Increase in Home Bias and Sovereign Debt Crisis in the Eurozone

Camille Cornand† Pauline Gandré‡ Céline Gimet§

May, 2014

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 which explain most of the variation in this share in a S-VAR model on a sample of 7 Eurozone countries in the period 2007-2012. 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 model theoretically the impact of the previous shocks in a second-generation model of crisis with endogenous home bias in sovereign debt. We derive conditions under which a higher home bias is associated with a change in the government’s decision. Finally, we discuss factually which case of the model best applies to the distinct countries of our sample during the recent Eurozone sovereign debt crisis.


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

---

†cornand@gate.cnrs.fr, Université de Lyon, Lyon, F-69007, France and CNRS, GATE Lyon Saint-Etienne, Ecullly, F-69130, France.
‡pauline.gandre@ens-lyon.fr, Ecole Normale Supérieure de Lyon, Lyon, F-69007, France and GATE Lyon Saint-Etienne, Ecullly, F-69130, France.
§celine.gimet@sciencespo-aix.fr, Institute of Political Studies, CHERPA, EA 4261, Aix-en-Provence, France and GATE Lyon Saint-Etienne, Ecullly, F-69130, France.

*We thank Stephan Sauer, Andrea Bonilla Bolaños, Nicolas Houy as well as participants at the 11th Infiniti Conference, the 11th Doctoriales Macrofi and the 2nd Finandebt Conference, in particular our discussants Livia Chitu and Matthieu Charpe, for helpful comments and discussions.
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 Brutti and Saure (2013), Van Riet (2014), Arslanalp and Tsuda (2012) and Merler and Pisani-Ferry (2012)). Despite a deep period of stress on the public debt market of the peripheral countries of the Eurozone, residents have significantly increased their purchases of domestic sovereign bonds, both in volumes and in proportions. By the end of March 2012, the share of public debt held by the domestic sector was above 40% in all GIIPS countries, and even close to 60% in Italy and to 70% in Spain (Andritzky (2012)).

This paper argues that the recent increase in home bias in sovereign debt in the Eurozone results from rising incentives to buy the debt for domestic investors relative to foreigners, following an increase in the expected probability of default. It aims at identifying empirically the macroeconomic factors which can lead home bias in sovereign debt to increase and at determining theoretically the consequences for the government’s strategic decision of default in the Euro area.\footnote{As 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 be different from its usual sense according to which home bias is the propensity of investors to make financial investments in their home country rather than in foreign markets (home bias in portfolios).}

First, with a Bayesian Structural VAR estimation, relying on a sample of 7 Eurozone countries in the period 2007Q1-2012Q1, we aim to go beyond the stylized facts by determining the causes and direct consequences of the recent increase in home bias in the Eurozone. We show that a shock on fundamental and a shock on country-specific expectations are the two main contributors to an increase in home bias in our empirical model. In addition, following the theoretical literature\footnote{The impact of an increase in home bias on other economic outcomes such as banking risk is beyond the scope of this paper.}
(Broner et al. (2014)), we investigate whether this increase has a destabilizing effect per se through its impact on the growth rate or on bonds yields spreads. We find no evidence that an increase in home bias directly leads to a decrease in the growth rate neither nor to an increase in the spreads in our sample.

In a second step, we propose a 2-period second-generation model of sovereign debt crises in a monetary union which assumptions are backed up by our empirical results. The model aims to illustrate the mechanism through which home bias impacts the government’s decision regarding default by incorporating both the plausible causes and direct consequences of an increase in home bias identified in our empirical tests. It derives the consequences of an increase in home bias on the government’s fiscal decision.

We model the decision of an optimizing government aiming at minimizing the economic and political costs of its fiscal policy. The government’s strategic decision is impacted both by the cost of taxation and the cost of default. We distinguish two components of the cost of default: the cost on debt held at home and the cost on debt held abroad. In our model, the positive impact of home bias on the total cost of default makes it crucial in the government’s decision, all the more so that the cost of taxation decreases in this variable.

Differently to most second-generation models of crises, the optimal decision of investors arises endogenously in the model (see Blot et al. (2014) for another example). Home bias at the equilibrium interest rate results from dissociated domestic and foreign demand for domestic sovereign bonds. Multiple equilibria conditional on expectations and home bias can arise for a given fundamental.

Our empirical results allow us to focus on two distinct exogenous sources of variation in the model. We show how a higher fiscal fundamental and more pessimistic

---

3 The foreign cost of default has long been identified in the theoretical literature (see Eaton and Gersovitz (1981) for a seminal work). Even though an empirical consensus relativizing this cost had emerged (see Panizza et al. (2009) for a survey), recent work provides empirical evidence of significant reputation costs and trade sanctions (Cruces and Trebesch (2013), Borenzstein and Panizza (2009)).
expectations (related to a change in higher order beliefs) shift the market equilibrium towards higher interest rate and home bias. We derive a straightforward sufficient condition for this variation in investors’ decision to lead 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 the switch in equilibrium less likely. The switch is thus conditional on the relative extent of the source of vulnerability triggering the increase in home bias and on this latter’s stabilizing impact. The model succeeds in replicating the recent stylized facts in the Eurozone. Finally, given recent facts on sovereign default and rescue packages in the Eurozone, 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 empirically the reasons of the recent increase in home bias in sovereign debt in the Eurozone and gathers in a theoretical model the several effects of home bias on the government’s fiscal decision identified in previous literature.

Our paper relates to Gros (2012) and De Grauwe (2011), who – in line with the literature on second generation speculative attack models (Obstfeld (1994), Obstfeld (1996)) and its application to sovereign debt crisis\(^4\) – analyze the recent European debt crisis as a self-fulfilling speculative dynamics. Like ours, these papers show that crises can be triggered by creditors’ sudden pessimism leading them either to refuse to buy debt or to demand very high interest rates. However, none of them directly focuses on home bias. Regarding home bias in sovereign debt or in banks’ sovereign bonds portfolios, recent literature has focused on its impact on the transmission of sovereign risk to the banking sector (Acharya et al. (2014), Cheng et al. (2014)) rather than on its direct impact on default’s decision. Broner et al. (2014),

\(^4\)First models of self-fulfilling sovereign debt crises include Calvo (1988) and Cole and Kehoe (2000). This category of models has recently been applied to the current crisis (Cooper (2012), Corsetti and Dedola (2011), Aguiar et al. (2014), Conesa and Kehoe (2013), and Lorenzoni and Werning (2013)). De Grauwe (2011), De Grauwe and Ji (2013), and Bruneau et al. (2012) among others have shown the empirical relevance of the theory of self-fulfilling prophecies in the context of the recent Eurozone debt crisis.
Mengus (2013) and Gennaioli et al. (2014) are recent exceptions. Broner et al. (2014) argue that creditors discrimination can favour purchases of sovereign debt by domestic investors and disrupt productive investment, what would lower growth. Differently to them, we consider the impact of an increase in home bias on the cost of default, which allows to account for its disciplining aspects. In addition, since we cannot find empirical evidence of a negative effect of home bias on growth in our sample once controlled for other main variables, we conclude that a higher home bias is not destabilizing per se, even though it reflects an ex ante increase in the probability of default. Similarly to us, Mengus (2013) argues that home bias increases the government’s internal cost of default. In Gennaioli et al. (2014), this cost arises endogenously as the result of domestic banks’ exposure to the debt of their sovereigns. Gennaioli et al. (2014) also provide empirical evidence based on historical data on sovereign default that a higher home bias in sovereign debt portfolios increases the cost of default. Nevertheless, none of these papers deal with the role of home bias in the government’s decision through the cost of taxation and the external cost of default. In addition, they do not focus on the recent Eurozone debt crisis and thus do not account for the reasons why home bias in sovereign debt has recently increased.

On the empirical side, Battistini et al. (2013) study the determinants of home bias seen as a measure of market segmentation in the Eurozone. They focus on home bias in banks’ portfolio – defined as the domestic sovereign debt holdings of the banks in one country scaled by the total assets of those banks – while we deal with a general measure of home bias in sovereign debt. Relying on a sample of advanced economies, Andritzky (2012) shows that the share of public debt held abroad responds positively to a negative shock on yields in the Euro area thanks to a panel VAR model. He does not find proof of a reverse causality effect, which is

\[^5\text{In his model, home bias results from bailout of domestic investors while in our model it arises more generally from distinct additional costs and benefits (increasing in the expected probability of default) of buying domestic public debt for both groups.}\]
consistent with our results. While Andritzky focuses on disentangling the causality relation between yields on sovereign bonds and the share of debt held by foreigners, we analyze the impact of fundamental shocks and world risk aversion shocks on the dynamics of home bias. In addition, we provide empirical elements on the causality relation between home bias and growth rate.

The next section presents some stylized 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 self-fulfilling debt crisis. Section 4 discusses which case of the model best applies to the distinct countries in our sample. Section 5 concludes.

2 Home bias in the Eurozone

In the following section, we first identify recent features in the evolution and origin of home bias that are specific to the Eurozone. Second, we analyze the shocks that explain most of the variation in home bias with a panel S-VAR model and provide some results on the impact of home bias on the other variables.

2.1 Evolution and origin of home bias

Four main stylized facts about home bias can be identified in the Eurozone as shown on Figure 1.6

First, there has been a recent increase in home bias during the Euro area sovereign debt crisis. The proportion of domestic holding of public debt had significantly

---

6Notice that the stylized facts that we emphasize here deal with variation in home bias and not with home bias in level, in a particular context of stress on the sovereign debt market in a monetary union. Consequently, we will focus on the causes and consequences of a short-term increase in home bias in this particular context. Therefore, the case we investigate is different to that of Japan, where home bias in public debt is known to be very high (90% in the first quarter of 2012 according to Andritzky's database) but stable. Consequently, it does not seem to be the short-term result of destabilizing macroeconomic shocks.
decreased since the creation of the Eurozone in 1999, revealing a deepening of European financial markets’ integration (Figure 1 a). Nonetheless, recently, home bias has started to increase again in most European countries, as it is commonly observed in the aftermath of a crisis (Andritzky (2012)), to the notable exception of Germany.\footnote{In the case of France, the increase is more recent than in other countries, therefore it is not visible on Figure 1 b but it is visible on Figure 1 a.} This recent increase in home bias coincides with the global financial crisis and the consecutive debt crisis in the Eurozone. It has been observed since 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, this increase has distinct features among European countries. In Italy, Spain...
and Ireland, it 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 (Figure 1 c). In France, the rising home bias is due to the increasing volume of public debt held by residents, which has recently been faster than the increase in the volume of public debt held by non-residents.

Fourth, in the Eurozone, domestic public debt holding 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 Europe in comparison with the UK and the US.

We now conduct empirical tests in order to provide some elements on the factors that may have triggered the increase in home bias and to come up with some empirical evidence on the effect of the increase in home bias per se.

### 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, have they faced a significant increase in home bias (Greece, Ireland, Italy, Portugal, Spain), a much more recent one (France) or a decrease in home bias (Germany), in the period 2007:Q1-2012:Q1.

---

8 The argument according to which banks have increased their general exposure to sovereign bonds following the Basel II regulation is not sufficient to explain the evolution observed in the data. Indeed, home bias in banks’ sovereign bonds portfolio has significantly increased (see Battistini et al. (2013)), meaning that banks have increased their exposure to domestic sovereign bonds more than to foreign sovereign bonds.

9 An interesting additional test would be to extend our sample period so that it starts with the beginning of the monetary union and to test for non-linearities. Nevertheless, since many data on home bias is missing before 2007 and would require frequent use of interpolation methods, we choose to focus the period 2007-2012. In addition, for this last period, we can check the robustness of our results by substituting the spread on bonds by the CDS premium spread, for which data is available only on the late period.
The previous period, prior to the outbreak of the global financial crisis in 2007, is likely to display structural differences while the following period may present inconsistent features following the Greek partial 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.

Our choice of a panel data analysis is motivated by the fact that we want to draw a general conclusion for the whole Eurozone on the reasons that have triggered the common increase in home bias for most of the countries in the sample. We want to establish a general relationship between our variables of interest that would be relevant for the whole sample once controlled for individual heterogeneity, and would allow to derive more than country-specific forecasts on the impact of an increase in home bias.

The sudden increase in home bias observed in most of the sample is very sudden and coincides with some lag with the start of the stress period on the Eurozone debt markets (the increase in home bias starts a bit before). Therefore, it is consistent to interpret the increase in home bias as the consequence of some unexpected shock. This is why we investigate the impact of different shocks on the dynamics of home bias in order to identify the most explanatory ones, 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, what would not be possible in a simple VAR model. Third, a S-VAR model makes
it possible to analyze bi-directional causalities without facing endogeneity issues. Therefore, we can both identify the shocks on the variables which lead home bias to respond positively and the impact of a shock on home bias on the other variables of the model.

Our S-VAR model includes 5 variables. In a first step, we aim at identifying the main sources of variation in home bias (hb). They are of two kinds: first, fundamental shocks, and second, expectations shocks.

The fundamental fiscal shock that we consider is a shock on the fiscal space variable which is the ratio of debt on total tax revenues (fs). Aizenman and Jinjarak (2013) show that this variable accounts for a significant part of market pricing of risk. In addition, we include two different expectations variables. First, we consider global non-Europe 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 shock with a shock on the spread on 10-year yields on sovereign bonds (spread) with the fundamental variables remaining constant. It 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 yields for all other countries in the sample.

We also include the quarter-on-quarter change of seasonally adjusted GDP at constant prices (gdp) as a further fundamental control and for assessing whether an increase in home bias can impact the GDP everything else being equal in the S-VAR.

Data on home bias defined as the share of total sovereign debt held by domestic investors was extracted from the new database of Andritzky (2012). Data on VIX comes from CBOE and data on 10-year government bonds yields, seasonally adjusted quarter-on-quarter change in real GDP and the fiscal space variables were
extracted from the Eurostat and OECD databases.\textsuperscript{10}

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

\[ Y_{i,t} = \sum_{i=1}^{n} \sum_{j=1}^{q} A_{j} Y_{i,t-j} + e_{i,t} \]  \hspace{1cm} (1)

where \( q \) is the number of lags, \( n \) is the number of countries, \( Y_{i,t} \) is the vector of endogenous variables, \( Y_{i,t-j} \) is the \( n \times 1 \) vector of lagged variables for each \( i \), \( A_{j} \) is the \( n \times n \) parameter matrix, and \( e_{i,t} \) is the vector of errors with \( e_{i,t} = b_{i} + b_{t} + b_{i,t} \) where \( b_{i} \) is the individual fixed effect, \( b_{t} \) the time fixed effect and \( b_{i,t} \) the disturbance term which variance-covariance matrix has no restrictions, that is \( E(b_{i,t}, b_{t}^{T}) = \Omega \) and \( E(b_{i,t}) = 0 \). Letting \( L \) be the lag operator, the VAR(q) model can be rewritten as:

\[ A(L)Y_{i,t} = e_{i,t}. \]

This process is transformed in moving average infinite structural form to yield the impulse response functions and the forecast error variance decomposition. An intermediate step consists in reversing the canonical VAR model using the Wold Theorem. This yields the moving average form:

\[ Y_{i,t} = \sum_{j=1}^{n} \sum_{k=0}^{\infty} C_{k} e_{i,t-k} = C(L)e_{i,t} \]

where \( e_{t} \) represents the vector of canonical innovations. The structural Moving Average representation is then:

\[ Y_{i,t} = \sum_{j=1}^{n} \sum_{k=0}^{\infty} \Theta_{k} e_{i,t-k} = \Theta(L)e_{i,t}, \]

\textsuperscript{10}We relied on interpolation methods for missing data on home bias for France and Portugal.
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 has to be estimated in order to identify the structural shocks. The short-run constraints are imposed directly on \( P \) and are equivalent to set some elements of the matrix to zero. The \( \Theta_j \) matrix represents the response functions of \( Y_{i,t} \) to structural shocks \( d_{i,t} \). These are assumed to be uncorrelated and to have a unit variance: \( E(d_{i,t}, d_{i,t}^T) = I_n \). Letting \( \Omega \) be 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 restrictions on the conditional mean of lagged variable coefficients. Nevertheless, this inference method restricts beliefs about lagged variable coefficients to be Gaussian and uncorrelated across equations conditional on contemporaneous variable coefficients, but they are allowed to be correlated differently in different 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, which enables better interpretation regarding significance and sign of the results (Sims (1988), Sims and Uhlig (1991)).

Let \( Y = \begin{pmatrix} \text{vix} \\ \text{hb} \\ \text{spread} \\ \text{fs} \\ \text{gdp} \end{pmatrix} \) be the vector of endogenous variables, and \( \varepsilon_t = \begin{pmatrix} \varepsilon_{\text{ext}} \\ \varepsilon_{\text{hb}} \\ \varepsilon_{\text{spread}} \\ \varepsilon_{\text{fs}} \\ \varepsilon_{\text{rs}} \end{pmatrix} \) the vector of structural shocks, where \( \varepsilon_{\text{ext}} \) represents the global financial shock and \( \varepsilon_{\text{hb}}, \varepsilon_{\text{spread}}, \varepsilon_{\text{fs}} \) and \( \varepsilon_{\text{rs}} \) are respectively the VIX shock, 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 \( \Omega \) matrix is symmetric. Therefore, \( \frac{n(n+1)}{2} \) orthogonalization constraints have already been imposed. Thus, it is necessary to determine the 10 remaining constraints, relying on the economic literature. First, we assume that the world risk aversion shock (the shock on the variable VIX) is contemporaneously exogenous to domestic variables in the Eurozone countries. Indeed, VIX as a proxy for global non-Europe financial conditions is expected to impact 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)). Going 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, what justifies that they order the US variables first. 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 (Prieto et al. (2013), Favero and Giavazzi (2008), Kim (2005)). 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 panel whole sample’s reactions to the different shocks in Appendix A and focus here on the reactions that deal with the dynamics of home bias. The distinct impulse response functions show the responses of the domestic variables and the global financial conditions indicator following each shock. They were gen-
erated using the Bayesian Monte-Carlo integration method proposed by Sims and Zha (1999). The standard errors associated with a one standard error deviation shock were calculated with the same method.\textsuperscript{11} The associated variance decompositions which enable to compare the relative importance of each shock in explaining the dynamics of the distinct variables are displayed in Appendix B.

First, Figure 2 shows that an unexpected shock on fiscal space triggers a positive significant response in home bias. This means that fundamental reasons can explain the increase in home bias. In addition, home bias responds to an unexpected shock on spreads with some lag. This result is in accordance with the model of Broner et al. (2013) (where the marginal buyer of sovereign bonds becomes a domestic one when the expected probability of default increases), and with the empirical investigation of Andritzky (2012).

Therefore, home bias seems to react to impaired credit risk fundamentals and expectations. Indeed, we interpret the shock on sovereign bonds spreads as a shock on expectations since it represents a one standard-error deviation in the risk premium with all the other endogenous variables of the empirical model remaining

\textsuperscript{11}The confidence interval calculated from the procedure proposed by Sims and Zha (1999) 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

---

13
constant, notably the fiscal space variable. This shock can impact home bias dynamics through different intermediary channels. They relate to distinct incentives for domestic and foreign creditors to invest in domestic sovereign debt, that arise when the probability of default increases (see the theoretical part for more details). Home bias in sovereign debt responds positively to a shock on VIX and negatively to a shock on GDP after some lag. Both results are rather intuitive. First, when global risk aversion unexpectedly increases, foreign investors may become more cautious and invest less in foreign public debt, especially the most risky one. Second, an unexpected increase in GDP provides a comforting signal on the fundamental economic situation of a particular country, what leads foreign investors to increase their participation on the sovereign debt market of this country. The variance decomposition (see Appendix B) reveals that the shock on sovereign bonds spreads explains 23.92% of the variation of home bias 3 quarters after the shock and more than 40% 12 quarters after the shock. The fundamental shock explains 7.3% of the variation in home bias 3 quarters after the shock, while the shock on GDP explains 2.12% of this variation and the shock on VIX less than 0.30% in the first periods when it is significant. Consequently, we will include in our theoretical model a change in fundamental and a change in country-specific sovereign default expectations as the two main sources of increase in home bias.

Another important result for the assumptions of our theoretical model is the causality effect of a shock on home bias on the dynamics of the growth rate. We do not interpret the increase in home bias observed in our sample as a shock on home bias but rather as the response of home bias to shocks on other variables. Nonetheless, we use the results of our S-VAR to analyze the causality impact of an increase in home bias per se, when all the other variables of the model remain constant. The

---

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 shocks on VIX, might be more explanatory of home bias dynamics than country specific shocks in the beginning of the period.
theoretical literature has emphasized a possible destabilizing effect of home bias through crowding-out effects. Indeed, Broner et al. (2014) show that, because of financial frictions, increasing incentives for domestic investors to buy public debt when interest rates increase disrupt productive investment, what lowers growth. Another possible effect of an increasing home bias on the growth rate could be related to its impact on domestic banks’ credit supply. This latter is all the more so reduced that banking risk increases due to banks’ exposure to sovereign risk, what could eventually lower investment and growth (Acharya et al. (2012)). Nevertheless, we cannot find empirical evidence of this effect: the growth rate does not significantly respond to a shock on home bias in sovereign debt in our sample. One possible explanation for this result could be that this is not home bias in sovereign debt but rather home bias in banks’ portfolio which directly impacts private credit supply. Thus, the literature on credit crunch following the sovereign debt crisis (see for instance Popov and Van Horen (2013)) has focused on this last variable. In addition, if any, the impact of home bias on the growth rate is likely to be very indirect and not to occur in the short run. In particular, Cantero-Saiz et al. (2014) show that in periods of easy monetary policy, no systematic linear relation between sovereign risk and credit supply can be found in Europe. Our empirical result could also 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, since we cannot find empirical grounds to plead for a negative effect of home bias on the growth rate in our sample of interest, we choose not to include it in our theoretical model. Similarly, a shock on home bias does not impact the dynamics of the spreads. This result seems rather intuitive: it is likely to reflect the fact that no precise public data on home bias is available every quarter, which explains that it is not precisely integrated in market pricing of risk. It means that an increase in home bias does not reinforce or reduce self-fulfilling dynamics.
Our different empirical results are robust to changes in the proxy variables.\textsuperscript{13} In addition, once we remove alternatively Germany and France from the sample (which present distinct characteristics relative to peripheral countries), the results are not significantly modified.

Now that we have identified the most important sources of variations in home bias in our empirical model, we examine their impact on the equilibrium of a second-generation model of sovereign debt crisis. This allows us to characterize the conditions under which an increase in home bias is associated with sovereign default.

3 A simple model of self-fulfilling debt crisis with home bias

We propose a second-generation model of crisis applied to sovereign debt crises in a monetary union. Our setting is a two-period strategic game involving three different players: domestic investors, foreign investors and the government.

In period 1, each individual investor – be it a domestic one or a foreign one – decides which share of its initial wealth to consume. He allocates the remaining part of its wealth between sovereign bonds and a world risk-free asset, in order to maximize the inter-temporal utility of his consumption. Both domestic and foreigners know how the government makes its decision. Nevertheless, ex-ante, they do not know for sure if the outcome will be default or not. Indeed, an exogenous worldwide random macroeconomic shock $r$ occurs between period 1 and period 2, and this shock impacts the government’s decision. Investors know the distribution of shock $r$ but they do not observe its realization before making their decision. Consequently, the probability of default that they consider in their maximization program is integrated over the whole distribution of $r$. Therefore, the market in-

\textsuperscript{13}We substituted the quarter-on-quarter change in growth rate with the year-on-year one and the spread on sovereign bonds with the premium on sovereign CDS.
interest rate also reflects the uncertainty on the ex-post outcome. The timeline is displayed in Figure 3.

3.1 The government’s decision

In period 2 (the final period of the game), the government observes the aggregate decision of domestic and foreign investors and the macroeconomic exogenous shock, and decides between paying back the debt (which includes in period 2 the interest rate payments) or defaulting on its full debt.\textsuperscript{14} Debt has a one period maturity. In period 1, the government rolls over the totality of the debt inherited from the past $d_1$. Following Gennaioli et al. (2014) and Mengus (2013), the government is non-discriminatory in our model. In their framework, this can be justified by trading on the secondary market and portfolios’ unobservability. In ours, this is justified by the one-period maturity of debt: if the government was expected to default only on foreign creditors, foreigners could stop rolling over their holdings of sovereign debt anytime.\textsuperscript{15}

A competitive equilibrium of our model is defined by a set of aggregate investors’ decisions $(i^*, H^*)$, the realization of the macroeconomic worldwide exogenous shock $r$ and the government’s decision (default or non-default). In order to make its decision regarding fiscal policy, the government strategically compares its loss function under full debt repayment with its loss function under full default, and

\textsuperscript{14}We 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 haircut.

\textsuperscript{15}After 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 impact 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 which are holding sovereign bonds. In addition, the ECB can impact ex-ante expectations, notably through liquidity injections and commitment or announcement that it will intervene to help countries facing difficulties. Endogenizing the ECB’s strategic decision is beyond the scope of this paper since it is unlikely to be impacted by home bias.
chooses the least costly option. The optimizing government focuses on minimizing the economic and political costs of its fiscal policy.

We characterize the two distinct loss functions associated with the different fiscal policy strategies of the government. On the one hand, the loss associated with full repayment of the debt $L_f$ is related to the cost of taxation on debt $u(H, d_1, i)$, with $0 < H < 1$ the home bias (the proportion of debt held domestically) and $d_1$ the amount of debt inherited from the past. Indeed, when the government fully repays its debt, it has to finance it through taxation\textsuperscript{16} which is supported by domestic taxpayers. We have:

$$\frac{\partial L_f}{\partial u} > 0, \frac{\partial u}{\partial H} < 0.$$

Indeed, domestic taxpayers are less reluctant to pay taxes for financing sovereign debt when they are the ones holding it (Gros (2012)) and the economic distortions related to taxation are lower if it allows at least to provide liquidity to residents through repayment on the assets they are holding. Therefore, the cost of taxation is decreasing in home bias. It can alternatively be interpreted as a cost of austerity which is similarly faced by residents only.

\textsuperscript{16}Since we are interested in the government's decision in the final period of the model, debt and interests payment cannot be funded through new emission of debt in this last period.
The total amount of debt to be paid back by the government in period 2 writes:
\[ d_2 = d_1 (1 + i), \]
the debt inherited from the past \( d_1 \) enhanced by the service of the debt. We have:
\[ \frac{\partial L_f}{\partial d_1} > 0, \quad \frac{\partial L_f}{\partial i} > 0, \]
since the higher the total amount of debt, the higher the taxes to be collected. Eventually,
\[ \frac{\partial L_f}{\partial r} < 0, \] (2)
since the higher \( r \), the better the state of the economy.\(^{17}\)
Therefore, the government’s loss function associated with the decision of fully repaying the debt \( L_f \) is defined as follows:
\[ L_f(u, d_1, r, H, i). \] (3)

The specificity of such a loss function in a monetary union is that national governments do not control monetary policy and then cannot monetize debt (Corsetti and Dedola (2011)), which reinforces the impact of the cost of taxation on the government’s decision. This specificity also makes the Eurozone countries more prone to self-fulfilling crises, due to liquidity shortages converting into solvency crises (De Grauwe and Ji (2013)). We assume that \( L_f \) is convex in all its arguments and that \( \lim_{d_1 \to 0} L_f = 0 \) and \( \lim_{d_1 \to +\infty} L_f = +\infty. \)

On the other hand, when the government defaults on its full debt, it faces a cost due to creditors’ opposition to default.

A key new feature of our model is that we distinguish between two components

\(^{17}\)Empirically, this shock could be interpreted as a shock lowering growth rates at the global level, such as a financial crisis or decline in world trade.
of the political and economic costs of default: the cost of default on the debt held domestically $v_D(H, d_1, i)$ and the cost on the debt held abroad $v_F(H, d_1, i)$. This makes the share of debt held domestically crucial in the government’s decision, all the more so that the cost of taxation also depends on this variable.

The domestic cost of default increases with home bias (Mengus (2013), Kremer and Mehta (2000)) since the volume of public debt held nationally increases for a given $d_1$ and since it makes residents more reluctant to default. Acharya 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 bigger 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.\footnote{The example of Japan also pleads for such an argument: Japanese public debt represents more than 200% of GDP but yields on sovereign bonds remain very low (below 2% in the last years) due to the high confidence of investors in the credibility of the Japanese government to repay its debt.}

Conversely, the foreign cost of default decreases with home bias:\footnote{Notice that those different effects on political and economic costs would also be present if the government only defaulted (or repaid) part of its debt.}

\[ \frac{\partial v_D}{\partial H} > 0, \frac{\partial v_F}{\partial H} < 0. \]

The government’s loss function in the case of default $L_d$ increases in both costs of default. We assume that: $v_D > v_F$ and $\frac{\partial L_d}{\partial v_D} > \frac{\partial L_d}{\partial v_F}$.

This means that the cost of default on the debt held domestically is higher than that on the debt held abroad and that a hike in the domestic cost of default leads to a stronger increase in the loss function than a change in the foreign cost of default.\footnote{Very appealing reasons for those last points are that domestic debt holders hold political power thanks to their voting rights that foreign debt holders do not have and that default on debt held at home directly impacts domestic economy.}

As a result,

\[ \frac{\partial L_d}{\partial H} > 0. \]
Similarly to the loss function under full debt repayment, the loss function under default increases in $d_1$ and $i$ but, contrary to the loss function under full debt repayment, it increases in $r$.

Following Gros (2012), the loss function increases in $L > 0$, which is an exogenous lump-sum cost of default. Empirically, this can be interpreted as the reputation cost that the government faces as soon as it defaults, whatever the amount of debt defaulted upon.

The loss function associated with the decision of default $L_d$ is the following:

$$L_d(v_D, v_F, d_1, r, L, H, i).$$ (4)

We assume that $L_d$ is convex in all its arguments and that $\lim_{d_1 \to 0} L_d = L$ and $\lim_{d_1 \to \infty} L_d = \infty$.

Since default is more likely when the debt to GDP ratio and interest rates are higher, we impose that:

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

We now solve the model by backward induction in order to characterize the government’s decision and thus the equilibrium once investors have made their decision to determine the Nash equilibria of the game.

In period 2, the government observes $i^*$ and $H^*$ resulting from the investors’ decision in period 1. It makes its decision given the value of those variables and the value of the exogenous variables $d_1, r$ and $L$.

The government decides not to default when:

$$L_f(u, d_1, r, H^*, i^*) - L_d(v_D, v_F, d_1, r, L, H^*, i^*) \leq 0,$$ (5)
that is when its losses under full debt repayment are lower than its losses under default, and conversely.

Therefore, a sufficient condition for having multiple equilibria conditional on expectations and home bias for a given fundamental is the following:

\[ \exists \text{ 2 pairs } (i^{*1}, H^{*1}) \text{ and } (i^{*2}, H^{*2}) \text{ such that there exists at least one value of } d_1 \text{ such that: } \]

\[ L_d(v_D, v_F, d_1, r, L, H^{*1}, i^{*1}) > L_f(u, d_1, r, H^{*1}, i^{*1}) \]
and
\[ L_d(v_D, v_F, d_1, r, L, H^{*2}, i^{*2}) < L_f(u, d_1, r, H^{*2}, i^{*2}). \]

When this condition is satisfied, multiple equilibria arise for fundamental values included between \( d_{1\inf} \) and \( d_{1\sup} \). \( d_{1\inf} \) is the unique fundamental value such that:

\[ L_d(v_D, v_F, d_1, r, L, H^{*2}, i^{*2}) = L_f(u, d_1, r, H^{*2}, i^{*2}). \]  
(6)

\( d_{1\sup} \) is the unique fundamental value such that:

\[ L_d(v_D, v_F, d_1, r, L, H^{*1}, i^{*1}) = L_f(u, d_1, r, H^{*1}, i^{*1}). \]  
(7)

The range of the multiple equilibria zone is given by:

\[ d_{1\sup} - d_{1\inf}. \]  
(8)

For fundamental values lower than \( d_{1\inf} \), whatever the market interest rate \( i \) and the realization of the exogenous macroeconomic shock \( r \), the debt to GDP ratio is so low that the government would never choose to default. For fundamental values higher than \( d_{1\sup} \), whatever \( i \) and \( r \), the government would never choose to fully repay its debt. Figure 4 provides a graphical example of multiple equilibria conditional on the interest rate and home bias. For any fundamental value \( d'_1 \) such that \( d_{1\inf} < d'_1 < d_{1\sup} \), in case 1, the government prefers to service its full debt

\[ 21 \text{This value exists since } L_d = L \text{ and } L_f = 0 \text{ when } d_1 = 0 \text{ and } \frac{\partial L_d}{\partial d_1} < \frac{\partial L_f}{\partial d_1}. \text{ It is unique since } L_f \text{ and } L_d \text{ are strictly monotonous in } d_1. \]

22
since $L_{1d}^1 < L_{1f}^1$ in the intermediary zone. In case 2, the government prefers to default since $L_{1f}^2 < L_{1d}^2$ in the intermediary zone.

3.2 Investors’ decision under uncertainty

Both domestic and foreign investors aim to maximize the inter-temporal utility of their consumption over the two periods. Individual demand for domestic sovereign bonds is given by:

$$\omega(i)(W_1 - C_1),$$

where $W_1$ is the individual initial endowment in period 1 (similar for domestic and foreigners), $C_1$ is consumption in period 1, and $\omega$ is the share of post-consumption wealth that is allocated to domestic sovereign bonds (with $1 - \omega$ the share invested in the risk-free world asset).

Since domestic investors represent a continuum on the $[0; 1]$ interval, aggregate
domestic demand for domestic sovereign bonds is:

\[ Q_D(i) = \omega_D(i)(W_1 - C_1). \]

Similarly, foreign demand for domestic sovereign bonds is:

\[ Q_F(i) = \omega_F(i)(W_1 - C_1). \]

The risk-free asset provides an exogenous constant return: \( E(R_f) = R_f. \)

In the midst of a deep stress episode on the sovereign debt market, the market interest rate \( i \) does not exactly represent what an investor will gain from investing in sovereign debt if no default occurs. Indeed, some particular benefits or costs which are increasing in the probability of default are added to the return on sovereign bonds for domestic and foreign investors.

As emphasized by 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 while they have increased for domestic ones. Battistini et al. (2013) (p.14) have identified several kinds of increasing incentives for residents (and especially banks) to invest in their own sovereign debt in fragile economies of the Eurozone.\(^{22}\) We thus include additional costs (for foreigners) and benefits (for domestic) to invest in domestic sovereign debt in the model. These costs determine the difference between the domestic and foreign demands.

\(^{22}\)The 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 has been 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, since sovereign debt would be redenominated in national currency. In addition, expectations of a possible bailout of residents following a default (Mengus (2013)) can provide incentives for domestic purchases of debt.
for sovereign bonds and thus the equilibrium home bias.

Because of the random macroeconomic shock $r$ which occurs after the investors make their decision, those latter cannot know for sure what the government’s decision will be, even if they can observe or anticipate the value of all other variables. Consequently, in their maximization program, agents include the cumulative probability of default over the whole distribution of $r$ (that is the probability to have $L_f > L_d$ conditional on $r$).

$$F(p(d_1, i, u, v_D, v_F, H, L, r)) = \int_r p(d_1, i, u, v_D, v_F, H, L, r)dr$$

is the cumulative probability of default, included between 0 and 1. For simplicity, in what follows, we will (improperly) write it $p(i, H, r)$ for a given fundamental $d_1$ and given functional forms $(u, v_D, v_F)$ and parameter $L$. Domestic sovereign bonds yield the following expected returns for domestic (given that the price of bonds is equal to their face value on the primary market):

$$E[R_{iD}] = i_D(b_D(p(i, H, r)))(1 - p(i, H, r)), \quad (9)$$

where $i_D(b_D(p(i, H, r)))$ represents the domestic interest rate – what a domestic investor really gains from the market interest rate $i$ once included the additional benefits for the domestic investors $b_D(p(i, H, r))$, which are increasing and convex in the probability of default.

Similarly, domestic sovereign bonds yield the following expected returns for foreigners:

$$E[R_{iF}] = i_F(c_F(p(i, H, r)))(1 - p((i, H, r))), \quad (10)$$

where $i_F$ represents the foreign implicit interest rate and $c_F(p(i, H, r))$ the additional costs for foreigners, which are increasing and convex in the probability of default. Given that domestic investors face additional benefits and foreign in-
vestors additional costs, it yields:

\[ 0 < i_F < i < i_D. \]

We now write \( i_j \) with \( j = (D, F) \) the gain from the return received on domestic sovereign bonds for the two groups of investors. We first characterize the domestic and foreign demand of bonds for each value of the interest rate \( i \).

The general program for a representative individual investor writes as follows:

\[
\begin{align*}
\max_{c_1, \omega} & \quad E_1[U(c_1, c_2)] = \ln(c_1) + \beta E_1[\ln(c_2)], \\
\text{s.t.} & \quad c_1 + \frac{c_2}{1 + E_1(R_T)} = W_1, \\
& \quad R_T = R_f + \omega(R_{ij} - R_f), \\
& \quad 0 \leq \omega \leq 1.
\end{align*}
\]

The F.O.C. write:

\[
\begin{align*}
\frac{1}{c_1} - \beta E_1[(1 + R_T)\frac{1}{(W_1 - c_1)(1 + R_T)}] &= 0, \\
\beta E_1[\frac{R_{ij} - R_f}{1 + R_f + \omega(R_{ij} - R_f)}] &= 0.
\end{align*}
\]

It yields:

\[ c_1^* = \frac{1}{1 + \beta} W_1, \]

\[ ^{23}\text{For simplicity of notation, we now write } i_D \text{ and } i_F \text{ without recalling their arguments.} \]
and:

$$\omega^*_j(i) = \frac{(1 + R_f)(i_j(1 - p(i, H, r)) - R_f)}{R_f(i_j - R_f)}.$$  \hspace{1cm} (18)

For a given interest rate on sovereign bonds, the domestic demand for sovereign bonds is equal to:

$$Q_D(i) = \omega^*_D(i)(W_1 - c^*_1),$$

and the foreign demand for domestic bonds is equal to:

$$Q_F(i) = \omega^*_F(i)(W_1 - c^*_1).$$

The interest rate has two effects on the demand function, playing in opposite directions. First, when the interest rate increases, the return on domestic public debt becomes higher, what would increase demand through a portfolio effect. Second, when the interest rate increases, this makes the probability of default increase. Indeed, everything else being equal, a higher interest rate makes the loss function under default increase less than the loss function under debt repayment. For foreign investors, the increase in probability also increases the additional costs of investing in sovereign debt while it increases additional benefits for domestic investors.

We assume that: $\frac{\partial Q_j}{\partial i} > 0$ on some interval of interest rates $[i_1, i_2]$, where $i_1$ is the lowest value of $i$ such that demand for sovereign bonds is non-null. This implies that on this interval, the positive effect of a marginal increase in the interest rate more than compensates its negative effect.\textsuperscript{24} In addition, we assume that $p$ is con-

\textsuperscript{24}This assumption allows to obtain a monotonous increasing demand function in $i$ on the interval $[i_1, i_2]$ and thus, if any, the market equilibrium on this interval is a stable equilibrium. If $i_2$ is a finite number, the negative effect of a higher $i$ (through its positive impact on the probability of default) dominates for $i > i_2$ and we may obtain two market equilibria. The one on the decreasing part of the demand curve would be unstable, what justifies that, even in that case, we focus on the equilibrium in the increasing part. In addition, this assumption enables us to generate an increase in the market interest rate following an
vex in $i$ (intuitively, the higher the interest rate the higher the impact of its increase on the probability of default) and that both demand functions are concave in $i$ on the interval $[i_1, i_2]$ (this implies that the higher $i$ on this interval, the lower its positive impact on demand relative to its negative impact which is consistent with the fact that for high levels of $i$, the probability of default is likely to be close to 1, what the portfolio effect cannot compensate).

Given that the higher probability of default associated with a higher interest rate does not only have a negative impact on domestic demand but also a positive impact (since it raises the additional benefits of investing in sovereign bonds), we have: $\frac{\partial Q_D}{\partial i} > \frac{\partial Q_F}{\partial i}, \quad |\frac{\partial^2 Q_D}{\partial i^2}| < |\frac{\partial^2 Q_F}{\partial i^2}|$.

**Market clearing** To derive the equilibrium condition, we calculate the aggregate demand for a given $i$ ($Q_T(i) = Q_D(i) + Q_F(i)$) and set it equal to the supply:

$$Q_D(i) + Q_F(i) = d_1.$$  \hspace{1cm} (19)

A sufficient condition for obtaining a stable market equilibrium is that there exists one value of $i_1 \leq i \leq i_2$ such that $Q_T(i) = d_1$ (A).

If total demand for sovereign bonds is too low relative to $d_1$ whatever the interest rate, there is no market equilibrium, leading to a roll-over crisis. This yields $i^*$ (and then $i_H^*$ and $i_F^*$) and $H^*$. Indeed,

$$i^* = Q_T^{-1}(d_1),$$  \hspace{1cm} (20)

and

$$H^* = \frac{\omega_D^*}{\omega_D^* + \omega_F^*} = \frac{\omega_D^*}{\omega_T^*}. $$  \hspace{1cm} (21)

Figure 5 illustrates the endogenous home bias.

---

28
3.3 Change in equilibrium with a higher home bias

Change in expectations  In order to assess the impact of an increasing home bias on the equilibrium, we now identify the conditions under which the shift from a situation with lower home bias to a situation with higher home bias can trigger a change in equilibrium for a given fundamental value.

We analyze the impact of an exogenous source of variation in country-specific expectations and of an exogenous change in fundamental on the equilibrium of our model. We compare two different situations in which expectations differ for the same fundamental, as in any standard second-generation model of crisis. More pessimistic expectations lower demand for a given interest rate through the beliefs on beliefs of others. Indeed, if some exogenous shock on higher order beliefs occurs and agents (both domestic and foreign, since they all have the same beliefs) think that others think that others (and so on and so forth) think that for a given $i$,

---

25The difference in our model is that expectations impact not only the government’s decision through the market interest rate (that we endogenize with respect to expectations), but also through the associated home bias.

29
is actually higher, they are going to lower their individual demand for a given $i$. They know that others’ beliefs on others are validated: if they lower their individual demand, aggregate demand decreases while supply does not shift, which gives rise to a new market equilibrium with a higher interest rate and therefore a higher equilibrium probability of default. Consequently, all agents lower their demand and expectations are validated. Market clearing is realized if and only if condition (A) is still satisfied. If not, the government faces a roll-over crisis and is pushed into default already in period 1.

**Proposition 1**: When expectations become more pessimistic, home bias always increases.

**Proof.** We write $Q_F(i^*)$ (respectively $Q_D(i^*)$) the foreign (respectively domestic) demand in equilibrium in the initial case and $Q_F'(i'^*)$ (respectively $Q_D'(i'^*)$) the foreign (respectively domestic) demand in equilibrium in the second case. Given that the gap between domestic demand in the situation with more pessimistic expectations and domestic demand in the situation with less pessimistic expectations is lower than that between foreign demand in the two respective situations, and given that domestic demand increases more strongly in $i$ than foreign demand, we have:

\[
Q_F(i^*) - Q_F'(i'^*) = Q_F(i^*) - Q_F'(i^*) + Q_F'(i^*) - Q_F'(i'^*) \\
> Q_D(i^*) - Q_D'(i^*) + Q_D'(i^*) - Q_D'(i'^*) \\
= Q_D(i^*) - Q_D'(i'^*).
\]

The market clearing conditions in both situations yield:

\[
Q_F(i^*) - Q_F'(i'^*) = -(Q_D(i^*) - Q_D'(i'^*)), \tag{22}
\]
which implies that:

\[ Q_D(i^*) - Q'_D(i'^*) < 0, \]

meaning that home bias is higher in the second situation relative to the first one.

\[ \square \]

Figure 6: More pessimistic expectations and home bias

We now assess the impact of such a change in investors’ decision on government’s decision when market clears in the first period and then on the equilibrium of the sequential game. Figure 6 provides a graphical example.

For both the change in expectations and the change in fundamental that we study below, we consider the realization of the exogenous worldwide macroeconomic shock \( r \) to be the same in the two cases that we compare.\(^{26}\)

If we write \((i^*, H^*)\) the investors’ decision in the initial situation and \((i'^*, H'^*)\) the investors’ decision in the situation with more pessimistic expectations, we can derive the straightforward sufficient condition for a change in equilibrium:

\(^{26}\)Hence the change in equilibrium cannot be due to a change in the realization of the shock, which is not what we investigate here.
A switch from the non-default equilibrium to the default equilibrium occurs if and only if: $L_d(i^*, H^*) > L_f(i^*, H^*)$ and $L_d(i^{'*}, H^{'*}) < L_f(i^{'*}, H^{'*})$. (B)

The fundamental $d_1$, the functional forms of the model $(u, v_{D}, v_{F})$, the parameter $L$ and the realization of $r$ are the same in both situations, since we are only interested in determining the effect of the expectations shock.

The distinct effects at work are the following. On the one hand,

$$\frac{\partial L_f}{\partial i} > \frac{\partial L_d}{\partial i}.$$  

In the situation with the expectations shock, the market interest rate $i$ is higher, which makes both the government’s loss under default and the government’s loss under full debt repayment increase. Nevertheless, it has a stronger impact on the loss function under default than on the loss function under full debt repayment. This leads to a destabilizing effect of the change in expectations (increase in the incentives to default).

On the other hand,

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

The increase in home bias following the change in expectations makes the loss function under default increase (through the increase in the cost of default), while the loss function under full debt repayment decreases (through the decrease in the cost of taxation). This leads to a stabilizing effect (decrease in the incentives to default).

Consequently, a higher home bias does not lead per se to a switch in equilibrium. Nevertheless, if the change in expectations which triggered it is strong enough and the exogenous worldwide shock is bad enough given the new expectations, the sufficient condition (B) can be satisfied. In addition, since investors have rational expectations, the expectations shock has to be justified by a hike in the probability of default, such that expectations are validated. This implies that, in order to
generate an increase in home bias in the model, the change in expectations has to be strong enough to compensate the stabilizing effect of the hike in home bias, but this is not a sufficient condition for a change in government’s decision. This means that we have:

\[ L'_d - L'_f < L_d - L_f, \]  

(23)

be it because \( L'_d - L'_f \) becomes negative or simply because \( L'_d \) increases less than \( L'_f \) (in comparison respectively with \( L_d \) and \( L_f \)).

**Change in fundamental**  We now consider the effect of a change in fundamental. We perform a comparative static exercise in order to derive the effect of an exogenous increase in the fiscal fundamental. An increase in \( d_1 \) has both an effect on demand and on supply of domestic sovereign bonds. On the one hand, it makes the exogenous supply increases. On the other hand, it raises the ex ante probability of default, which is conditional on the fundamental. Consequently, in comparison with the situation of a lower fundamental, it decreases demand for a given \( i \). Supply is higher and demand is lower, which leads the market interest rate to increase.

**Proposition 2:** When fundamental increases, home bias always increases.

**Proof.** Proof of Proposition 2 is similar to Proof of Proposition 1 except that the change in fundamental has to be taken into account.

A graphical illustration is provided on Figure 7.

If we now insert these new endogenous variables in the government’s decision, we can derive that a switch from the non-default equilibrium to the default equilibrium occurs if and only if: \( L_d(d_1, i^*, H^*) > L_f(d_1, i^*, H^*) \) and \( L_d(d'_1, i^{*'}, H^{*'}) < L_f(d'_1, i^{*'}, H^{*'}) \). (C)

The distinct effects at work are the following. On the one hand, the increase in the debt to GDP ratio and in the interest rate increases the probability of default. On
the other hand, the increase in home bias has a stabilizing effect. Condition (C) provides a sufficient condition for a change in equilibrium. Therefore, an increase in home bias reflects some exogenous source of fragility that can lead to a switch in equilibrium, but this is not an ex-post additional source of fragility itself. On the reverse, it plays as a stabilizing mechanism – through political costs – which mitigates the effect of the ex-ante source of fragility that triggered it, and makes the sufficient condition for a switch in equilibrium less likely.

Once again, we have:

\[ L_d' - L_f' < L_d - L_f, \]

so that this is consistent with the rational expectations assumption (the ex ante change in beliefs on the probability of default is validated ex post).

Therefore, we have identified a sufficient condition, both in the case of a change in expectations and a change in fundamentals, such that the situation that triggers an increase in home bias ends up in a sovereign default. Nevertheless, if this condi-
tion is not satisfied, the ex-ante probability of default increases but, ex-post, it re-
mains suboptimal to default for the government, be it because home bias increases
enough to partly compensate for the deteriorating macroeconomic conditions or
because those latter have not deteriorated enough. The next section provides a
discussion on which case of the model better represents what happened recently
in the Eurozone.

4 Which case of the model best applies to the Euro-
zone debt crisis? A factual discussion

The model is able to replicate recent stylized facts in the Eurozone – the increase in
home bias associated with an increase in bond yields and episodes of partial de-
fault. It is able to explain two distinct cases for countries where home bias in public
debt has increased. First, it can replicate the case of countries where sovereign de-
fault or debt repayment conditional on rescue plans has occurred following a very
destabilizing fiscal shock. Second, it can explain the case of countries where gov-
ernment committed to repay its debt despite impaired conditions. Regarding our
sample period, it is possible to identify which countries have satisfied the suffi-
cient condition for the government’s equilibrium to change following the increase
in home bias. The only country which 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 around 80 billion euros over the period May 2010 through
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 Eco-
nomic Adjustment Programme to Greece for the years 2012-2014 conditional to
new austerity measures and the realization of the so-called private sector involvement. It required voluntary debt swap from private creditors who were under 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 on, the collective action clause was activated in order to constrain creditors who hadn’t voluntarily agreed to the debt swap to participate, what led to the activation of Greek sovereign CDS. Greek partial default on government debt finally took place in March 2012.\footnote{See the European Commission website for more details.}

More generally, the change in government’s equilibrium condition can be seen as satisfied for countries which have requested rescue packages from the EFSF, what has been the case for Ireland, Portugal and more recently for 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 to be granted a rescue package. In those countries, the increase in home bias has not prevented from a change in the government’s equilibrium.

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

36
pact 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 strong enough to make default becomes 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 bigger 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 situation was 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 particular, in the French case, 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, what suggests that the shock triggering the increase in home bias has been a much less negative expectations shock (or even a positive expectations shock) relative to what happened in other countries. Therefore, if the sufficient condition for a change in government’s decision following an increase in home bias has not held true in France, this is probably due to better perceptions from foreign investors rather than to any stabilizing effect of home bias. Consequently, it is possible to empirically identify in our sample which countries have faced a change in the government’s decision regarding the decision of default and which have not in the period when home bias has 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 to identify two main shocks which impact the dynamics of home bias: fundamental shocks and country-specific expectations shocks. We find no evidence that a higher home bias is destabilizing per se, what relativizes the view held in the theoretical literature. Thanks to a second-generation model of sovereign debt crisis shedding light on the costs of default and taxation, we emphasize the possibility of multiple equilibria conditional on expectations and home bias. Introducing a change in expectations and a change in fundamental as sources of variation in the variables and the parameters, we show that a switch in the government’s fiscal decision is conditional on the relative effect of the increase in home bias and that of the source of fragility which triggered the increase.

Therefore, the relaxation of capital controls in order to decrease home bias does not seem to be a relevant measure for limiting sovereign default risk in the Eurozone since, if any, the increase in home bias has a stabilizing effect. Our results plead for the idea that the Eurozone economies could withstand turmoil periods on sovereign debt markets as long as the share of debt held domestically is high enough relative to the initial destabilizing shock. This makes national governments’ will to repay their debt more credible by allowing less politically costly transfers from debt holders to taxpayers. More worrying is the impact of an increasing home bias in banks’ portfolio, what could justify policies favoring diversity in domestic debt holders. On the other hand, identifying the drivers of the increase justifies ECB interventions on sovereign bonds markets in order to avoid expectations or fundamental shocks. If efficient in restoring confidence, those measures would limit the transmission of sovereign risk to banking risk and make the foreign investors come back on the domestic sovereign debt market in the longer term.
References


39


A  Impulse response functions

![Impulse response functions](image)

Figure 8: Impulse response functions

B  Variance Decompositions

<table>
<thead>
<tr>
<th>Vix shock</th>
<th>Vix</th>
<th>hb</th>
<th>spread</th>
<th>fs</th>
<th>gdp</th>
<th>Spread shock</th>
<th>Vix</th>
<th>hb</th>
<th>spread</th>
<th>fs</th>
<th>gdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>99.88</td>
<td>0.11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>36.12</td>
<td>63.88</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>99.12</td>
<td>0.21</td>
<td>0.13</td>
<td>0.4</td>
<td>0.06</td>
<td>2</td>
<td>3.85</td>
<td>27.11</td>
<td>53.9</td>
<td>3.98</td>
<td>2.13</td>
</tr>
<tr>
<td>3</td>
<td>98.7</td>
<td>0.27</td>
<td>0.31</td>
<td>0.5</td>
<td>0.1</td>
<td>3</td>
<td>6.69</td>
<td>23.92</td>
<td>47.28</td>
<td>7.79</td>
<td>1.92</td>
</tr>
<tr>
<td>4</td>
<td>98.24</td>
<td>0.31</td>
<td>0.6</td>
<td>0.51</td>
<td>0.14</td>
<td>4</td>
<td>6.88</td>
<td>25.13</td>
<td>43.97</td>
<td>10.69</td>
<td>1.68</td>
</tr>
<tr>
<td>8</td>
<td>93.05</td>
<td>1.62</td>
<td>3.37</td>
<td>1.55</td>
<td>0.26</td>
<td>8</td>
<td>4.37</td>
<td>36.49</td>
<td>38.35</td>
<td>14.91</td>
<td>1.13</td>
</tr>
<tr>
<td>12</td>
<td>74.86</td>
<td>8.88</td>
<td>10.54</td>
<td>4.51</td>
<td>0.4</td>
<td>12</td>
<td>3</td>
<td>41.6</td>
<td>36.28</td>
<td>15.31</td>
<td>0.95</td>
</tr>
<tr>
<td>Fs shock</td>
<td>Vix</td>
<td>hb</td>
<td>spread</td>
<td>fs</td>
<td>gdp</td>
<td>Hb shock</td>
<td>Vix</td>
<td>hb</td>
<td>spread</td>
<td>fs</td>
<td>gdp</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1.93</td>
<td>0.03</td>
<td>95.9</td>
<td>1.28</td>
<td>1</td>
<td>0</td>
<td>99.06</td>
<td>0.94</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>3.95</td>
<td>4.97</td>
<td>0.14</td>
<td>84.22</td>
<td>4.18</td>
<td>2</td>
<td>8.35</td>
<td>87.72</td>
<td>1.1</td>
<td>0.45</td>
<td>0.09</td>
</tr>
<tr>
<td>3</td>
<td>10.85</td>
<td>7.3</td>
<td>0.25</td>
<td>74.43</td>
<td>4.04</td>
<td>3</td>
<td>12.9</td>
<td>81.74</td>
<td>1.45</td>
<td>0.78</td>
<td>0.13</td>
</tr>
<tr>
<td>4</td>
<td>14.13</td>
<td>8.87</td>
<td>0.42</td>
<td>68.82</td>
<td>3.88</td>
<td>4</td>
<td>15.58</td>
<td>77.44</td>
<td>1.94</td>
<td>1.1</td>
<td>0.16</td>
</tr>
<tr>
<td>8</td>
<td>17.47</td>
<td>11.42</td>
<td>1.92</td>
<td>59</td>
<td>3.49</td>
<td>8</td>
<td>16.39</td>
<td>66.99</td>
<td>6.28</td>
<td>3.16</td>
<td>0.27</td>
</tr>
<tr>
<td>12</td>
<td>15.46</td>
<td>16.72</td>
<td>6.36</td>
<td>50.25</td>
<td>2.98</td>
<td>12</td>
<td>12.06</td>
<td>57.98</td>
<td>15.4</td>
<td>6.77</td>
<td>0.44</td>
</tr>
<tr>
<td>Gdp shock</td>
<td>Vix</td>
<td>hb</td>
<td>spread</td>
<td>fs</td>
<td>gdp</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0.8</td>
<td>0.28</td>
<td>12.65</td>
<td>85.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>43.14</td>
<td>1.28</td>
<td>2.32</td>
<td>8.3</td>
<td>37.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>44.39</td>
<td>2.12</td>
<td>4.18</td>
<td>9.24</td>
<td>32.97</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>43.01</td>
<td>3.57</td>
<td>6.49</td>
<td>10.29</td>
<td>29.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>28.33</td>
<td>16.81</td>
<td>18.27</td>
<td>13.55</td>
<td>17.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>14.24</td>
<td>31.49</td>
<td>27.64</td>
<td>14.78</td>
<td>7.81</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>