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Increase in Home Bias and the Eurozone Sovereign Debt Crisis *

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Abstract: One of the most striking consequences of the recent episode of sovereign debt market stress in the Eurozone has been the increase in the share of public debt held by the domestic sector in fragile economies. First, we identify the shocks that explain most of the variation in this share in an S-VAR model on a sample of 7 Eurozone countries between 2007 and 2012. Home bias in sovereign debt responds positively to fundamentals and expectations shocks but we find no evidence that the increase in home bias is destabilizing per se. Second, we theoretically investigate the impact of exogenous variations in fundamentals and expectations in a simple model of debt crisis with endogenous home bias in sovereign debt. We derive conditions under which home bias increases and is associated with a change in the government's strategic decision regarding default. Finally, we discuss which case of the model best applies to the distinct countries in our sample during the recent sovereign debt crisis in the Eurozone.

JEL classification: E4, E5, F3, G15.

Keywords: Eurozone, Sovereign debt crises, Home bias, Bayesian panel S-VAR.

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1 Introduction

One of the most striking and seemingly surprising consequences of the recent episode of sovereign debt market stress in the Eurozone has been the increase in the share of public debt held by the domestic sector in fragile economies (see Merler and Pisani-Ferry (2012) and Van Riet (2014)). Despite a deep turmoil period on the public debt market of the peripheral Eurozone countries, residents have significantly increased their purchases of domestic sovereign bonds, both in volume and in proportion. By the end of March 2012, the share of public debt held by the domestic sector was above 40% in all GIIPS countries, and close to 60% in Italy and 70% in Spain (Andritzky (2012)).

This paper argues that the increase in home bias in sovereign debt¹ during the recent Eurozone sovereign debt crisis results from rising incentives for domestic investors to buy domestic public debt relative to foreigners following an increase in the expected probability of default. The paper empirically identifies the macroeconomic factors that can prompt home bias in sovereign debt to increase and theoretically determines the consequences on the government's strategic decision to default in the Euro area.²

Using a Bayesian Structural VAR estimation that relies on a sample of 7 Eurozone countries between 2007Q1 and 2012Q1, we go beyond the descriptive empirical facts by determining the shocks that affect most of the dynamics in home bias in our sample and by providing some additional results on the direct consequences of a variation in home bias in the Eurozone. We show that fundamental shocks and country-specific expectations shocks are the two main contributors to increased

¹As Acharya et al. (2012), we consider that '*Home bias in government debt is total home sovereign debt as a share of total sovereign debt*' (p. 54). Our definition may differ from the commonly accepted definition, according to which home bias is the propensity of investors to make financial investments in their home countries rather than in foreign markets (home bias in portfolios).

²The impact of an increase in home bias on other economic outcomes, such as banking risk, is beyond the scope of the paper.

home bias in our empirical model. In addition, we find no evidence that, everything else being equal, an increase in home bias per se leads to a decrease in the growth rate or to an increase in the spreads in our sample.

We then propose a simple model of sovereign debt crises in a monetary union, the assumptions of which are supported by our empirical results. We model the decision of an optimizing government attempting to minimize the economic and political costs of its fiscal policy— the cost of taxation and the cost of default, which both depend on home bias. The model provides microfoundations to explain the recent increase in home bias in the Eurozone and illustrates the mechanism through which the government’s decision regarding default is affected when home bias increases. Differently to standard second-generation models of self-fulfilling debt crises, the equilibrium interest rate on domestic sovereign bonds and the equilibrium home bias arise endogenously in the model when market clears. Our empirical results then allow us to focus on two distinct exogenous sources of variation affecting the equilibrium. We derive sufficient conditions under which a suddenly higher fiscal fundamental and suddenly more pessimistic expectations shift the initial market equilibrium – if any – towards higher interest rate and home bias. We then identify a straightforward necessary and sufficient condition such that the variation in investors’ decision leads to a switch in the government’s decision from a non-default to a default equilibrium.

If the increase in home bias has any effect per se, it is to make sovereign default less likely. The switch thus depends on the extent to which the stabilizing impact of the endogenous increase in home bias mitigates the destabilizing impact of the exogenous source of increased vulnerability. Finally, we identify which case of the model best applies to the distinct countries of our sample.

To the best of our knowledge, no other work investigates the reasons for the recent increase in home bias in sovereign debt in the Eurozone by distinguishing fundamental and self-fulfilling factors and gathers in a theoretical model of debt crisis

the several effects of home bias on the government's fiscal decision, – identified in prior studies – to derive simple implications.

Our paper relates to De Grauwe (2011) and Gros (2012), who – in line with the literature on second-generation speculative attack models (Obstfeld (1994), Obstfeld (1996)) and its application to sovereign debt crisis³ – analyze the recent European debt crisis as a self-fulfilling, speculative dynamic. These papers show that crises can be triggered by creditors' sudden pessimism, leading them to refuse to buy debt or to demand high interest rates. However, none of these papers address the role of home bias in sovereign debt.

Regarding home bias, recent literature has focused on its impact on the transmission of sovereign risk to the banking sector (Acharya et al. (2014)) rather than on its direct impact on default decisions. Broner et al. (2014), Mengus (2014) and Gennaioli et al. (2014) are recent exceptions. Broner et al. (2014) argue that creditors' discrimination can favor purchases of sovereign debt by domestic investors. Because of financial frictions, this can lead to crowding-out effects by disrupting domestic productive investment, and lower growth. Similarly to us, Mengus (2014) argues that home bias increases the government's internal cost of default.⁴ This cost arises endogenously in Gennaioli et al. (2014), who also provide empirical evidence showing that higher home bias in sovereign debt portfolios increases the cost of default. Nevertheless, none of these papers address the role of home bias in the government's decision through the cost of taxation and investigate the consequences of exogenous changes in both fundamentals and expectations in order to

³First models of self-fulfilling sovereign debt crises include Calvo (1988) and Cole and Kehoe (2000). This category of models was recently applied to the current crisis (Lorenzoni and Werning (2013), Aguiar et al. (2014), Corsetti and Dedola (2014) and Blot et al. (2014)). De Grauwe (2011), De Grauwe and Ji (2013), Bruneau et al. (2014) and Schumacher (2014) among others, have shown the empirical relevance of the theory of self-fulfilling prophecies in the context of the recent Eurozone debt crisis.

⁴In his model, home bias results from the bailout of domestic investors, whereas in our model, home bias arises more generally from the increasing divergence between implicit returns on domestic public debt for domestic and foreign creditors when the expected probability of default increases.

match the result of empirical tests in the specific context of the Eurozone sovereign debt crisis.

Empirically, Battistini et al. (2014) study how home bias, seen as a measure of market segmentation, responds to yields differentials in the Eurozone. Brutti and Saure (2014) investigate the impact of experiencing a crisis (defined by a threshold on bond yields) on home bias with a static panel model. Because none of those papers aim at addressing the consequences of an increasing home bias on the decision of default, they focus on home bias in banks' portfolios, defined as the domestic sovereign debt holdings of the banks in one country scaled by their total assets. By contrast, we address a general measure of home bias in sovereign debt, the one that matters for the government's decision. As Brutti and Saure (2014), we emphasize the importance of country-specific factors in explaining home bias, but we distinguish between fundamental and expectations shocks (both being indirect shocks on the probability of default) and we investigate bi-directional transmission patterns, which justifies that we rely on an S-VAR model which allows to investigate various dynamic interdependencies.

Relying on a sample of advanced economies, Andritzky (2012) shows that the share of public debt held abroad responds positively to negative yield shocks in the Euro area thanks to a panel VAR model. The author does not find proof of a reverse causality effect, which is consistent with our results. Whereas Andritzky focuses on disentangling the causal relationship between sovereign bond yields and the share of debt held by foreigners, we analyze the impact of distinct structural shocks on the dynamics of home bias.

The next section presents empirical facts about home bias in the Eurozone and performs econometric analyses that are useful for selecting the main assumptions of our theoretical model. Section 3 develops the model of debt crisis with endogenous home bias. Section 4 discusses which case of the model best applies to the distinct countries in our sample. Section 5 concludes the paper.

2 Home bias in the Eurozone

In the following section, we identify recent features in the origin and evolution of home bias in sovereign debt that are specific to the Eurozone. We then analyze the shocks that explain most of the variation in home bias in our sample using a panel S-VAR model and provide additional results on the impact of home bias on the other endogenous variables.

2.1 Evolution and origin of home bias in sovereign debt

Four main features regarding the recent evolution of home bias in sovereign debt can be identified in the Eurozone as shown in Figure 1.⁵

First, there was an increase in home bias during the Euro area sovereign debt crisis. The proportion of domestic holding of public debt significantly decreased since the creation of the Eurozone in 1999, revealing a deepening of European financial markets integration (Figure 1 a). Nonetheless, home bias began increasing again in most Eurozone countries except Germany, in the aftermath of the global financial crisis and the consecutive debt crisis in the Eurozone.⁶ Thus, the increase in home bias started at the end of 2008 or the beginning of 2009 in peripheral Eurozone countries.

Second, the increase in home bias seems to be higher in the most fragile Eurozone economies, such as Greece, Italy, Spain, Ireland and Portugal (Figure 1 b).

Third, the increase in home bias has distinct features across European countries.

⁵Notice that the facts that we emphasize here deal with variation in home bias, and not with the level of home bias, in a particular context of stress on the sovereign debt market in a monetary union. Consequently, we focus on the causes and consequences of a short-term increase in home bias in this particular context rather than on structural factors. The case we investigate is thus different from that of Japan, where home bias in public debt is known to be structurally high (90% in the first quarter of 2012, according to Andritzky's database), but stable. Therefore, the high Japanese home bias does not seem to be the short-term result of unexpected destabilizing macroeconomic shocks.

⁶In the case of France, the increase in home bias is more recent than in other countries. Therefore, it is not visible in Figure 1 b but it is visible in Figure 1 a.

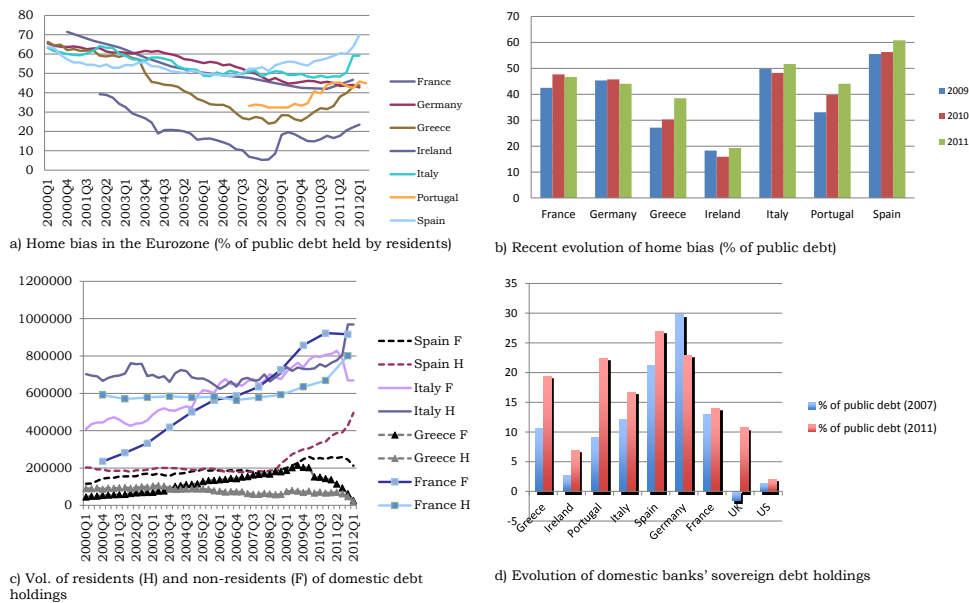


Figure 1: Evolution and origin of home bias - Sources: Andritzky (2012) (a, b, c); Merler and Pisani-Ferry (2012) (d).

In Italy, Spain and Ireland, the increase is due to a decrease in the volume of public debt held by non-residents simultaneous to an increase in the volume of public debt held by residents. In Greece, it is due to a decrease in both volumes in the most recent quarters (Figure 1 c). In France, the increase is due to the increasing volume of public debt held by residents, which has recently grown faster than the volume of public debt held by non-residents.

Fourth, domestic public debt holding in the Eurozone is mainly concentrated in the banking and financial sectors, which deepens the intertwining between sovereign debt risk and banking sector risk (Acharya et al. (2014)). More notably, this intertwining has recently increased, with a stronger exposure of domestic banks to

domestic sovereign debt (Figure 1 d). This feature is clearly more significant in the Eurozone compared with the UK and the US.

We now conduct empirical tests to provide further insights on the exogenous factors that may have triggered the increase in home bias and on the direct consequences of the increase in home bias.

2.2 Empirical Tests

We rely on a quarterly panel sample of 7 Eurozone economies for which data on home bias in public debt is available, and which faced either a significant increase in home bias (Greece, Ireland, Italy, Portugal, Spain), a more recent increase in home bias (France) or a decrease in home bias (Germany)⁷, between 2007:Q1 and 2012:Q1.

The period prior to the outbreak of the 2007 global financial crisis is likely to display structural differences, whereas the next period may present inconsistent features following the partial Greek default. On the one hand, the starting point of our analysis coincides with the beginning of a turmoil period on financial markets characterized by much higher volatility in both advanced and emerging economies (Dooley and Hutchinson (2009)). On the other hand, the first quarter of 2012 represents the climax of the European sovereign debt crisis, with the Greek partial default and the consecutive activation of sovereign CDS on Greek debt.⁸

Our choice of a panel data analysis is motivated by the fact that we want to iden-

⁷Even though our sample is limited by data availability, it includes the biggest Eurozone countries and all the PIIGS, on which concerns focused during the recent crisis. Including Germany allows us to enlarge our sample with a counterfactual case and we observe no change in the results when we remove Germany or France from the sample.

⁸A relevant additional test would be to extend our sample period backward so that it starts with the beginning of the monetary union and to test for non-linearities. Nevertheless, because many data on home bias are missing before 2007 and would require frequent use of interpolation methods, we focus on the period 2007-2012. In addition, for this last period, we can check the robustness of our results by substituting the sovereign bond yield spread by the sovereign CDS premium spread, for which data are available only for the end of the period.

tify the common factors behind the common increase in home bias for most of the countries in the sample. We want to establish a general transmission mechanism between our variables of interest that would be relevant for the entire sample once individual heterogeneity is controlled for and that would allow for obtaining non-country-specific results regarding home bias.

The increase in home bias observed in most of the sample is sudden and approximately coincides with the start of the stress period on the Eurozone debt markets. Therefore, it is consistent to interpret the increase in home bias as the result of unexpected exogenous shocks. This is why we investigate the impact of distinct shocks on the dynamics of home bias to identify the most explanatory ones in our sample, relying on a Structural VAR model.

The empirical model Distinct arguments support our empirical strategy. First, the S-VAR model enables us to perform an analysis of unexpected shocks. Second, our identification strategy allows us to interpret the shocks in economic terms, which would be impossible in a simple VAR model. Third, an S-VAR model makes it possible to analyze bi-directional causalities without facing endogeneity issues. Therefore, we can both determine the shocks that prompt home bias to respond positively and the impact of home bias shocks on the other variables in the model. Our S-VAR model includes 5 variables. In a first step, we identify the main sources of variation in home bias (hb). There are two types of sources of variation: fundamental shocks and expectations shocks.

The fundamental fiscal shock that we consider is a fiscal space shock (the fiscal space variable is the ratio of debt on total tax revenues (fs)). Aizenman and Jinjark (2013) show that this variable accounts for a significant portion of the market pricing of risk and is a relevant fundamental proxy for assessing debt sustainability as the capacity to raise taxes is crucial in this respect (see also De Grauwe and Ji (2013)). In addition, we include two distinct expectations variables. First, we

consider global, non-European-specific expectations, as proxied by the VIX (vix), which represents the near term volatility conveyed by stock index option prices (S&P 500 index) and is used as a proxy for global risk aversion (Favero and Giavazzi (2008), among others, have shown that the Eurozone economies are deeply affected by global conditions). Second, we consider country-specific expectations of sovereign default. We proxy a country-specific expectations of default shock with a 10-year sovereign bond yield spread shock (spread), with the fundamental control variables remaining constant. The variable 'spread' is calculated as the difference between the US yield and the German yield for Germany and as the difference between the German yield and each country yield for all other countries in the sample. It is the most widely used measure for country-specific expectations of sovereign default (De Grauwe and Ji (2013)).

Additionally, we include the year-on-year change of seasonally adjusted GDP at constant prices (gdp) as a further fundamental control variable (Schumacher (2014)). Data on home bias, defined as the share of total sovereign debt held by domestic investors, was extracted from Andritzky (2012)'s database. Data on VIX comes from CBOE and data on 10-year government bond yields, seasonally adjusted year-on-year change in real GDP and fiscal space were extracted from the Eurostat and OECD databases.⁹

The reduced form of the panel vector auto-regression model VAR(q) is:

$$Y_{i,t} = \sum_{j=1}^q A_j Y_{i,t-j} + e_{i,t},$$

where q is the number of lags, $Y_{i,t}$ the vector of n endogenous variables for country i and period t , $Y_{i,t-j}$ the $n \times 1$ vector of lagged variables, A_j the $n \times n$ parameter matrix, and $e_{i,t}$ the vector of errors with $e_{i,t} = b_i + b_t + b_{i,t}$, where b_i is the individual

⁹We relied on interpolation methods for missing data on home bias for France and Portugal.

fixed effect, b_t the time fixed effect, and $b_{i,t}$ the disturbance term which variance-covariance matrix has no restrictions, that is $E(b_{i,t}, b_{i,t}^T) = \Omega$ and $E(b_{i,t}) = 0$. The VAR(q) model can be rewritten using the lag operator L :

$$A(L)Y_{i,t} = e_{i,t}.$$

Relying on the Wold theorem, the canonical VAR model can be reverted. Thus, we can rewrite the process in moving average infinite structural form:

$$Y_{i,t} = \sum_{k=0}^{\infty} C_k e_{i,t-k} = C(L)e_{i,t},$$

where e_t represents the vector of canonical innovations and L is the lag operator. This allows to derive the impulse response functions and the forecast error variance decomposition. The structural Moving Average representation is then:

$$Y_{i,t} = \sum_{k=0}^{\infty} \Theta_k \varepsilon_{i,t-k} = \Theta(L)\varepsilon_{i,t},$$

where $\varepsilon_{i,t} = d_i + d_t + d_{i,t}$, and $b_{i,t} = Pd_{i,t}$ (Beetsma et al. (2006), Canova and Ciccarelli (2013)).

P is a $n \times n$ invertible matrix which needs to be estimated in order to identify the structural shocks. The short-run constraints are imposed directly on P and consist in setting some elements of the matrix to zero. The Θ_k matrix represents the response functions of $Y_{i,t}$ to structural shocks d_{it} . These latter are assumed to be uncorrelated and to have a unit variance: $E(d_{i,t}, d_{i,t}^T) = I_n$. With Ω the variance-covariance matrix of the canonical innovations $b_{i,t}$, we have:

$$E(b_{i,t}, b_{i,t}^T) = PE(d_{i,t}, d_{i,t}^T)P^T = PP^T = \Omega.$$

For the estimation of our panel S-VAR, we rely on Bayesian inference with the standard priors of Sims and Zha (1998) in order to identify the P matrix. The advantages of such an estimation strategy are threefold. First, the priors are not flat,

they enable to incorporate economic theory. Second, they do not imply any restriction on the conditional mean of lagged variable coefficients. Nevertheless, beliefs about lagged variable coefficients are restricted to be Gaussian and uncorrelated across equations conditional on contemporaneous variable coefficients. However, they are allowed to be correlated differently in distinct equations. Third, Bayesian inference is not affected by the presence of unit roots and cointegration. Consequently, we can introduce the variables in levels rather than in first differences. This enables better interpretation regarding significance and sign of the results (Sims (1988), Sims and Uhlig (1991)).

We define $Y = \begin{pmatrix} vix \\ hb \\ spread \\ fs \\ gdp \end{pmatrix}$ the vector of endogenous variables, and $\varepsilon_t = \begin{pmatrix} \varepsilon_{ext} \\ \varepsilon_{hb} \\ \varepsilon_{spread} \\ \varepsilon_{fs} \\ \varepsilon_{rs} \end{pmatrix}$ the vector of structural shocks, where ε_{ext} represents the global financial shock, and ε_{hb} , ε_{spread} , ε_{fs} , and ε_{rs} are respectively the home bias shock, the spread shock, the fiscal space shock and the real supply shock.

The short-run restrictions We only impose short-run restrictions. Our objective is to identify the n^2 elements of the P matrix. The Ω matrix is symmetric and the shocks have a one-unit variance. Therefore, $\frac{n(n+1)}{2}$ orthogonalization and normalization constraints have already been imposed. Thus, it is necessary to determine the 10 remaining constraints by relying on the economic literature. First, we assume that the world risk aversion shock (the VIX shock) is contemporaneously exogenous to domestic variables in the Eurozone countries. Indeed, the VIX, as a proxy for global non-European financial conditions, is expected to affect the European financial markets in a first step and then to be impacted by the impaired conditions in the European countries through a feedback effect only in a second

step (Gonzalez-Hermosillo and Johnson (2014)).¹⁰ Second, we assume that the real variables (GDP and fiscal space) react with a lag to financial disturbances (national and international: spreads and VIX) and to the composition of debt due to reaction delays (Kim (2005), Favero and Giavazzi (2008), Prieto et al. (2013)).

Therefore, given the ordering in the Y matrix, the P matrix of restrictions is defined as:

$$P = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ P_{21} & 1 & P_{23} & P_{24} & P_{25} \\ P_{31} & P_{32} & 1 & P_{34} & P_{35} \\ 0 & 0 & 0 & 1 & P_{45} \\ 0 & 0 & 0 & P_{54} & 1 \end{pmatrix}.$$

2.3 Interpretation of results

We display the whole panel sample's reactions to the different shocks in Appendix A and focus here on the reactions that address the dynamics of home bias. The distinct impulse response functions show the responses of domestic variables and of the global financial conditions indicator following each shock. They were generated using the Sims and Zha (1999) Bayesian Monte-Carlo integration method. The standard errors associated with a one standard error deviation shock were calculated with the same method.¹¹ The associated variance decompositions, which allow for a comparison of the relative importance of each shock in explaining the dynamics of the distinct variables, are displayed in Appendix B.

First, Figure 2 shows that a fiscal space shock triggers a positive significant response in home bias. In addition, home bias responds to a spread shock with some lag. This result is in accordance with Broner et al. (2014) (in which the marginal

¹⁰Going further, Favero and Giavazzi (2008) consider that the US economy behaves as a closed economy and is therefore not impacted by economic conditions in Eurozone countries, which justifies that they consider the US variables as the most exogenous ones with respect to Euro area variables shocks.

¹¹The confidence interval calculated from the Sims and Zha (1999) procedure outperforms other procedures for short horizons (Kilian and Chang (2000)). Error bands correspond to the 16% and 84% quartiles. Results are significant if the confidence interval does not include the 0 axis.

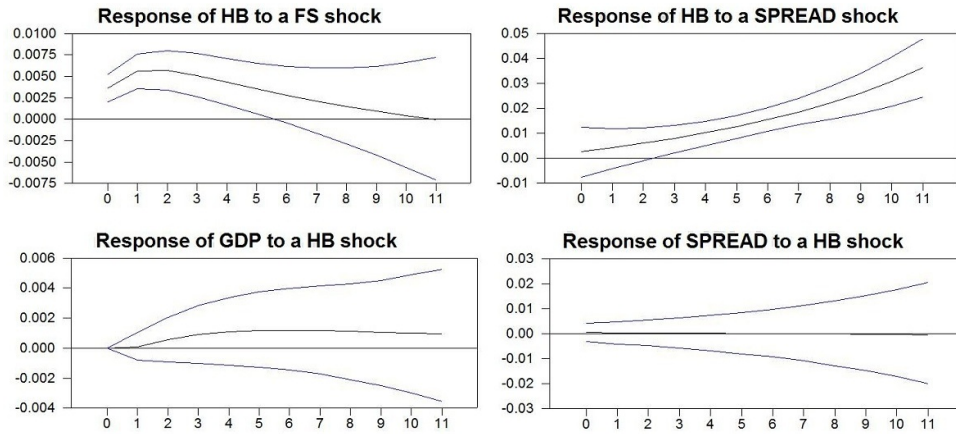


Figure 2: Main impulse response functions

buyer of sovereign bonds becomes a domestic one following a sovereign bond return shock), and with the empirical investigation of Andritzky (2012). Similarly, Schmidt and Zwick (2014) show that country-specific risk factors are crucial in explaining extreme capital flows in the Euro area.

Therefore, home bias seems to react to sudden impaired fiscal fundamentals and sovereign risk expectations. Indeed, we interpret the sovereign bond spread shock as an expectations shock because it represents a one standard error deviation in the risk premium, with all of the other endogenous variables of the empirical model – particularly the fiscal space variable – remaining constant. This shock can affect home bias dynamics through various intermediary channels. Our interpretation is that the transmission channel between the expectations shock and home bias dynamics — similar to that with the fundamental shock – relates to the increase in the expected probability of default triggered by more pessimistic expectations (the so-called self-fulfilling effect). This deepens the differences between incentives for domestic and foreign creditors to invest in domestic sovereign debt, as emphasized by previous literature (see the theoretical section for more details).

Home bias in sovereign debt responds positively to VIX shocks and negatively to GDP shocks after some lag.¹² Both results are intuitive. First, when global risk aversion unexpectedly increases, foreign investors may become more cautious and invest less in public debt abroad, particularly the most risky debt. Second, an unexpected exogenous increase in GDP provides a comforting signal on the fundamental economic situation of a particular country, which causes foreign investors to increase their participation on the sovereign debt market of this country. The variance decomposition (see Appendix B) reveals that the sovereign bond spread shock explains 24.16% of the variation in home bias 3 quarters after the shock and more than 42% 12 quarters after the shock. The fundamental shock explains 7.7% of the variation in home bias 3 quarters after the shock, whereas the GDP shock explains 1.22% of this variation and the VIX shock less than 0.33% in the first periods when it is significant. Consequently, we will include in our theoretical model an exogenous unexpected increase in the fiscal fundamental and an exogenous increase in country-specific sovereign default expectations as the two main sources of variation in home bias.

To fully exploit the results of our S-VAR estimation, another conclusion that we can draw is the impact of a home bias shock on the dynamics of the growth rate. Even though we do not interpret the increase in home bias observed in our sample as a home bias shock but rather as the endogenous response of home bias to other shocks, we use the results of our S-VAR to provide further insights on the direct transmission impact of an increase in home bias, when all of the other endogenous variables remain constant. Indeed, one significant advantage of the S-VAR is that it enables to distinguish between bi-directional transmission mechanisms. The theoretical literature emphasizes a possibly destabilizing direct effect of increased

¹²Home bias starts to increase before the period of deep stress on the Eurozone sovereign bonds markets in most countries of the sample. This suggests that global shocks related to the global financial crisis, such as VIX shocks, might be more explanatory of home bias dynamics than country specific shocks in the beginning of the period.

home bias on the growth rate through crowding-out effects. Indeed, Broner et al. (2014) show that, due to financial frictions, increasing incentives for domestic investors to buy public debt when its return rises disrupt domestic productive investment, which in turn reduces growth. Another possible effect of increasing home bias on the growth rate may be related to its potentially negative impact on domestic banks' credit supply due to banks' exposure to sovereign risk, eventually reducing investment and growth (Acharya et al. (2012)). Nevertheless, we cannot find empirical evidence of a transmission mechanism to the growth rate: the latter does not significantly respond to positive home bias shocks in our sample.

One possible explanation for this result could be that the impact, if any, of home bias on the growth rate is likely to be very indirect and to not occur in the short run. In particular, Cantero-Saiz et al. (2014) show that in periods of easy monetary policy, no systematic linear relationship between sovereign risk and credit supply exists in Europe. Additionally, our empirical result may relativize the extent of the financial frictions and the prominence of residents in domestic productive investment assumed in the theoretical literature (see Broner et al. (2014)). Consequently, because we cannot find empirical grounds to plead for a direct negative effect of increasing home bias on the growth rate in our sample, we choose not to include it in our theoretical model. Our empirical results are robust to changes in the proxy variables.¹³

Now that we have identified the most important sources of exogenous variation in home bias in our empirical model, we examine their impact on the equilibrium of a simple model of sovereign debt crisis in which home bias affects the strategic decision of national governments regarding sovereign default. This allows us to formalize our interpretation of the transmission mechanism between exogenous variations in fundamentals or expectations and home bias and to characterize the

¹³We substituted the year-on-year change in growth rate with the quarter-on-quarter change in growth rate and the sovereign bond yield spread with the sovereign CDS premium spread.

conditions under which an increase in home bias is associated with sovereign default.

3 A simple model of debt crisis with endogenous home bias

We now propose a model of sovereign debt crisis in a monetary union, the assumptions of which are supported by our empirical results. It aims at replicating the recent rise in home bias associated with an increase in sovereign bond yields and at characterizing its consequences for the government's decision to default. Our setting is a two-period strategic game involving three different players: domestic investors, foreign investors and the government.

3.1 The sequential game

The investors' decision In period 1, the government aims at rolling over an exogenous amount of one-period maturity debt d_1 on the primary sovereign bonds market. Each group of investors (the group of domestic creditors and the group of foreign ones) consists of a continuum of identical agents over the interval $[0;1]$. All individual investors have logarithmic utility and the same initial endowment W_1 at the beginning of period 1. In period 1, each individual investor – be it domestic or foreign – chooses the level of his current consumption C_1 . He allocates the remaining part of his initial wealth $W_1 - C_1$ between risky sovereign bonds, which yield an uncertain return (depending on whether sovereign default occurs or not), and a risk-free world asset which yields a constant certain exogenous return. A worldwide random macroeconomic shock r (with density probability $f(\tilde{r})$) affecting the government's fiscal decision (a higher realization r of the shock affects positively the government's solvency) occurs at the beginning of period 2. As they do

not know the realization of the shock when they make their decision in period 1, investors cannot know with certainty whether the outcome will be default or not. Therefore, they derive the expected probability of default in period 1, $E_1[p_D]$, for given values of the model's parameters (in particular the debt level) over the whole distribution of the macroeconomic shock.

The timeline of the game is displayed in Figure 3.¹⁴

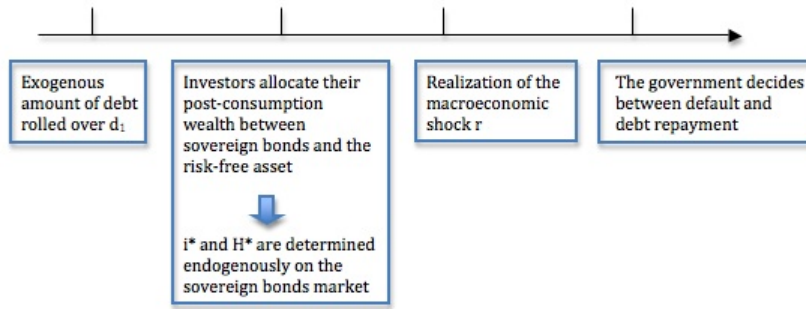


Figure 3: Timeline of the sequential game

The maximization problem of an individual investor in each group is the following (with $j = (D, F)$ a general subscript, the subscript D referring to domestic investors, the subscript F to foreign ones):

$$\max_{C_{1,j}, \omega_j} E_1[U(C_{1,j}, C_{2,j})] = \max_{C_{1,j}, \omega_j} \ln(C_{1,j}) + \beta E_1[\ln(C_{2,j})],$$

¹⁴After the government makes its decision regarding default, the monetary policy authority – in the Eurozone, the ECB – can take action in order to avoid a sovereign default. Indeed, it can affect the government's political costs (notably, the cost of default), grant rescue loans with preferential conditions, buy government debt at lower interest rates on the secondary market, and refinance banks that are holding sovereign bonds. In addition, the ECB can affect ex-ante expectations, notably through liquidity injections and commitment or announcement that it will intervene to help countries facing difficulties. Nevertheless, endogenizing the ECB's strategic decision is beyond the scope of this paper as it is unlikely to be affected by home bias.

s.t.

$$C_{1,j} + \frac{C_{2,j}}{R_{T,j}} = W_1,$$

$$R_{T,j} = (1 - \omega_j)(1 + R_f) + \omega_j R_j,$$

$$0 \leq \omega_j \leq 1,$$

where ω_j is the share of post-consumption wealth ($W_1 - C_{1,j}$) invested in domestic sovereign bonds (with $1 - \omega_j$ the share invested in the risk-free asset), β is the discount factor, $R_{T,j}$ is the total return on the portfolio, R_f is the constant certain exogenous return on the risk-free world asset and R_j is the implicit equilibrium return on sovereign bonds (when $j = D$, it corresponds to the return for domestic creditors and when $j = F$ to the return for foreign creditors).

For a given nominal equilibrium interest rate i^* on domestic sovereign bonds and a given home bias in sovereign debt H^* in equilibrium, the expected implicit domestic return $E_1[R_D^*]$ writes:

$$E_1[R_D^*] = (1 + i_D^*)(1 - E_1[p_D]) + 0 \cdot E_1[p_D] = (1 + i_D^*)(1 - E_1[p_D]),$$

and the expected implicit foreign return $E_1[R_F^*]$ writes:

$$E_1[R_F^*] = (1 + i_F^*)(1 - E_1[p_D]),$$

where i_D^* is the implicit return on domestic sovereign bonds for domestic creditors for given i^* and H^* and i_F^* is the implicit return for foreign creditors. When sovereign default occurs (with expected probability $E_1[p_D]$), sovereign bonds yield a null return and the principal is not recovered by the creditors. When no sovereign default occurs (with probability $1 - E_1[p_D]$), the creditors recover the principal ($W_1 - C_{1,j}$) ω_j and the implicit equilibrium return on the principal i_j^* . For given i^* and H^* , the implicit equilibrium return for domestic investors i_D^* differs from

the implicit equilibrium return for foreign investors i_F^* . This results from some additional costs (for foreigners) or benefits (for domestic creditors) of investing in domestic sovereign bonds which are added to the nominal interest rate on bonds i^* such that $i_F^* \leq i^* \leq i_D^*$. These additional costs and benefits differ all the more so in the midst of a stressful episode on the sovereign debt market. Indeed, as emphasized in the empirical literature, in the context of the Eurozone debt crisis, incentives to invest in the sovereign debt of the most fragile economies have decreased for foreign investors and increased for domestic ones. Thus, Battistini et al. (2014) (p. 205) identified several types of increasing incentives for residents to invest in their own sovereign debt in fragile economies of the Eurozone.¹⁵

Consequently, the difference $i_D^* - i_F^*$ increases in the expected probability of default $E_1[p_D]$. This determines the difference between optimal aggregate domestic demand $Q_D^* = \omega_D^*(W_1 - C_{1,D}^*)$ and optimal aggregate foreign demand $Q_F^* = \omega_F^*(W_1 - C_{1,F}^*)$ for domestic sovereign bonds.

By definition, equilibrium home bias in domestic sovereign bonds is the share of domestic debt held by domestic investors in equilibrium:

$$H^* = \frac{Q_D^*}{Q_D^* + Q_F^*} = \frac{\omega_D^*}{\omega_D^* + \omega_F^*}.$$

¹⁵The first one is the pressure government can exert on domestic banks to have them buy public debt – financial repression in the words of Reinhart and Sbrancia (2011). Financial repression in the recent Eurozone debt crisis was thoroughly documented by Van Riet (2014). The second one is that undercapitalized banks, that are mostly located in peripheral countries, can choose to engage in ‘carry-trades’ by going long on more risky public debt and short on less risky one (see also Gennaioli et al. (2014)). The third one is related to a possible exit from the Eurozone, in which domestic investors would have a comparative advantage, as sovereign debt would be redenominated in national currency, what would be costly for foreign creditors. In addition, expectations of potential compensations of residents following a default (Mengus (2014), Brutti and Saure (2014)) can provide incentives for domestic purchases of debt. The first two reasons can only explain why banks have increased their exposure to domestic sovereign debt while the last two also apply to non-bank domestic investors.

The equilibrium interest rate on domestic sovereign bonds i^* is the interest rate for which market clears, that is to say for which total demand for domestic sovereign bonds Q_T equals the exogenous supply amount of domestic sovereign bonds d_1 .

The government's decision In period 2, the government observes (i^*, H^*) and the realization of the macroeconomic shock r which occurs at the beginning of period 2. It then decides between paying back the debt (which in period 2 includes interest rate payments: $d_2 = d_1(1 + i^*)$) or defaulting on its full debt.¹⁶ As in Gennaioli et al. (2014) and Mengus (2014), the government is non-discriminatory regarding default in our model.¹⁷

To make its decision regarding fiscal policy in period 2, the government strategically compares its loss function under full debt repayment L_f with its loss function under full default L_d , and chooses the least costly option. Thus, the optimizing government focuses on minimizing the economic and political costs of its fiscal policy. The loss associated with full repayment of the debt L_f is related to the cost of taxation on debt. Indeed, when the government fully repays its debt, it must finance it through taxation which is supported by domestic taxpayers. This cost can alternatively be interpreted as a cost of austerity which is faced by residents only. The loss function in case of default L_d is related to the economic cost of a sovereign default for the domestic economy and to the political and economic cost of creditors opposition to default.¹⁸

¹⁶We focus on the binary alternative between full repayment and full default without taking into account the possibility of a partial haircut on debt. Nevertheless, the mechanism and results of the model would be similar when allowing for a haircut.

¹⁷This can be justified by trading on the secondary market (or by the one-period maturity of debt in our simple case), portfolios' unobservability and the monetary union that renders a selective default very unlikely. Gennaioli et al. (2014) provide empirical results supporting the non-discriminatory assumption. See also Panizza et al. (2009).

¹⁸The specificity of such loss functions in a monetary union is that national governments do not control monetary policy and thus cannot monetize debt, which reinforces the impact of the latter on the government's decision. This specificity also renders the Eurozone countries more prone to self-fulfilling crises due to liquidity shortages converting into solvency crises (De Grauwe and Ji (2013), Corsetti and Dedola (2014)).

Both the cost of debt repayment and the cost of default increase in the debt:

$$\frac{\partial L_d}{\partial d_1} > 0, \frac{\partial L_f}{\partial d_1} > 0,$$

with

$$\frac{\partial L_f}{\partial d_1} > \frac{\partial L_d}{\partial d_1},$$

so that the probability of default increases in the debt.

In addition,

$$\frac{\partial L_d}{\partial r} > 0, \frac{\partial L_f}{\partial r} < 0,$$

as a higher realization of the shock r positively affects the government's solvency.

Both loss functions increase in the market interest rate on sovereign bonds i^* as it raises debt service, and therefore raises debt in period 2. The loss function in case of default L_d increases more, so that the probability of default increases when debt service rises. Home bias in equilibrium H^* affects both the cost of taxation and the cost of default. Overall, a higher home bias reduces the government's incentives to default. First, it decreases the cost of taxation. Indeed, domestic taxpayers are less reluctant to pay taxes for financing sovereign debt when they are the ones holding the debt (Gros (2012)). In addition, the economic distortions related to taxation are lower if taxation allows at least the provision of capital gains to residents through repayment on the sovereign bonds they are holding. On the contrary, a higher home bias raises the cost of default. Indeed, it raises the impact of a sovereign default for the domestic economy (Kremer and Mehta (2000), Mengus (2014)) as the latter increases in the volume of domestic debt defaulted upon.¹⁹

Finally, in period 1, before the realization of the macroeconomic shock r , the equi-

¹⁹Acharya et al. (2014) and Gennaioli et al. (2014) relate the internal domestic cost of default to domestic banks' holdings of domestic sovereign bonds. Gennaioli et al. (2014) provide evidence that the larger the exposure of domestic banks to sovereign risk, the more costly the default for the domestic economy through its ex post impact on private credit.

librium probability of default (the probability that $L_f > L_d$) writes:

$$p_D^* = \int p[d_{1,+}, \tilde{r}, H_{-}^*, i_{+}^*] f(\tilde{r}) d\tilde{r}.$$

We now solve for the subgame perfect Nash equilibrium by backward induction, by first characterizing the government's best response to investors' strategy, and second by characterizing each type of investors' optimal strategy given the government's expected response.

3.2 Characterization of the subgame perfect Nash equilibrium

The government's best response At the time the government plays its optimal strategy (at the end of period 2), it observes the strategy played by investors in period 1 and thus the aggregate outcome (H^*, i^*) .

If:

$$L_f(d_1, r, H^*, i^*) - L_d(d_1, r, H^*, i^*) < 0,$$

the government's best response to creditors' action is to pay back the debt, as it is less costly than defaulting on the debt.

If:

$$L_f(d_1, r, H^*, i^*) - L_d(d_1, r, H^*, i^*) > 0,$$

the government's best response is to default.

Investors' best response under uncertainty on the ex-post outcome Now that we have characterized the government's best response to investors' decision in period 2, we characterize the investors' optimal decision in period 1 when they anticipate the government's best response (that they include in their maximization program through the ex-ante expected probability of default).

In order to characterize the optimal decision for an individual investor such that he does not have incentives to deviate from equilibrium, the action of all other investors (both in the same group and in the other group) – and then the aggregate outcomes resulting from these individual actions – are taken as given.

The F.O.C. for each individual investor yield:

$$C_1^* = \frac{1}{1 + \beta} W_1,$$

$$\omega_D^* = \max \left[\min \left(\frac{i_D(i^*, H^*) - R_f - E_1[p_D(i^*, H^*)](1 + i_D(i^*, H^*))}{i_D(i^*, H^*) - R_f}, 1 \right), 0 \right],$$

$$\omega_F^* = \max \left[\min \left(\frac{i_F(i^*, H^*) - R_f - E_1[p_D(i^*, H^*)](1 + i_F(i^*, H^*))}{i_F(i^*, H^*) - R_f}, 1 \right), 0 \right].$$

In the above equations, we make clear which quantities are functions of the endogenous aggregate investors decisions in equilibrium i^* and H^* . The latter impact the expected probability of default directly and the implicit domestic and foreign equilibrium returns on sovereign bonds i_D^* and i_F^* indirectly as they depend on the expected probability of default.

Market clearing implies:

$$Q_T(i^*, H^*) = d_1.$$

The aggregate outcome of investors' individual best responses to the government's expected decision is then given by the solution to the following system of 2 equations with 2 unknown i^* and H^* :

$$H^* = \frac{\omega_D(i^*, H^*) W_1 \frac{\beta}{1 + \beta}}{d_1}$$

with $0 \leq H^* \leq 1$, and

$$\omega_D(i^*, H^*) + \omega_F(i^*, H^*) = d_1 \frac{1 + \beta}{W_1 \beta},$$

as $W_1 - C_1^* = W_1 \frac{\beta}{1 + \beta}$. This system can have 0, 1, or several solutions. When demand for domestic sovereign bonds is too low relative to supply, there is no market clearing and therefore no solution to this system of equations. Figure 4

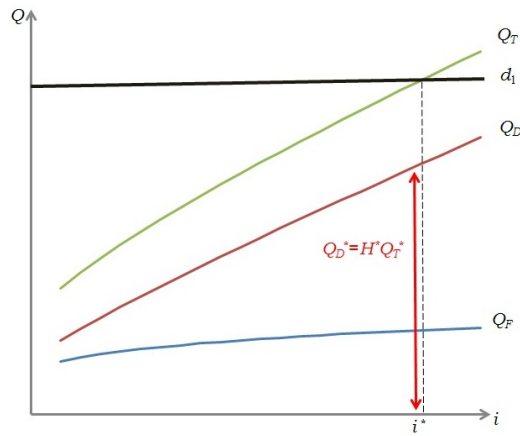


Figure 4: Endogenous home bias

illustrates the endogenous home bias.

We now assess the impact of more pessimistic expectations and higher debt level on the model's equilibrium to replicate the increase in home bias and assess its impact on the government's decision.

3.3 Change in equilibrium following exogenous changes increasing the expected default probability

We consider an initial market clearing equilibrium²⁰ and we assess the consequences on the creditors and the government's decisions of first an exogenous change in expectations and second an exogenous change in the fiscal fundamental, based on our prior empirical results. In our theoretical setting, we define the exogenous change in expectations as a sudden increase in the perceived probability of default for a given fundamental d_1 and a given interest rate i . Formally, creditors suddenly believe that the functional form for the probability of default for given d_1 and i is such that the probability of default is higher. As for the exogenous variation in the fiscal fundamental, it is defined as an increase in the level of debt that is rolled over on the primary market d_1 .

Both exogenous changes are assumed to raise the expected probability of default for a given interest rate i (not specifically in equilibrium, but in any point on the demand curve) and a unique associated home bias H .²¹

Shift in investors' decision Let us assume an exogenous variation triggering an overall increase in the expected default probability for a given i . For convenience of explanation, we rewrite the expected probability of default $p(i, H)$ for some interest rate i and the associated home bias H as an exogenous variable P in

²⁰In this subsection, we leave aside the case in which there is no solution to the system of equations because in that case there is no initial equilibrium.

²¹Given that the probability of default both depends on exogenous parameters and endogenous individual decisions in our model, assuming that the expected probability of default increases for a given interest rate i implies that the adjustment in the endogenous home bias H (which is expected by creditors) does not offset the positive impact of the exogenous initial variation (in expectations or fundamentals) on the probability of default. Nevertheless, the change in equilibrium (the adjustment in i^* and H^*) is not imposed ex ante and still arises endogenously. In addition, this assumption makes sense empirically. If the exogenous change triggering the overall increase in the default probability for a given i is to be interpreted as an increase in the fiscal fundamental (the debt level for instance), it is very unlikely that any adjustment in home bias following this change may compensate the positive impact this initial change has on the default probability for a given i .

order to compare a situation where the expected probability of default is higher to a situation where it is lower for the same i .

Proposition 1: If demand for domestic sovereign bonds is continuous on some interval of interest rates on domestic sovereign bonds $[i_1, i_2]$, $\frac{\partial Q_F}{\partial P} < \frac{\partial Q_D}{\partial P} < 0$ and $0 < \frac{\partial Q_F}{\partial i} < \frac{\partial Q_D}{\partial i}$ on this interval, home bias and interest rate increase in equilibrium when expectations become more pessimistic.

Proof: see Appendix C.

The sufficient conditions for an increase in home bias and interest rate in equilibrium identified in Proposition 1 mean that both domestic and foreign demand decrease when the expected probability of default becomes higher for a constant i and constant parameters, with domestic demand decreasing less, and when domestic and foreign demand increase in the nominal return on sovereign bonds i , with foreign demand increasing less. These conditions are realistic as a higher expected probability of default for a given i not only increases expected risk for domestic creditors but also expected implicit returns, whereas it increases expected risk and decreases expected implicit returns for foreign investors. Similarly, a higher nominal interest rate i increases more the expected implicit return of domestic creditors relative to that of foreign investors as it also raises the default probability. Figure 5 provides a graphical example.

To sum-up, we identified sufficient conditions such that the model replicates the empirical observation: more pessimistic expectations lead to higher market interest rate and home bias.

Proposition 2: If demand for domestic sovereign bonds is continuous on some interval of interest rates $[i_1, i_2]$, $\frac{\partial Q_F}{\partial P} < \frac{\partial Q_D}{\partial P} < 0$ and $0 < \frac{\partial Q_F}{\partial i} < \frac{\partial Q_D}{\partial i}$ on this interval, home bias and interest rate increase in equilibrium when the fiscal fundamental is higher.

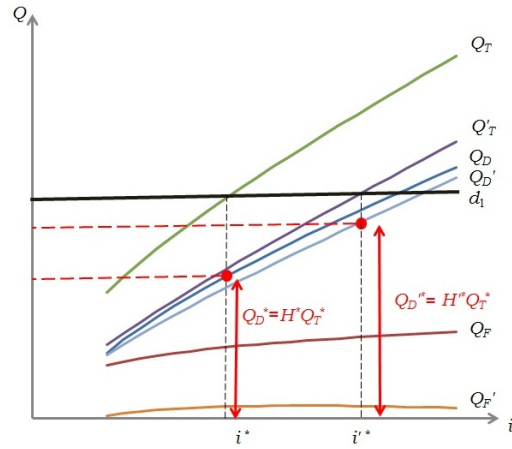


Figure 5: More pessimistic expectations and home bias

The proof of proposition 2 is similar to that of Proposition 1, except that the change in the fundamental has to be taken into account in the market clearing condition. Under the previous conditions, the model replicates the empirical fact: a higher fiscal fundamental leads to higher market interest rate and home bias. A graphical illustration is provided in Figure 6.

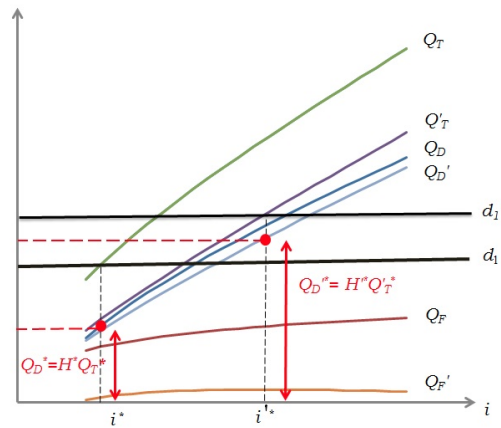


Figure 6: Increase in fundamental and home bias

Change in the government's decision We now assess the impact of the change in investors' optimal decision on the government's best response due to exogenously more pessimistic expectations and worst fiscal fundamental, in order to fully characterize the new subgame perfect Nash equilibrium.

Proposition 3: When expectations are more pessimistic, a switch from the government non-default equilibrium to the default equilibrium occurs if and only if:

$$L_f(d_1, r, H^*, i^*) - L_d(d_1, r, H^*, i^*) < 0$$

and

$$L_f(d_1, r, H'^*, i'^*) - L_d(d_1, r, H'^*, i'^*) > 0.$$

(1)

The distinct effects at work are the following. On the one hand, in the situation with more pessimistic expectations, the market interest rate i'^* is higher, which makes the probability of default increase. This leads to a destabilizing effect of the change in expectations. On the other hand, the increase in home bias in equilibrium H'^* following the change in expectations causes a decrease in the incentives to default.

All in all, whether this leads to a switch in the government's decision depends on the value of the model's parameters, on the shapes of the government's loss functions (which capture the relative effect of a destabilizing change in expectations and a stabilizing increase in home bias) and on the realization of the macroeconomic shock r . The necessary and sufficient condition (1) is satisfied if and only if the impact of the increase in the market interest rate i'^* on the probability of default is strong enough relative to that of the increase in the equilibrium home bias H'^* and the realization of the worldwide shock r is low enough.

Proposition 4: When the fiscal fundamental is higher, a switch from the non-default equilibrium to the default equilibrium occurs if and only if:

$$L_f(d'_1, r, H^{I*}, i'^*) - L_d(d_1, r, H^{I*}, i'^*) < 0$$

and

$$L_f(d'_1, r, H^{I*}, i'^*) - L_d(d'_1, r, H^{I*}, i'^*) > 0.$$

(2)

On the one hand, the increase in the fiscal fundamental raises the probability of default. It also causes the market interest rate to increase, what further raises the probability of default. On the other hand, the increase in home bias that it triggers partly contains this rise. Condition (2) provides a necessary and sufficient condition such that a switch in the government's best response occurs in the case of the fiscal fundamental shock. It is satisfied when the size of the positive impact of the exogenous increase in the debt and of the endogenous increase in the market interest rate on the probability of default is high enough relative to that (negative) of the endogenous increase in home bias and if the realization of the macroeconomic shock r is low enough.²²

Therefore, an increase in home bias reflects the existence of an exogenous source of fragility that can lead to a switch in the government's decision, but this is not an ex-post additional source of fragility itself. On the reverse, it plays as a stabilizing mechanism – notably through political costs – that mitigates the effect of the ex-ante source of fragility that triggered it, and makes the condition for a switch in the government's decision less likely. The next section provides a discussion about which case of the model best represents what recently occurred in the distinct Eurozone countries.

²²For beliefs to be validated ex-post in equilibrium, the actual probability of default in equilibrium should increase, despite the increase in home bias. Nevertheless, this does not imply that default is necessarily the optimal ex-post solution.

4 Which case of the model best applies to the Eurozone debt crisis? A factual discussion

The model replicates recent facts in the Eurozone – the increase in home bias associated with an increase in sovereign bond yields and episodes of sovereign default. The model enables to explain two distinct cases for countries where home bias in public debt has increased. First, it replicates the case of countries where sovereign default or rescue plans have taken place following a destabilizing fiscal shock. Second, it explains the case of countries where governments repaid their debt despite impaired conditions. Regarding our sample period, it is possible to identify which countries have satisfied the sufficient condition for the government's optimal decision to change following the increase in home bias. The only country that has defaulted on part of its debt in our sample is Greece. A first rescue package consisting of loans from the IMF and bilateral loans from the other Eurozone countries was allowed to Greece in May 2010, amounting to approximately 80 billion euros between May 2010 and June 2013. Default on part of the debt occurred later, in the context of the second rescue plan (October 2011) for Greece. The IMF and the EFSF allocated new loans amounting to 130 billion euros in addition to the final payments of the first Economic Adjustment Programme to Greece for the years 2012 to 2014, conditional on new austerity measures and the realization of so-called private sector involvement. The new loans required voluntary debt swaps from private creditors who were subject to Greek law. This implied a haircut of 53.5% in nominal terms and a conversion of the remaining debt into new long-term Greek government bonds, short-term EFSF notes and detachable GDP-linked securities. Later, the collective action clause was activated to constrain creditors who refuse to agree to the debt swap, which led to the activation of Greek sovereign CDS. Greek partial default on government debt finally took place in March 2012. More generally, the change in the government's equilibrium condition can be seen

as satisfied for countries that have requested rescue packages from the EFSE, such as Ireland, Portugal and more recently Spain. In our theoretical framework, this can be interpreted as those countries reaching the point where default would have become more beneficial than debt repayment if no help was provided, leading them to request a rescue package. In those countries, the increase in home bias did not prevent from a change in the government's decision.

In Ireland, an Economic Adjustment Programme was agreed in December 2010 and covered the period 2010 to 2013, for an amount of 85 billion euros. Portugal benefited from a similar programme, agreed in May 2011, covering the period 2011 to 2014, amounting to 78 billion euros. The case of Spain is slightly different because the support package agreed in July 2012 (representing 100 billion euros) was directed to the recapitalization of financial institutions.

In our theoretical framework, this can be interpreted as those countries reaching the point where default has become more beneficial than debt repayment if no help is provided, leading them to request to be granted a rescue package. Therefore, in the case of the countries of our sample mentioned here above, the increase in home bias has clearly not been stabilizing enough relative to the negative impact of the shocks that have triggered it. It has not prevented from a change in the government's equilibrium.

Regarding the remaining countries where home bias has increased in our sample, the case of the model that would best apply to those countries is the one in which the destabilizing shocks occurring throughout the period of stress were not sufficient to cause default to become more beneficial for governments. This may be partly due to the possibly stabilizing effect of the increase in home bias that may have played a larger role in some countries than in others due to distinct taxation and domestic default costs among countries. Nevertheless, this can also be explained by the fact that country-specific expectations were less pessimistic or fiscal situations less critical for those countries relative to the countries for which

the sufficient condition for a change in the government's decision has held true at some point during the period. In the French case in particular, the increase in home bias has been more recent and less significant, with the volume of debt held abroad stagnating but not decreasing, and has been associated with decreasing yields, which suggests that the shock that triggered the increase in home bias was a much less pessimistic expectations shock relative to what occurred in other countries. Therefore, if the sufficient condition for a change in the government's decision following an increase in home bias has not held true in France, this is most likely due to the less negative perceptions of foreign investors rather than to any stabilizing effect of home bias.

Consequently, it is possible to empirically identify in our sample the countries that have faced a change in the government's decision regarding the decision of default and the countries that have not faced such a change in the period when home bias increased, revealing distinct sensitivities to home bias and/or sufficiently distinct fiscal situations and perceptions from investors on the sovereign bond market.

5 Conclusion

Empirical investigation enables us to identify two main shocks that affect the dynamics of home bias: fundamental shocks and country-specific expectations shocks. In addition, we relativize the view held in the theoretical literature that an increase in home bias is destabilizing per se through its impact on the growth rate. In our model of sovereign debt crisis shedding light on the costs of default and taxation and providing microfoundations for investors' decision, home bias in sovereign debt arises endogenously. Introducing an exogenous change in expectations and in the fiscal fundamental as sources of variation in the endogenous variables of the model in equilibrium, we show that a switch in the government's fiscal decision depends on the relative effects of the increase in home bias and of

the source of fragility that triggered it on the government's loss functions.

Therefore, the relaxation of capital controls to decrease home bias does not seem to be a relevant measure for limiting sovereign default risk in the Eurozone in the short-term, as the increase in home bias is expected to have a stabilizing effect on governments' fiscal credibility, by allowing less politically costly transfers from taxpayers to debt holders. Our results support the idea that the Eurozone economies could withstand short-term turmoil periods on sovereign debt markets as long as the share of debt held domestically is high enough. However, identifying the drivers of the increase justifies ECB interventions on sovereign bonds markets to avoid expectations or fundamental shocks. If efficient in restoring confidence, those measures would limit the transmission of sovereign risk to banking risk and induce foreign investors to return to the domestic sovereign debt market in the longer term.

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A Impulse response functions

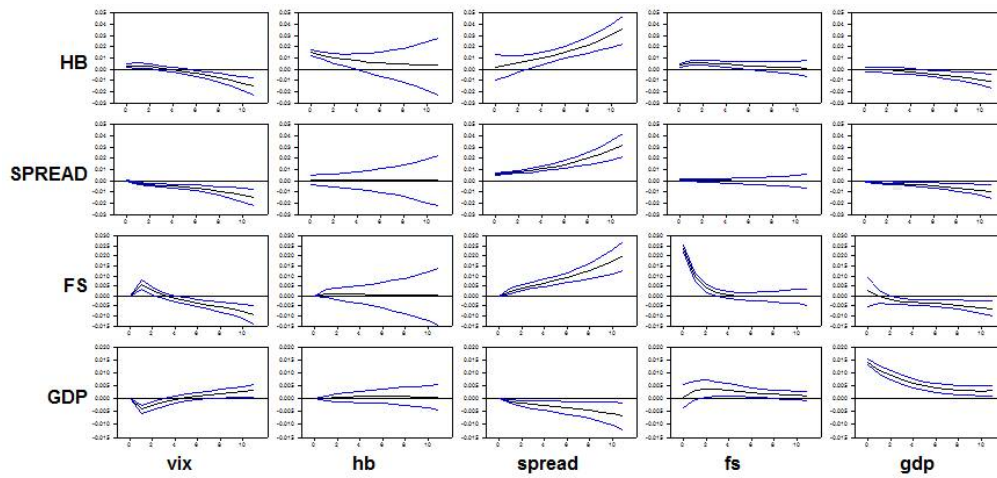


Figure 7: Impulse response functions

B Variance Decompositions

Vix shock (%)	Vix	hb	spread	fs	gdp	Spread shock (%)	Vix	hb	spread	fs	gdp
1	99.89	0.1	0	0	0	1	0	32.96	67.04	0	0
2	98.97	0.25	0.09	0.38	0.2	2	3.38	25.36	57.98	4.2	0.64
3	98.5	0.33	0.24	0.47	0.27	3	4.14	24.16	51.73	8.02	1.24
4	98.14	0.37	0.44	0.48	0.29	4	4.13	26.16	47.52	10.59	1.62
8	94.89	1.3	2.18	1.07	0.46	8	3.24	37.6	38.81	13.98	1.89
12	83.03	5.82	6.94	2.83	0.69	12	2.6	42.42	35.84	14.2	1.69
Fs shock (%)	Vix	hb	spread	fs	gdp	Hb shock (%)	Vix	hb	spread	fs	gdp
1	0	2.11	0.04	95.27	1.57	1	0	98.99	1.01	0	0
2	7.14	5.3	0.09	80.64	2.97	2	6.57	89.13	1.27	0.49	0.06
3	13.4	7.7	0.17	69.89	4.36	3	10.39	83.47	1.68	0.85	0.17
4	17.94	9.19	0.27	62.42	5.37	4	12.64	79.34	2.21	1.19	0.32
8	23.94	11.24	1.22	49.69	6.88	8	14.69	67.41	6.51	3.07	0.94
12	22.28	14.98	4.14	42.61	6.68	12	11.65	58.18	14.92	6.14	1.34
Gdp shock (%)	Vix	hb	spread	fs	gdp						
1	0	0.88	0.16	10.9	86.65						
2	26.34	1.02	0.46	6.19	60.3						
3	35.34	1.22	0.83	5.44	52.25						
4	38.48	1.52	1.32	5.76	48.31						
8	35.76	5.88	5.61	8.43	38.32						
12	25.15	17.23	14.41	10.83	26.86						

C Proof of Proposition 1

We first prove Proposition 1, before identifying realistic sufficient conditions in which Proposition 1 holds.

We write $Q_F(i^*)$ (respectively $Q_D(i^*)$ and $Q_T(i^*)$) the foreign (respectively domestic and total) demand in equilibrium in the initial case and $Q'_F(i'^*)$ (respectively $Q'_D(i'^*)$ and $Q'_T(i'^*)$) the foreign (respectively domestic and total) demand in equilibrium in the case in which expectations are more pessimistic. Therefore, we focus on the case where market still clears, even when expectations are more pessimistic (otherwise, there is no home bias as demand for sovereign bonds does not meet supply). For convenience of explanation, we rewrite the expected probability of default $p(i, H)$ as an exogenous variable P in order to compare a situation where the expected probability of default is higher to a situation where it is lower for the same i . We thus differentiate the demand functions with respect to P for a given i . Following this exogenous change, home bias H corresponding to a given i adjusts.

- *Proof.* Under the assumptions of Proposition 1, we have $\frac{\partial Q_F}{\partial P} < \frac{\partial Q_D}{\partial P} < 0$ for a given interest rate i . Thus, $Q'_T(i) < Q_T(i)$ for all i (as P is higher in the second case where total demand is equal to Q'_T). In particular, $Q'_T(i^*) < Q_T(i^*)$. In addition, Q_T and Q'_T are continuous and $\frac{\partial Q_T}{\partial i} > 0$ as $\frac{\partial Q_D}{\partial i} >$

$\frac{\partial Q_F}{\partial i} > 0$. Consequently, Q_T and Q'_T are bijective. As the supply of domestic sovereign bonds d_1 does not shift, the market clearing condition yields:

$$Q_T(i^*) = Q'_T(i'^*) = d_1.$$

Therefore,

$$Q_T(i^*) = Q'_T(i'^*) < Q_T(i'^*).$$

As $\frac{\partial Q_T}{\partial i} > 0$ and Q_T is bijective, this yields: $i^* < i'^*$.

We have:

$$Q_F(i^*) - Q'_F(i^*) > Q_D(i^*) - Q'_D(i^*),$$

because $\frac{\partial Q_F}{\partial P} < \frac{\partial Q_D}{\partial P} < 0$ and:

$$0 < Q'_D(i^*) - Q'_D(i'^*) < Q'_F(i^*) - Q'_F(i'^*)$$

as $\frac{\partial Q_D}{\partial i} > \frac{\partial Q_F}{\partial i} > 0$ and $i^* < i'^*$. Therefore,

$$\begin{aligned} Q_F(i^*) - Q'_F(i'^*) &= Q_F(i^*) - Q'_F(i^*) + Q'_F(i^*) - Q'_F(i'^*) \\ &> Q_D(i^*) - Q'_D(i^*) + Q'_D(i^*) - Q'_D(i'^*) \\ &= Q_D(i^*) - Q'_D(i'^*). \end{aligned}$$

The market clearing conditions in both situations yield:

$$Q_F(i^*) - Q'_F(i'^*) = -(Q_D(i^*) - Q'_D(i'^*)),$$

which implies that: $Q_D(i^*) - Q'_D(i'^*) < 0$, and therefore that $H^* < H'^*$. □

We now identify realistic sufficient conditions, under which assumptions of Proposition 1 hold.

The derivative of the share of post-consumption wealth invested in domestic sovereign bonds by domestic creditors ($j = D$) (respectively by foreign creditors when $j = F$) with respect to the variable P is the following:

$$\frac{\partial \omega_j}{\partial P} = \frac{R_f + (-1 + R_f - i_j(i, P))i_j(i, P) + (1 + R_f)\frac{\partial i_j}{\partial P}}{(i_j(i, P) - R_f)^2}.$$

As i is set constant here, $\frac{\partial i_D}{\partial P} > 0$. Indeed, when the probability of default increases for a given nominal return on domestic sovereign bonds, the additional benefits for domestic investors, and thus their implicit return, increase. On the contrary, $\frac{\partial i_F}{\partial P} < 0$, as the additional costs of investing in domestic sovereign bonds for foreign investors increase in the expected probability of default.

A sufficient condition for domestic demand to be decreasing in the variable P is:

$$\frac{\partial i_D}{\partial P} < \frac{i_D(i, P) - R_f + i_D(i, P)(i_D(i, P) - R_f)}{P(1 + R_f)}$$

In economic terms, this means that for domestic demand to be decreasing in P , the risk impact of an exogenous increase in the probability of default has to be high enough relative to its return impact through the increase in the domestic implicit return on domestic sovereign bonds.

Similarly, a sufficient condition for foreign demand to be decreasing in the variable P is:

$$\frac{\partial i_F}{\partial P} < \frac{i_F(i, P) - R_f + i_F(i, P)(i_F(i, P) - R_f)}{P(1 + R_f)}.$$

This condition is always satisfied as the left-hand side term is always positive on an interval of interest rates where foreign demand is positive and the right-hand side is, by definition, negative. Not surprisingly, foreign demand always decreases when the probability of default is higher, differently to domestic demand, as an increase in the probability both increases risk and decreases the implicit return on sovereign bonds for foreign creditors. A sufficient condition for foreign demand to decrease more in P than domestic demand is the following:

$$\begin{aligned} & \frac{R_f + (-1 + R_f - i_D(i, P))i_D(i, P) + (1 + R_f)\frac{\partial i_D}{\partial P}}{(i_D(i, P) - R_f)^2} \\ & - \frac{R_f + (-1 + R_f - i_F(i, P))i_F(i, P) + (1 + R_f)\frac{\partial i_F}{\partial P}}{(i_F(i, P) - R_f)^2} > 0. \end{aligned}$$

In addition, a sufficient condition for domestic demand to be increasing in the nominal return i is:

$$\frac{\partial i_D}{\partial i} > \frac{\partial p (i_D(i) - R_f)(1 + i_D(i))}{\partial i (1 + R_f)p(i)}.$$

In economic terms, this means that the increase in the implicit domestic return on domestic sovereign bonds when i increases has to be high enough relative to the increase in the default probability related to a higher service of the debt.

Similarly, a sufficient condition for foreign demand to be increasing in i is:

$$\frac{\partial i_F}{\partial i} > \frac{\partial p (i_F(i) - R_f)(1 + i_F(i))}{\partial i (1 + R_f)p(i)}. \quad (1)$$

The economic interpretation of this condition is similar to that of the previous condition.

When these sufficient conditions are satisfied, if:

$$\frac{\partial i_D}{\partial i} > \left(\frac{i_D - R_f}{i_F - R_f}\right)^2 \frac{\partial i_F}{\partial i} + \frac{(i_D - R_f)(1 + i_D) \frac{\partial p}{\partial i}}{(1 + R_f)p(i)} - \frac{(i_D - R_f)^2 (1 + i_F) \frac{\partial p}{\partial i}}{i_F - R_f (1 + R)p(i)}, \quad (2)$$

then domestic demand increases more in the nominal interest rate on domestic sovereign bonds than foreign demand. In economic terms, this means that the return effect of a higher nominal return for domestic creditors is high relative to that for foreign creditors.