</sup> (0.0930)	0.2713 <sup>a</sup> (0.0913)	0.2829 <sup>a</sup> (0.0908)	0.2927 <sup>a</sup> (0.0922)	0.3063 <sup>a</sup> (0.0920)
Trend	-0.0015 <sup>a</sup> (0.0004)	-0.0015 <sup>a</sup> (0.0004)	-0.0011 <sup>a</sup> (0.0004)	-0.0012 <sup>a</sup> (0.0004)	-0.0012 <sup>a</sup> (0.0004)	-0.0013 <sup>a</sup> (0.0004)
<i>Error correction coefficients</i>						
	-0.3716 <sup>a</sup> (0.0326)	-0.3851 <sup>a</sup> (0.0381)	-0.3605 <sup>a</sup> (0.0279)	-0.3679 <sup>a</sup> (0.0325)	-0.3611 <sup>a</sup> (0.0256)	-0.3613 <sup>a</sup> (0.0263)
<i>Short-run coefficients</i>						
Δ ER flexibility	0.1027 <sup>a</sup> (0.0414)	0.0703 (0.0732)	0.0796 (0.0617)	0.0642 (0.1029)	0.0411 (0.0530)	-0.0790 (0.0867)
Δ ER flexibility for asymmetric countries		0.0957 (0.1596)		0.0251 (0.1130)		0.0381 (0.0843)
Δ Inflation	0.0123 (0.0275)	0.0224 (0.0266)	0.0444 <sup>c</sup> (0.0271)	0.0368 (0.0268)	0.0071 (0.0276)	0.0014 (0.0298)
Intercept	-0.0329 (0.0224)	-0.0391 (0.0229)	-0.0301 (0.0214)	-0.0325 (0.0218)	-0.030 (0.0221)	-0.0275 (0.0221)

Note: Columns denoted by 1 contain results from specification (1) and columns denoted by 2 contain results from specification (2) that includes exchange rate flexibility measure for asymmetric countries. Dynamic specifications are: ARDL (1,1,1,0,0,0) for specification (1), ARDL (1,1,1,1,0,0,0) for specification (2).

Significance levels at 1, 5, and 10% are denoted by <sup>a</sup>, <sup>b</sup>, and <sup>c</sup>, respectively. ER flexibility denotes one of the three exchange rate flexibility measures used; e.g. average change, standard deviation, and z-score. Numbers in parentheses are standard errors.

Table 3 The Short- and Long-Run Effects on the aggregate output growth (pooled mean group estimator)

Variable	Exchange Rate Flexibility Measures					
	Average change		Standard deviation		z-score	
	1	2	1	2	1	2
<i>Long-run coefficients</i>						
ER flexibility	-0.7788 <sup>a</sup> (0.1203)	-0.3494 <sup>a</sup> (0.1465)	-0.8403 <sup>a</sup> (0.0672)	-0.7577 <sup>a</sup> (0.1019)	-0.8576 <sup>a</sup> (0.0949)	-1.2185 <sup>a</sup> (0.1454)
ER flexibility for asymmetric countries		-0.8059 <sup>a</sup> (0.2278)		-0.1596 (0.1446)		-0.3974 <sup>b</sup> (0.1824)
Inflation	0.0106 (0.0239)	0.0194 (0.0219)			0.0046 (0.0250)	-0.0067 (0.0293)
Interest rate	-1.0386 <sup>a</sup> (0.1924)	-1.0144 <sup>a</sup> (0.1922)	-0.3793 <sup>a</sup> (0.1229)	-0.3719 <sup>a</sup> (0.1213)	-0.9544 <sup>a</sup> (0.1828)	-0.9607 <sup>a</sup> (0.1841)
Trade openness	0.0370 <sup>a</sup> (0.0092)	0.0360 <sup>a</sup> (0.0090)	0.0559 <sup>a</sup> (0.0111)	0.0569 <sup>a</sup> (0.0112)	0.0795 <sup>a</sup> (0.0153)	0.0829 <sup>a</sup> (0.0154)
Trend	-0.0009 <sup>a</sup> (0.0001)	-0.0009 <sup>a</sup> (0.0001)	-0.0005 <sup>a</sup> (0.001)	-0.0005 <sup>a</sup> (0.0001)	-0.0013 <sup>a</sup> (0.0001)	-0.0013 <sup>a</sup> (0.0001)
<i>Error correction coefficients</i>	-0.2401 <sup>a</sup> (0.0169)	-0.2376 <sup>a</sup> (0.0172)	-0.2681 <sup>a</sup> (0.0224)	-0.2655 <sup>a</sup> (0.0225)	-0.2416 <sup>a</sup> (0.0163)	-0.2350 <sup>a</sup> (0.0164)
<i>Short-run coefficients</i>						
Δ ER flexibility	0.1141 <sup>a</sup> (0.0306)	0.0902 (0.0852)	0.0845 <sup>b</sup> (0.0433)	0.0045 (0.0505)	0.0476 (0.0346)	-0.0260 (0.0363)
Δ ER flexibility for asymmetric countries		0.07066 (0.1158)		0.1662 <sup>a</sup> (0.0589)		0.0766 <sup>c</sup> (0.0504)
Δ Inflation	0.0441 <sup>b</sup> (0.0211)	0.0412 <sup>b</sup> (0.0214)	0.0412 <sup>b</sup> (0.0186)	0.0391 <sup>b</sup> (0.0185)	0.0377 <sup>c</sup> (0.0199)	0.0339 <sup>c</sup> (0.0196)
Intercept	0.0208 <sup>a</sup> (0.0021)	0.0201 <sup>a</sup> (0.0021)	0.0111 <sup>a</sup> (0.002)	0.0103 <sup>a</sup> (0.0021)	0.0197 <sup>a</sup> (0.0025)	0.0204 <sup>a</sup> (0.0026)
Hausman test (mean against pooled mean group)	19.35 [0.00]	21.66 [0.00]	10.43 [0.03]	14.25 [0.01]	16.53 [0.00]	34.52 [0.00]

Note: Columns denoted by 1 contain results from specification (1) and columns denoted by 2 contain results from specification (2) that includes exchange rate flexibility measure for asymmetric countries. Dynamic specifications are: ARDL (1,1,1,0,0,0) for specification (1), ARDL (1,1,1,1,0,0,0) for specification (2).

Significance levels at 1, 5, and 10% are denoted by <sup>a</sup>, <sup>b</sup>, and <sup>c</sup>, respectively. ER flexibility denotes one of the three exchange rate flexibility measures used; e.g. average change, standard deviation, and z-score. Numbers in parentheses are standard errors. Brackets contain *p*-values for Hausman test.

Table 4 The Short- and Long-Run Effects on the aggregate output growth (dynamic fixed effects)

Variable	Exchange Rate Flexibility Measures					
	Average change		Standard deviation		z-score	
	1	2	1	2	1	2
<i>Long-run coefficients</i>						
ER flexibility	-1.0176 <sup>a</sup> (0.1681)	-0.7831 <sup>a</sup> (0.2064)	-0.8444 <sup>a</sup> (0.1983)	-0.7437 <sup>a</sup> (0.2360)	-0.7056 <sup>a</sup> (0.1767)	-0.5959 <sup>a</sup> (0.2274)
ER flexibility for asymmetric countries		-0.4942 <sup>c</sup> (0.2831)		-0.2946 (0.4120)		-0.2807 (0.2959)
Inflation	0.0367 (0.0314)	0.0391 (0.0319)			0.0282 (0.0353)	0.0303 (0.0346)
Interest rate	-0.6735 <sup>a</sup> (0.2013)	-0.6844 <sup>a</sup> (0.2007)	-0.5612 <sup>a</sup> (0.1890)	-0.5672 <sup>a</sup> (0.1888)	-0.5828 <sup>a</sup> (0.1941)	-0.5967 <sup>a</sup> (0.1910)
Trade openness	0.0617 <sup>a</sup> (0.0200)	0.0614 <sup>a</sup> (0.0199)	0.0518 <sup>b</sup> (0.0205)	0.0519 <sup>a</sup> (0.0202)	0.0502 <sup>a</sup> (0.0177)	0.0509 <sup>a</sup> (0.0174)
Trend	-0.0008 <sup>a</sup> (0.0002)	-0.0009 <sup>a</sup> (0.0003)	-0.0007 <sup>a</sup> (0.0002)	-0.0007 <sup>a</sup> (0.0002)	-0.0008 <sup>a</sup> (0.002)	-0.0008 <sup>a</sup> (0.0002)
<i>Error correction coefficients</i>	-0.2731 <sup>a</sup> (0.0184)	-0.2729 <sup>a</sup> (0.0186)	-0.2744 <sup>a</sup> (0.0181)	-0.2748 <sup>a</sup> (0.0179)	-0.2740 <sup>a</sup> (0.0183)	-0.2748 <sup>a</sup> (0.0181)
<i>Short-run coefficients</i>						
Δ ER flexibility	0.1372 <sup>a</sup> (0.0294)	0.0772 <sup>b</sup> (0.0314)	0.1122 <sup>a</sup> (0.0423)	0.0996 <sup>a</sup> (0.0368)	0.0805 <sup>a</sup> (0.0312)	0.0627 <sup>b</sup> (0.0321)
Δ ER flexibility for asymmetric countries		0.1143 <sup>b</sup> (0.0532)		0.0278 (0.0719)		0.0427 (0.0471)
Δ Inflation	-0.0097 (0.0121)	-0.0093 (0.0122)	-0.0101 (0.0120)	-0.0106 (0.0123)	-0.0103 (0.0122)	-0.0111 (0.0124)
Intercept	0.0125 <sup>a</sup> (0.0052)	0.0127 <sup>b</sup> (0.0052)	0.0156 <sup>a</sup> (0.0052)	0.0158 <sup>a</sup> (0.0053)	0.0167 <sup>a</sup> (0.0049)	0.0169 <sup>a</sup> (0.0051)
Hausman test (mean group against fixed effects)	0.02 [1.00]	0.02 [1.00]	0.01 [1.00]	0.02 [1.00]	0.02 [1.00]	0.03 [1.00]

Note: Columns denoted by 1 contain results from specification (1) and columns denoted by 2 contain results from specification (2) that includes exchange rate flexibility measure for asymmetric countries. Dynamic specifications are: ARDL (1,1,1,0,0,0) for specification (1), ARDL (1,1,1,1,0,0,0) for specification (2).

Significance levels at 1, 5, and 10% are denoted by <sup>a</sup>, <sup>b</sup>, and <sup>c</sup>, respectively. ER flexibility denotes one of the three exchange rate flexibility measures used; e.g. average change, standard deviation, and z-score. Numbers in parentheses are standard errors. Brackets contain *p*-values for Hausman test.

Table 5: Diagnostic checking of the residuals and cointegration

<i>Flexibility measure</i>		z-score						
<i>Model specification</i>		1			2			
		Statistics	Z Values	P Values		Statistics	Z Values	P Values
Panel unit-root tests of the residuals	P	359.2075		0.000	P	385.5133		0.000
	Z	-9.855		0.000	Z	-10.6779		0.000
	L*	-12.518		0.000	L*	-13.5948		0.000
	Pm	18.008		0.000	Pm	19.8499		0.000
Tests of cointegration	G1	-3.828	-12.192	0.000	G1	-4.088	-11.048	0.000
	G2	-19.831	-9.491	0.000	G2	-10.864	2.434	0.993
	P1	-24.745	-10.877	0.000	P1	-22.440	-6.723	0.000
	P2	-20.013	-12.894	0.000	P2	-9.172	0.647	0.741
<i>Flexibility measure</i>		Standard deviation						
<i>Model specification</i>		1			2			
Panel unit-root tests of the residuals	P	367.6745		0.000	P	406.1817		0.000
	Z	-9.7014		0.000	Z	-10.9242		0.000
	L*	-12.465		0.000	L*	-14.1442		0.000
	Pm	18.6009		0.000	Pm	21.2970		0.000
Tests of cointegration	G1	-4.265	-13.470	0.000	G1	-4.100	-10.884	0.000
	G2	-10.361	1.178	0.881	G2	-10.713	2.501	0.994
	P1	-22.456	-8.163	0.000	P1	-22.010	-6.628	0.000
	P2	-8.705	-0.561	0.287	P2	-8.901	0.838	0.799
<i>Flexibility measure</i>		Average change						
<i>Model specification</i>		1			2			
Panel unit-root tests of the residuals	P	464.134		0.000	P	455.8971		0.000
	Z	-12.5923		0.000	Z	-12.3615		0.000
	L*	-16.7280		0.000	L*	-16.3874		0.000
	Pm	25.3545		0.000	Pm	24.7778		0.000
Tests of cointegration	G1	-3.963	-11.506	0.000	G1	-3.905	-9.617	0.000
	G2	-8.725	2.591	0.995	G2	-8.783	4.036	1.000
	P1	-22.069	-7.846	0.000	P1	-20.578	-5.428	0.000
	P2	-7.938	0.078	0.531	P2	-8.125	1.426	0.923

Notes: Panel unit-root tests of the residuals are based on Choi (2001). The following notation denote the tests: P - inverse chi-squared; Z - inverse normal; L\* - inverse logit; Pm - modified inverse Chi-squared. Tests of cointegration are based on Westerlund (2007). Two tests are designed to test the alternative hypothesis that the panel is cointegrated as a whole (namely panel test; P1 and P2), whereas the two other test the null hypothesis of no cointegration against the alternative that at least one element in the panel is cointegrated (namely group-mean tests; G1 and G2).