

# Repatriation of Debt in the Euro Crisis: Evidence for the Secondary Market Theory\*

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## Abstract

This paper uncovers three main empirical regularities concerning cross-border bank positions during the Euro Crisis. First, crisis countries tend to repatriate their debt, i.e. debt issued in crisis countries flowed from foreign to local investors. Second, this repatriation is especially strong for public debt and, third, public debt of crisis countries is reallocated to politically influential countries within the Euro Area. Standard theories of portfolio allocation and home bias can explain the first pattern at best. We argue that the second and, to some extent, the third pattern constitute evidence in favor of the “secondary market theory” of sovereign debt.

**Keywords:** Debt Repatriation, Sovereign Risk, Secondary Markets, Euro Crisis, Portfolio Home-Bias

**JEL Classification:** F34, F36, G01, G11, G21

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# 1 Introduction

The Euro Crisis has been associated with a reversal of cross-border capital flows among European countries, resulting in a fragmentation of financial markets.<sup>1</sup> Commercial banks, in particular, showed an increasing propensity to hold domestic assets, a tendency that we call *repatriation* of debt. These developments, in turn, have raised concerns among policy makers about the resilience of financial integration in the region.

The present paper uncovers three empirical regularities that characterize the observed process of debt repatriation and help to understand its driving forces. First, the repatriation occurred primarily in countries in acute state of crisis. Figure 1 illustrates this fact, plotting the average share of domestically held debt for different groups of countries between 2006 and 2011.<sup>2</sup> The figure shows that for those countries that were directly affected by the crisis, i.e. Portugal, Ireland, Italy, Greece and Spain (PIIGS), the average share increased from roughly 80% to 87%. The increase was especially strong after the last quarter of 2009, a date that marks the beginning of the Euro Crisis. Within the same period, the share of domestically held debt of other Euro Area countries remained essentially unchanged.

Second, the repatriation of debt mainly affected the public debt of countries in distress. Figure 2 plots the share of domestically held debt in the PIIGS countries and in the other Euro Area countries, distinguishing between non-bank private debt (left panel) and sovereign debt (right panel). The graphs clearly show that the share of domestic ownership increased only in the PIIGS countries and only for public debt positions. Conversely, no significant change of debt ownership is visible in other Euro Area countries nor for the private debt of PIIGS countries.

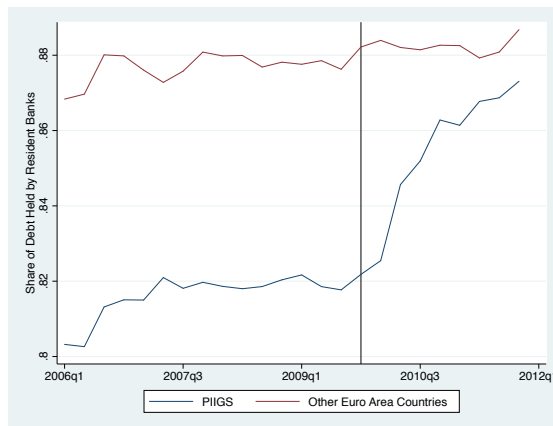
Third and finally, the debt of crisis-stricken Euro Area countries was also reallocated to politically influential countries within the Euro Area. The estimation results, discussed later in the paper, show that such reallocation was particularly strong for public debt. In contrast, there is no sign of a similar tendency in the case of private debt.

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<sup>1</sup>The European Financial Stability and Integration Report published by the ECB in 2011 observes that “the European sovereign bond market crisis strongly affected the euro area financial system, whose degree of integration has deteriorated.” Similar considerations appear in a recent report by the IMF (see Goyal et al. 2013).

<sup>2</sup>The shares are computed for aggregate non-bank debt, thus referring to the sum of non-bank private debt and sovereign debt.

Figure 1: Share of Domestically Held Debt - Total Non-Bank Debt



Debt holdings by local banks relative to total bank-held debt of the country. Simple averages by country group. The group of PIIGS countries includes Portugal, Ireland, Italy, Greece, Spain. The group of other Euro Area countries includes Austria, Belgium, Finland, France, Germany and the Netherlands. The vertical line denotes the outbreak of the Euro Crisis. See Section 3.2 for the description of the data and the counterparty countries considered. Source: Locational Banking Statistics (BIS) and IFS (IMF).

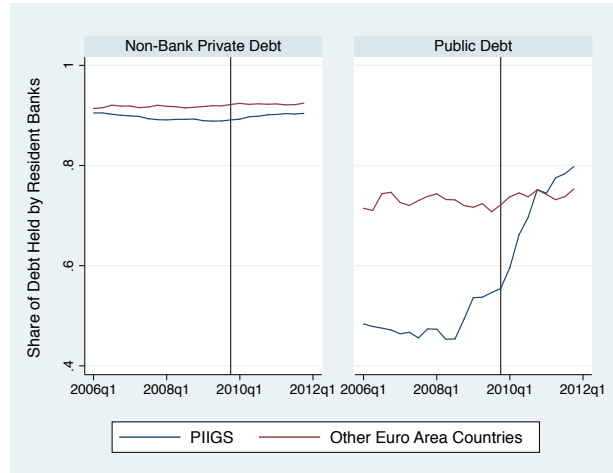
The general picture conveyed by the three stylized facts is consistent with the “secondary market theory” of sovereign debt, recently advanced by Broner, Martin and Ventura (2010). Like most theories of sovereign debt, the secondary market theory starts from the premises that sovereigns care more about domestic creditors than about foreign creditors. Therefore, sovereigns are less likely to default on their debt, the more of it is held domestically.<sup>3</sup> If, however, an exogenous shock raises the government’s temptation to default under the prevailing debt allocation, the secondary market theory predicts that sovereign bonds should flow back from foreign investors to domestic investors. The latter, indeed, will rationally buy bonds from the former in secondary markets, expecting that government bonds appreciate as a fraction of the country’s debt is repatriated.<sup>4</sup> The theory thus exhibits a sharp and testable implication for time series data: following an exogenous shock to the sovereign

<sup>3</sup>More specifically, the equilibrium share of debt held by domestic residents cannot fall short of a minimum threshold. Otherwise, the government will choose optimally to default on its obligations.

<sup>4</sup>More precisely, the existence of competitive secondary markets allows for multiple equilibria of the model. One in which there is no repatriation of debt and the government defaults. One in which debt is repatriated and there is no default. In the presence of an even negligible degree of coordination among domestic creditors, the latter equilibrium is unique.

risk of a country, its bonds are reallocated to local investors. In the words of BMV, when “penalties are known to be insufficient foreign creditors try to sell their debts, perhaps at a discount, and ‘leave’ the country.” This is precisely the pattern we observe in the data.

Figure 2: **Share of Domestically Held Debt - Private and Public Debt**



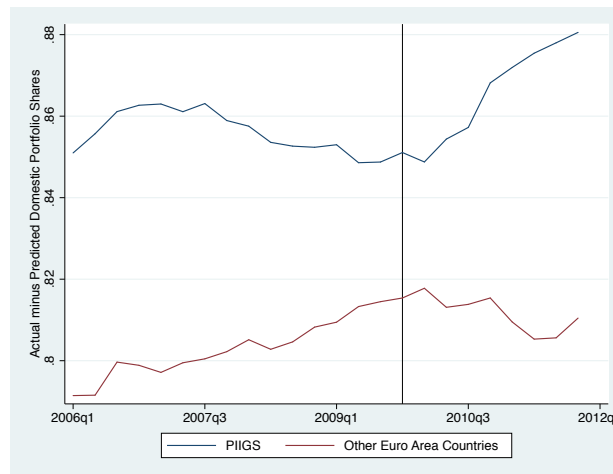
Debt holdings by local banks relative to total bank-held debt of the country. Simple averages by country group. See also notes to Figure 1 and Section 3.2 for a definition of the sector-breakdown. Source: Locational Banking Statistics (BIS), Consolidated Banking Statistics (BIS) and IFS (IMF).

In search for competing explanations for the patterns uncovered, it seems natural to refer to conventional theories of portfolio allocation and home bias. The observed repatriation of debt may, indeed, reflect an increase in the home bias of crisis countries’ investors.<sup>5</sup> This interpretation is corroborated by Figure 3, which plots a measure of home bias for the set of PIIGS countries and for the set of other Euro Area countries. The figure shows that the repatriation of debt in crisis countries occurred simultaneously with an increase in the respective home bias, which indicates that the banks of crisis countries were rebalancing their portfolios in favor of local assets.

<sup>5</sup>The attentive reader would object that there is no direct mapping between the level of portfolio home bias in a country and the share of the country’s debt held by domestic residents. An increase in the share of debt held domestically can come about simply with a general expansion of domestic investors’ positions (portfolio growth), without any change in the relative share of domestic assets in the portfolio (portfolio rebalancing). When contemplating the evolution of the Euro Crisis, however, it is hard to believe that the repatriation of debt was the result of an increase in the relative portfolio size of banks located in crisis countries. We nevertheless control for this potential effect in our empirical analysis.

We consider two main sources of portfolio home bias, following a recent article by Coeurdacier and Rey (2011). The first source of home bias relates to the existence of informational asymmetries between domestic and foreign investors. Domestic investors will naturally bias their portfolios towards local assets if they have an informational advantage relative to foreign investors on these assets. According to this view, one should expect an increase in home bias during a crisis, since informational asymmetries are likely to worsen in times of uncertainty (Brennan and Cao 1997). It is, however, hard to explain why the repatriation of debt affected especially public debt. In particular, cross-border trade in government bonds appear to be less informational intensive than trade in corporate bonds or equities (Portes et al. 2001).

Figure 3: **Home Bias - Total Non-Bank Debt**



Home bias is defined as the actual share of domestic assets in local banks' portfolios minus the share predicted by a standard capital asset pricing model (CAPM). The latter corresponds to the market value of a country's debt relative to the aggregate value of debt issued by the country in the sample. Simple averages by country group. See also notes to Figure 1. Source: Locational Banking Statistics (BIS) and IFS (IMF).

The second class of explanations for portfolio home bias invokes standard hedging motives. This view maintains that local assets may provide better insurance against key risks faced by local investors, such as real exchange rate fluctuations and non-tradable income risk. To rule out the real exchange rate channel, we estimate the effect of crises on debt repatriation, focusing on a restricted sample which includes only countries within the Euro

Area. Within this set of countries, real exchange rate fluctuations are virtually inexistent.<sup>6</sup> We find no significant difference relative to the full sample results, which indicates that real exchange rate hedges cannot explain the observed repatriation of debt in crisis countries. Concerning the hedging motives of non-tradable income risk, this specific channel has mixed or little empirical support (see Coeurdacier and Rey 2011). It is thus unlikely that the strong empirical patterns illustrated above are driven by such hedging motives. Moreover, it is unclear why public debt provides a better hedge against the mentioned risk than private debt, as one should conclude from our results.<sup>7</sup> Overall, we find no convincing evidence that the observed repatriation of debt in the countries hit by the Euro crisis can be explained by conventional theories of home bias.

Methodologically, we apply a difference-in-difference approach to estimate the effect of the crisis on debt repatriation. Our sample comprises quarterly bilateral bank positions of both public and private debt for 17 countries between 2006 and 2011. Focusing on the Euro Crisis, we define a country to be in crisis if, first, it is member of the Euro Area and, second, its bond yields exceed the threshold of 700 basis points, which is considered to be a critical level by financial market observers.<sup>8</sup> A crucial assumption for our estimation strategy is that the incidence of the crisis was exogenous to the subsequent reallocation of debt. If this assumption is violated, our results are potentially biased, through reverse causality or omitted variables.

We argue that reverse causality is not likely to affect our results. According to the usual narrative of the Euro Crisis, indeed, the increase in risk premia in our set of crisis countries (Greece, Ireland and Portugal and, in some specifications, Italy and Spain) was mainly the result of bad fundamentals and unsound policies. Moreover, it is hard to believe that the increase in bond yields was driven by the change in the geographical allocation of debt, or by investors' anticipation of such change for that matter. This view is also corroborated by the fact that the debt of crisis countries was repatriated only after the start of the

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<sup>6</sup>Obviously, nominal exchange rate fluctuations are absent. In addition, inflation rates have been close to zero since the beginning of the Euro Crisis in most of these countries.

<sup>7</sup>Casual observation reveals that the correlation in the returns on government and corporate bonds is very large. For example, the correlation between the returns on Treasury bonds and the returns on Aaa Corporate Bonds with equal maturity exceeds .99.

<sup>8</sup>We check the sensitivity of our results by considering a crisis threshold of 600 and 500 basis points. We also use bond yields to capture the effect of marginal increases in the risk of default, independently of any specific crisis threshold.

crisis (compare Figure 1), i.e., with a lag to the financial market's awareness of the distress affecting these countries. As an additional check, we substitute the crisis dummy in all our specifications with the yields of government bonds and instrument the yields using a number of macroeconomic indicators which are arguably independent of the distribution of debt. The instrumental variables (IV) estimations confirm our previous results, indicating that an exogenous increase in bond yields causes a repatriation of public debt.

Also problems of omitted variables cannot be dismissed a priori. Indeed, it is possible that an unobserved shock to the fundamentals of, say, the Greek economy has a contemporaneous effect on the health of Greek banks and on the solvency of the Greek government. If Greek banks react to an adverse shock by investing in risky assets in an attempt to gamble for resurrection, the reallocation of Greek sovereign debt to Greek banks could be independent of the sovereign's incentives to repay debt. In our empirical specifications we control for related effects and find that our results do not change qualitatively: we still find that the positions of domestic sovereign debt increased significantly in crisis countries. We are thus confident to have identified the endogenous default temptations as the true motives for reallocations in the bond market.

Taking on a broader perspective, our paper relates to the extensive literature on sovereign risk. This literature has largely focused on the lack of an enforcement mechanism for debt repayment and the role played by default penalties (e.g., financial autarky, trade sanctions, reputation spillovers) to sustain positive amounts of sovereign borrowing.<sup>9</sup> The secondary market theory of BMV, instead, interprets the problem of sovereign risk as one of a missing market rather than one of a missing penalty. It shows that, in the hypothetical case of a frictionless secondary market, the lack of debt enforcement plays no role on sovereign borrowing. Our contribution to the literature is to provide empirical evidence supporting the latter view of sovereign risk problems.

The remainder of the paper is structured as follows. Section 2 discusses a number of additional stylized facts related to the repatriation of debt during the Euro Crisis. Section

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<sup>9</sup>Influential contributions to the literature include Eaton and Gersovitz (1981), Grossman and Van Huyck (1988), Bulow and Rogoff (1989), Cole and Kehoe (1998, 2000), Kletzer and Wright (2000), among others. See also the survey papers by Eaton and Fernandez (1995) and Panizza, Sturzenegger and Zettelmeyer (2009). A more recent strand of the literature includes Aguiar and Gopinath (2006), Yue (2006), Arellano (2008), Cuadra and Sapriza (2008), Sandleris (2008), Hatchondo, Martinez and Sapriza (2009), Broner and Ventura (2010, 2011), Brutti (2011), Gennaioli et al. (2009) and Mendoza and Yue (2011).

3 describes the empirical framework and the data. Section 4 presents the main results and compares alternative explanations of the observed patterns. Section 5 discusses potential caveats of our estimations and Section 6 concludes.

## 2 A Look at Debt Repatriation by Country

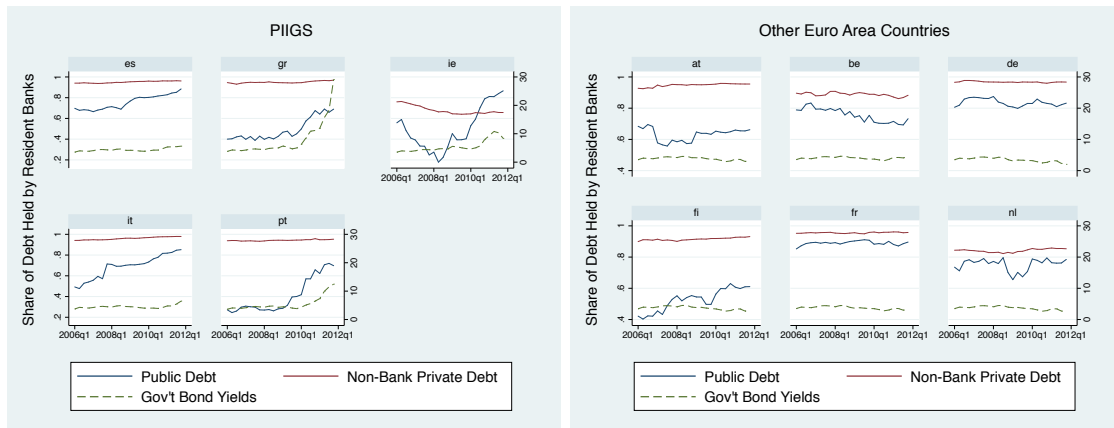
Before turning to the formal empirical framework, we document a number of distinctive features of debt repatriation during the Euro Crisis. The evidence reported in this section provides a more detailed picture of the patterns displayed in Figure 1 and 2 on a country-level. It thereby substantiates an interpretation based on the secondary market theory.

First, within the group of PIIGS countries, the repatriation of public debt was stronger in the countries that experienced the fastest escalation of sovereign risk, like Greece, Ireland and Portugal. In Italy and Spain, instead, the crisis was less virulent and, accordingly, the fraction of public debt reallocated from foreign to domestic banks was lower. Figure 4 reports the shares of public debt and private non-bank debt held by domestic banks, separating between individual PIIGS countries (left panel) and other Euro Area countries (right panel). These shares are plotted together with the corresponding yield on government bonds, which is taken as a measure of the intensity of the crisis. A first look at the graphs reveals that the tendency towards repatriation of public debt was common to all PIIGS countries, whereas we do not find any evidence of a clear trend in other Euro Area countries (with the exception of Finland). In addition, the shift in debt ownership was larger for Ireland, Greece and Portugal than for Italy and Spain. Figure 4 thus documents a strong association between the intensity of the crisis and the extent to which public debt was reallocated between foreign and domestic banks.

Second, the repatriation of public debt in the PIIGS countries was not only caused by a contraction of foreign banks' positions but also by an expansion of domestic banks' positions, both of which would, in principle, be consistent with Figures 1 and 4. This observation suggests that there has been a true reallocation of public debt from foreign to domestic banks. Figure 5 plots the positions of domestic and foreign banks across individual countries in the PIIGS group (left panel) and in the group of other Euro Area countries (right panel). Once again, the effect of the crisis on the allocation of debt emerges more evidently in Ireland, Greece and Portugal. In these countries we observe a clear divergence



Figure 4: **Share of Domestically Held Debt - Individual Countries**



(a) PIIGS

(b) Other EA Countries

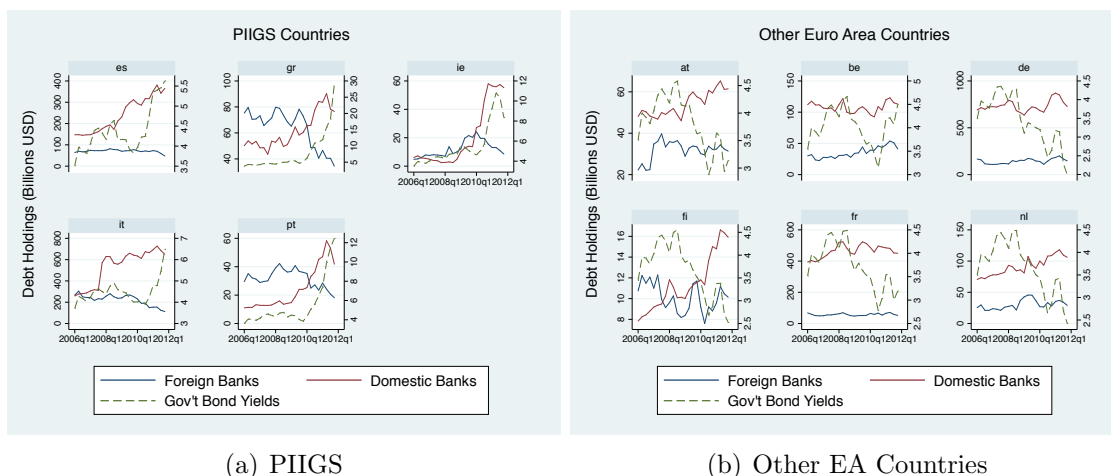
Debt holdings by local banks relative to total bank-held debt of the country. PIIGS countries are Spain (ES), Greece (GR), Ireland (IE), Italy (IT) and Portugal (PT). Other Euro Area countries are Austria (AT), Belgium (BE), Germany (DE), Finland (FI), France (FR) and the Netherlands (NL). See also notes to Figure 1 and 2. Source: Locational Banking Statistics (BIS), Consolidated Banking Statistics (BIS) and IFS (IMF).

between the debt holdings of domestic banks and those of foreign banks.<sup>10</sup> The same qualitative pattern emerges in Italy and Spain, although the divergence between domestic and foreign banks positions appears less evident. Conversely, foreign and domestic positions move in parallel in the group of other Euro Area countries, consistently with our previous findings (see Figure 2).

We will argue below that the patterns in Figures 1 to 4 provide support to the secondary market theory. Indeed, this theory applies primarily to the allocation of public debt positions and predicts, moreover, that the larger the shock suffered by the borrowing country, the larger should be the reallocation of debt in order to re-incentivize the sovereign to avoid default.

<sup>10</sup>This trend starts around the first quarter of 2010 and continues until the second half of 2011, when we observe an inversion in the tendency of domestic banks to buy local public debt. One interpretation of the inverted tendency in late 2011 is that domestic banks started to unwind their positions once the crisis entered its most acute phase and some forms of debt restructuring appeared unavoidable. However, we don't know exactly how much of the reduction of domestic banks' positions was due to active unwinding of positions or to a drop in the price of the underlying bonds.

Figure 5: Foreign and Domestic Positions - Levels



Nominal debt held by local and foreign banks. See also notes to Figure 1 and Figure 2.  
 Source: Locational Banking Statistics (BIS), Consolidated Banking Statistics (BIS) and IFS (IMF).

### 3 Empirical Framework and Data

In this section, we lay down our strategy to formally test the predictions of the secondary market theory and we provide a description of the data.

#### 3.1 The Empirical Framework

Our testable hypothesis is derived in the Appendix using a model that builds on BMV and can be formulated as follows: when an adverse shock raises the sovereign’s temptation to default, a fraction of the country’s debt is repatriated by local investors. Our identification strategy relies on the fact that, during the period between 2006 and 2011, a number of countries within the Euro Area (namely, the “PIIGS” countries) suffered a negative shock to their sovereign’s ability to repay. These shocks were arguably exogenous to the allocation of sovereign debt, allowing us to estimate the causal effects on debt repatriation. Throughout our analysis, we use a panel of bilateral bank positions for 17 countries.<sup>11</sup>

We proceed in two steps. In the first step, we focus on total (non-bank) debt positions

<sup>11</sup>These are, Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States.

and document a significant increase of the share of local debt held by domestic banks in the crisis countries. This increase is robust to a large number of controls, including country-effects and country-specific trends. In a second step, we analyze whether the effect of a crisis differs across classes of assets: i.e., non-bank private debt and public debt.

We start by considering the following empirical specification:

$$y_{c,b,t} = \beta \cdot Crisis_{b,t} * Own_{c,b} + \gamma \cdot Controls_{c,b,t} + \epsilon_{c,b,t} \quad (1)$$

In equation (1), the subscripts  $c$  and  $b$  denote the creditor and borrower country, and  $t$  indicates time, measured in quarters. The dependent variable  $y_{c,b,t}$  indicates the logged position of total (non-bank) debt issued by country  $b$  and held by the banks of country  $c$  at time  $t$ . The variable  $Crisis_{b,t}$  is an indicator function, which equals one if the borrowing country is in a crisis and zero otherwise. A crisis is defined as a period of elevated sovereign risk; for the baseline definition we take the standard threshold level of 700 basis points on bond yields.<sup>12</sup> The variable  $Own_{c,b}$  is defined as one if the creditor country is equal to the borrower country and zero otherwise.

In our set of controls, we include country-pair fixed effects as well as a series of borrower-time and creditor-time dummies. The country-pair fixed effects control for long-run determinants of bilateral asset positions, such as distance (both in terms of geographic proximity and informational flows) or the aggregate market size of the two countries. These factors have been shown to be highly significant in explaining bilateral capital flows (Portes and Rey 2005), consistently with gravity models of global portfolio allocation (Martin and Rey 2004).<sup>13</sup> The borrower-time and creditor-time dummies control for country-specific shocks or trends in the level of outstanding debt and in the portfolio size of banks, respectively. Our specification, thus, allows us to control for several sources of variation in the allocation of bank positions.

The coefficient of interest  $\beta$  measures the percentage change of domestic banks' positions of local debt in the crisis countries. As we control for borrower-time fixed effects (which absorb the total outstanding debt of each country), this change is to be read relative to

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<sup>12</sup>We check later on whether our results depend on the exact definition of crisis by considering different thresholds: e.g., 600 basis points and 500 basis points.

<sup>13</sup>Notice that these fixed effects control for the average *home bias* of international portfolio investment. Specifically, the coefficient on the dummy *Own* is large and significant in regressions without fixed effect.

the change of foreign banks' positions in the crisis countries. Moreover, as we control for creditor-time fixed effects (which absorb the portfolio size of each country), the mentioned change is also relative to the change of domestic banks' positions in foreign countries.<sup>14</sup> Thus, the coefficient  $\beta$  can be equivalently interpreted as the repatriation of debt or as the change of portfolio home bias in crisis countries. The secondary market theory corresponds to the hypothesis  $\beta > 0$ .

In the second step, we test whether the effect of crises differs across classes of assets. To do so, we exploit an additional level of disaggregation in bank positions, distinguishing between holdings of (non-bank) private debt and holdings of public debt. Accordingly, our empirical specification is now described by the following equation

$$y_{s,c,b,t} = \beta_0 \cdot Crisis_{b,t} * Own_{c,b} + \beta_1 \cdot Crisis_{b,t} * Own_{c,b} * Publ_s + \gamma \cdot Controls_{s,c,b,t} + \epsilon_{s,c,b,t} \quad (2)$$

In equation (2), the additional subscript  $s$  denotes the “sector” of each debt position. The variable  $Publ_s$  denotes a dummy variable that identifies the positions of public debt. In this specification, the coefficient  $\beta_0$  measures the effect of a crisis on the domestic positions of local private debt, while the coefficient  $\beta_1$  measures the additional effect on the domestic positions of local public debt. Thus, a positive value for  $\beta_1$  indicates that the repatriation of debt is stronger for public debt than for private debt.

The set of controls include creditor-borrower-sector fixed effects as well as creditor-time, borrower-time and sector-time dummies. In addition, we control for the interactions  $Crisis_{b,t} * Publ_s$  and  $Crisis_{c,t} * Publ_s$ .<sup>15</sup> Specifically, the first term controls for the increase of foreign banks' positions of public debt in the crisis countries, relative to the change in the corresponding private debt positions. With this term, we aim to capture a potential flight by foreign banks from private to public debt of crisis countries. The second term, conversely, controls for the increase in local banks' positions of public debt in foreign non-crisis countries, relative to the change in the corresponding private debt positions. This term thus captures a potential tendency of banks located in crisis countries to substitute between private and public foreign bonds.

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<sup>14</sup>Notice that sum of the coefficients on  $Crisis_{b,t}$ ,  $Crisis_{c,t}$  and  $Crisis_{b,t} * Own_c$  identifies the change in the local positions of banks located in crisis countries relative to the average positions in non-crisis countries of banks located outside the crisis countries.

<sup>15</sup>The variable  $Crisis_{c,t}$  denotes a crisis in the creditor country and is defined in parallel with  $Crisis_{b,t}$ .

## 3.2 Data

Our analysis requires to combine two sources of data: the *Monetary and Financial Statistics* of IMF's International Financial Statistics (IFS), which report aggregate bank positions vis-a-vis domestic residents, and the *Locational Banking Statistics* (LBS) of the BIS, which report bank positions vis-a-vis non-resident on a bilateral basis. Data have a quarterly frequency and are expressed in millions of US dollars.<sup>16</sup>

The two sets of data share a number of common characteristics that make them comparable: i) they use the same definition of banks, which correspond to deposit-taking corporations except for the central bank; ii) they attribute bank positions based on the country of *residence* rather than the *nationality* of the institutions involved, consistently with Balance of Payments statistics; and iii) they apply the same valuation principles, reporting banks' positions at market prices.

To check further the comparability of the two datasets, we aggregate the bilateral cross-border claims in the LBS to obtain a measure of total claims on non-residents for each country. We then compare this measure with the corresponding data available in the IFS. Table A2 shows that the within-country correlation between these two measures is, on average, 0.971. We confidently conclude that the two datasets evaluate banks' positions consistently.<sup>17</sup>

Regrettably, the sectorial disaggregation available in the two sets of data is different. Specifically, the IFS data separate domestic claims between those on the central government and those on the non-bank private sector.<sup>18</sup> Domestic bank-to-bank lending is not reported since bank positions are consolidated within each country. The LBS data, instead,

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<sup>16</sup>The IFS originally report banks' positions in national currency. We convert them into millions of US dollars using end-of-period exchange rates, consistently with the built-in currency conversion in the BIS data. The data on the exchange rate between US dollars and each national currency are taken from the IFS. Since we add time dummies in the estimations, the choice of currency is irrelevant as long as it is consistent for all positions.

<sup>17</sup>We do find some differences in the levels between the two datasets. However, as we control for country fixed effects in our estimations, the differences in the levels of bank positions will be controlled for.

<sup>18</sup>More precisely, the IFS data report claims on other domestic sectors, which include claims on other financial (non-bank) corporations, claims on the private sector, claims on non-financial public corporations and claims on local and state government. These categories correspond almost exactly to the definition of non-bank private debt used by the BIS, with the only difference that the BIS considers the claims to local governments as general public debt. The difference in definitions, however, would tend to underestimate the relative increase of local public debt positions in crisis countries. Therefore, the bias in our coefficients of interest will go in the opposite direction of our testable hypothesis.

distinguish only between cross-border claims on banks and cross-border claims on non-bank borrowers. The latter category includes both claims on the government and claims on the non-bank private sector. The different sectorial classification in the two datasets does not affect the estimation of model (1). Indeed, the sum of public and non-bank private debt positions reported in the IFS corresponds exactly to the definition of non-bank debt in the BIS. However, the sectorial discrepancy prevents us from estimating equation (2), where we inspect the different effect of crises on public and private debt positions.

To bypass this problem, we compute a synthetic sector decomposition of the LBS data using the sector breakdown reported in the Consolidated Banking Statistics (CBS), also provided by the BIS.<sup>19</sup> Specifically, we multiply the LBS positions of aggregate non-bank debt with the respective bilateral sector shares reported in the CBS.<sup>20</sup> Some caveats, however, apply to this synthetic decomposition. Because the CBS data are consolidated on the level of banking groups, they comprise headquarters as well as foreign affiliates' positions. This means that the CBS attributes positions based on the nationality of the bank's ownership. In contrast, the positions reported in the LBS are based on the residency.

Our synthetic decomposition may then differ from the actual sector breakdown in the LBS due to two main discrepancies. The first discrepancy concerns the positions of foreign affiliates in the recipient country: e.g., positions of Greek debt held by the Greek offices of German banks. These positions are included in the CBS, whereas they do not enter the LBS data. The potential mistake, however, tends to be small for the following reasons. First, local lending by foreign affiliates constitutes a small share of foreign banks' positions in the CBS data (the median is less than 11 percent of bilateral claims on crisis countries).<sup>21</sup> Thus, changes in the claims of foreign affiliates cannot generate the large percentage changes in positions we observe in our empirical exercise. More importantly, however, the CBS records only local lending in non-local currency of foreign affiliates. Indeed, local positions

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<sup>19</sup>We use the immediate borrower classification of the CBS data.

<sup>20</sup>The CBS indeed report banks' positions at the same level of sector disaggregation of the IFS.

<sup>21</sup>To compute this value, we take the share of local positions of foreign affiliates over total foreign claims (cross-border positions plus local positions of foreign affiliates) for each country pair. We then restrict the sample to include only positions vis-a-vis the PIIGS countries, and we calculate the median value. The period is 2006:Q1 - 2011:Q4. The data used come from the ultimate risk classification of the CBS. These data are reported in slightly differently way with respect to the immediate borrower classification, which we use to perform our synthetic sectorial decomposition. It is reasonable, however, to expect that the share of local lending by foreign affiliates does not change much between the different classifications of the CBS data.

by foreign affiliates in local currency do not enter the CBS statistics. As we focus only on crises countries in the Euro Area, and the debt issued by these countries is largely denominated in Euros, this restriction is likely to eliminate a large part of the discrepancy.

The second discrepancy concerns the positions of foreign affiliates in third countries. Specifically, the positions of Greek debt held by the Italian offices of German banks are reported as positions of Germany on Greece in the CBS, while they are treated as positions of Italy on Greece in the LBS. However, this classification error is unlikely to bias our estimates. The reason is that our coefficients of interest capture the change of local claims on a crisis economy relative to (average) foreign claims on the same crisis economy.<sup>22</sup> Foreign claims, in turn, cannot be systematically biased in one direction by misclassifying Italian claims on Greece as German claims on Greece or vice versa: a decrease of the first positions implies an increase in another country so that the average foreign position is unaffected.

Notice finally that claims of headquarters on foreign affiliates are recorded as bilateral claims in the LBS and could in principle introduce differences with respect to the CBS data. However, we exclude data on bank-to-bank lending from our exercise so that this problem does not arise. In sum, we can use our synthetic sectorial breakdown of the LBS positions with some confidence.

We combine the resulting panel of bilateral bank positions with data on sovereign bond yields for each country. The data refer to daily yields on 10-year government bonds and come from Thomson Reuters. We use the average yield in each quarter to identify periods of crisis. Finally, we restrict the sample to the period between the first quarter of 2006 and the last quarter of 2011. The choice of the period is dictated both by data coverage and by the focus on the Euro Crisis. We then exclude all country-pairs with missing or discontinuous observations over this period in order to obtain a balanced panel of bilateral exposures. Finally, we keep only those countries that appear in both the IFS and the BIS data. The final sample includes 17 countries.<sup>23</sup>

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<sup>22</sup>We log all positions so that our coefficients of interest measure relative growth rates.

<sup>23</sup>Namely, Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States.

### 3.3 Summary Statistics

Table A2 reports summary statistics of the public debt positions held by banks in each country. The first column reports the share of government debt held by banks, which includes both the positions of domestic banks and of foreign banks. The total value of government debt stems from the Public Sector Debt Database of the World Bank. The data show that banks' holdings of government debt were, on average, about 34 percent of the total government debt outstanding between 2006 and 2011. This value suggests that banks were major holders of government debt in the set of countries considered.<sup>24</sup>

The second and the third column indicate that, on average, domestic banks' positions of public debt were roughly three times the corresponding positions of foreign banks. Consistently with the patterns reported in Figure 2, the average rate of domestic ownership is lower in the PIIGS countries (57 percent) than in other countries (80 percent).

In the third and fourth column, we report the growth rate of local and foreign holdings of government debt over the period 2009 to 2011. Specifically, the growth rate is defined as the log deviation between the average positions in 2011 and the average positions in 2009.<sup>25</sup> The data show that domestic banks increased their positions by 61 percent in the PIIGS countries. At the same time, foreign banks reduced their exposure by 46 percent. Conversely, in non-PIIGS countries, the positions of domestic and foreign banks moved in parallel. In both groups of countries, however, we find substantial heterogeneity in the change of foreign banks' positions. This result is indicated by the large standard deviation reported in the last column of the table.

Table A3 reports the summary statistics for the positions of private non-bank debt.<sup>26</sup> The reported data show both the average allocation of bond positions across domestic and foreign banks (Columns 1 and 2) are comparable between PIIGS and non-PIIGS countries. Also, the average decline of foreign banks' positions in the PIIGS countries is about 26 percent, which is smaller than the decline observed for public debt positions. The table finally documents a general decline in private debt positions of foreign banks (with the

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<sup>24</sup>The United States constitute a notable exception insofar as the fraction of government debt held by banks is only 6 percent. This value is in line with data by the US Treasury (e.g., Treasury Bulletin, Ownership of Federal Securities, Table OFS-2).

<sup>25</sup>Moreover, the growth rate of foreign banks' positions is an average of the growth rate between different creditors.

<sup>26</sup>Unfortunately, we cannot compute the fraction of total private non-bank debt held by banks as the aggregate value of private non-bank debt is not available in the data.



exception of a handful of countries), which is consistent with the global retrenchment of cross-border positions documented by previous studies (Milesi-Ferretti and Tille 2010, among others).

Overall, the comparison of Table A2 and A3 suggests that the crisis had a significant effect on debt repatriation only in the PIIGS countries and primarily for public debt, consistently with the graphs reported in the previous section.

## 4 Results

This section presents the estimates of the empirical models (1) and (2). In the first model, banks positions are aggregated across the (non-bank) private and the public sector, while in the second we use the sectorial disaggregation available in the data to inspect the different effects of the crisis across the two classes of assets.

### 4.1 Total Claims

Table 1 reports the estimation results for model (1), where we inspect the effect of crises on the international allocation of total non-bank debt. All reported estimations include fixed effects for each country pair and time dummies individually for each creditor and each borrower.

Column I shows that in our baseline specification, the estimate of the coefficient on  $Crisis_{b,t} * Own_{c,b}$  is positive and significant. It shows that banks in crisis countries increased their claims on the local economy by a factor of about 2.5 ( $\exp(.914) \approx 2.494$ ). More precisely, the estimate indicates that banks in crisis countries have increased their claims on the local economy relative to the claims on foreign economies (indicating an increased home bias during a crisis) and relative to foreign banks' claims on the local economy (indicating a repatriation of such claims).

Column II of Table 1 reports the results of a specification that includes the interaction term  $Crisis_{b,t} * EUR_c$ , where  $EUR_c$  is defined as the share of the creditor's GDP in the Euro Area (i.e., the creditor's GDP over Euro Area GDP).<sup>27</sup> We set  $EUR_c = 0$  for countries that are not member of the Euro area. This variable proxies the political weight of a creditor country  $c$  within the Euro Area. By including this proxy of political influence, we control

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<sup>27</sup>Notice that the direct effect of  $EUR_c$  is captured by country dummies.

for potential effects by which banks may alter their investment strategies, internalizing the own country’s political influence. We will come back to this variable later. The coefficient on  $Crisis_{b,t} * EUR_c$  is estimated to be positive, which indicates that banks in countries of higher political weight (e.g., Germany and France) tend increase their claims on crisis countries relative to banks in other countries.<sup>28</sup> At the same time, the estimated coefficient of interest, the one on  $Crisis_{b,t} * Own_{c,b}$ , barely changes in magnitude and significance.

The specification reported in Column III includes the interaction term  $Crisis_{c,t} * Crisis_{b,t}$ . Including this term, we aim to control for the possibility that troubled banks in crisis countries invest over-proportionally not only in the domestic country but also in other crisis countries, seeking assets that are supposedly risky and yield high returns. For example, troubled banks may invest primarily in assets with high risk and high returns in an attempt to “gamble for resurrection”. Such behavior could induce an upward bias in the coefficient on  $Crisis_{b,t} * Own_{c,b}$  in the specifications of Columns I and II. The estimated coefficient of  $Crisis_{c,t} * Crisis_{b,t}$ , however, is small and statistically insignificant, while all other coefficients remain practically unchanged in magnitude and significance.

We observe that equation (1) is reminiscent of the so-called gravity model of international trade (see e.g. Anderson (1979)). The traditional gravity equation, in which the log of bilateral trade flows (or bilateral bond positions in our case) is regressed on the log of the economic size of trade partners plus country-pair constant characteristics (e.g., distance or common language), is in fact nested in our specification with country-time and country-pair fixed effects.<sup>29</sup> Recent work by Santos Silva and Tenreyro (2006) has uncovered severe drawbacks of estimating the gravity equation using a log-linearized transformation. Specifically, the authors show the presence of heteroskedasticity can generate severely biased estimates of the log-linear model and propose to estimate the class of constant-elasticity models (which includes the gravity equation) in their multiplicative form using a Poisson pseudo-maximum-likelihood (PPML) estimator.<sup>30</sup> While the authors recognize that “the presence of the individual effects may reduce the severity of this problem”, they also add

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<sup>28</sup>Notice that this “political effect” of Euro Area’s largest members, Germany, with a political weight of 0.28, is smaller than the effect of  $Crisis * Own_c$  by computing  $0.28 * 1.674 \approx 0.469$ .

<sup>29</sup>Previous literature has also used the gravity-approach to explain bilateral asset positions (see for instance Portes and Rey (2005) and Rose and Spiegel (2002)).

<sup>30</sup>In particular, the crucial independency assumption on the error term would be violated if the variance of the latter depends on some of the explanatory variables in the regression.

that “whether or not that happens is an empirical issue”. We thus follow the strategy developed in Santos Silva and Tenreyro (2006) and run a Poisson panel estimation.<sup>31</sup>

The results from the PPML estimations are reported in Columns IV - VI of Table 1.<sup>32</sup> All reported coefficients have the same sign of the corresponding coefficients in the linear estimations. The coefficient of interest, the one on  $Crisis_{b,t} * Own_{c,b}$ , is still positive, yet smaller in magnitude. Overall, the tendency toward debt repatriation is confirmed in both types of estimations.

## 4.2 Further Estimations and Related Theories

The previous paragraphs presented robust evidence for a trend for crisis countries to repatriate debt. This pattern is in line with the predictions of the secondary market theory, but it is also consistent with alternative theories of global portfolio allocation and home bias. In this subsection, we aim to separate between different explanations using different specifications of equation (2). In discussing the results, we review and summarize each of the theories considered.<sup>33</sup>

**Secondary Market Theory.** We first observe that the theory advanced by BMV predicts a stronger repatriation of public debt relative to private debt. In particular, this theory interprets the reallocation of public debt from foreign to domestic creditors as the market response to a looming sovereign default. Domestic creditors, indeed, purchase government bonds from foreign creditors, expecting that the repatriation of debt will incentivize the sovereign to honor its obligations. Government bonds will then appreciate and domestic creditors will get a positive return. Similar strategic considerations are instead missing in the case of private debt, where the risk of opportunistic default by the borrower is limited. The secondary market theory thus provides an explanation for debt repatriation that is more directly applicable to sovereign debt.

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<sup>31</sup>Santos Silva and Tenreyro (2006) state that the “estimator can be easily adapted to deal with [...] panel data”. Hausman et al (1984) and Wooldridge (1990) have developed this strategy, which has been used by Acemoglu and Linn (2004).

<sup>32</sup>In all estimations we use the `ppml` Stata command developed by Santos Silva and Tenreyro (2010) and we include a number of dummies to capture the same fixed effects considered in the linear regressions.

<sup>33</sup>In our review of the theories on the home bias, we largely follow on Couerdacier and Rey (2011) in reverse order.

A clean assessment of this theory requires a direct comparison between the repatriation of public and private debt in the crisis countries. To this purpose, we run a new set of regressions according to the empirical model (2). The secondary market theory then predicts that the repatriation should primarily affect public debt over private debt. In other words, we should expect the coefficient on  $Crisis_{b,t} * Own_{c,b} * Publ_s$  to be positive.

Table 2, Columns I - III report the estimation results for the different specifications of equation (2). The set of regressors is defined in parallel to those underlying Columns I - III of Table 1, while now the interaction terms with  $Publ_s$  are included.<sup>34</sup> Column I reports a negative coefficient on  $Crisis_{b,t} * Publ_s$ , indicating that all countries had the tendency to reduce positions of public debt from crisis countries. This observation supports the conjecture that the overall effect estimated in Columns I of Table 1 was partly driven by valuation effects of sovereign bonds and partly by purchases by the ECB. Further, the coefficient on  $Crisis_{c,t} * Publ_s$  is positive, suggesting that the banks located in crisis countries increased their holdings of foreign public debt relative to foreign private debt.

The two coefficients of interest, however, are those on  $Crisis_{b,t} * Own_{c,b}$  and  $Crisis_{b,t} * Own_{c,b} * Publ_s$ . The first is positive and significant, indicating that private debt was repatriated in the crisis countries. The second coefficient, too, is positive and significant (albeit at the 5 percent level only) showing that sovereign debt was over-proportionally affected by this repatriation. Together, these estimates suggest that banks in crisis countries increased their positions of domestic private debt by a factor of 2.24 ( $\exp(0.805) \approx 2.24$ ) but increased, at the same time, their positions of domestic public debt by a factor of 4 ( $\exp(0.805 + 0.607) \approx 4.104$ ). This finding is a sign that the crisis had a major effect on the repatriation of public debt. We read it as a moderate initial support for the secondary market theory.

Next, Column III of Table 2, reports the regression results of a specification including the variables  $Crisis_{b,t} * EUR_c$  and  $Crisis_{b,t} * EUR_c * Publ_s$ . The coefficient on  $Crisis_{b,t} * EUR_c$  is not significantly different from zero, while the one on  $Crisis_{b,t} * EUR_c * Publ_s$  is positive and significant, albeit at the 5 percent level only. This result indicates that the debt of crisis-stricken Euro Area countries was reallocated to those Euro Area countries of high political weight (i.e., the positive coefficient on  $Crisis_{b,t} * EUR_c * Publ_s$ ). We argue that the

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<sup>34</sup>Fixed effects refer to creditor-borrower-sector now, so that  $Publ_s$  itself drops out of the set of regressors.

secondary market theory is consistent with this finding. Indeed, the logic of the secondary market theory, read somewhat generally, implies that the sovereign debt of a crisis country should be reallocated to countries whose governments have a say on a potential default. For example, if the German government decides whether Greece defaults or not, Greek sovereign debt should reallocate to German banks, who know that the decisive political agent (the German sovereign) is less inclined to let Greece default, the more of Greek debt is held by German banks. In the Euro Crisis, the relevant decisions were taken collectively through a process that certainly reflected the respective political weights of Euro Area countries. Thus, we can read the positive coefficient on  $Crisis_{b,t} * EUR_c * Publ_s$  (and the simultaneous insignificance of  $Crisis_{b,t} * EUR_c$ ) as additional evidence for the secondary market theory. Importantly, the estimated coefficient on  $Crisis_{b,t} * Own_{c,b}$  and  $Crisis_{b,t} * Own_{c,b} * Publ_s$  are largely unaffected by the inclusion of the variables including  $EUR_c$ . The influence of a sovereign on the decisions regarding a default on its own debt remains significant.

In Column III of Table 2, we include the regressors  $Crisis_{b,t} * Crisis_{c,t}$  and  $Crisis_{b,t} * Crisis_{c,t} * Publ_s$ . The negative and significant coefficient on the second term, combined with the insignificant coefficient on the first term, indicates that banks in crisis countries reduced their positions of public debt from other crisis countries. Moreover, the coefficients indicating the relative increase of local debt positions are even larger than in the previous specifications. We thus conclude that the repatriation of public debt cannot be read as a manifestation of gambling strategies by banks in crisis countries.

The results reported in Columns IV - VI of Table 2 correspond to the PPML estimates. The picture that emerges is even stronger than the one painted by the linear estimations. In all three specifications, the estimated coefficients on  $Crisis_{b,t} * Own_{c,b}$  and on  $Crisis_{b,t} * Own_{c,b} * Publ_s$  are significant at the one percent level and the point estimates are in the same realm of the ones obtained from the linear regressions. In addition, the coefficient on  $Crisis_{b,t} * EUR_c * Publ_s$  is significant on the one percent level, while the one on  $Crisis_{b,t} * Crisis_{c,t} * Publ_s$  remains insignificant.

We next review alternative explanations the the observed repatriation of debt, which are based on theories of the home bias of portfolio investment. While the repatriation of debt and changes in home bias are not congruent phenomena, they are intimately linked. We thus inspect whether the patterns evidenced so far can be explained by conventional

theories of home bias.

**Information Frictions.** A large part of this literature focuses on the existence of information asymmetries between domestic and foreign investors. Gehrig (1993) shows that portfolio home-bias naturally arises when signals on the asset's future performance are more precise for domestic than for foreign investors. Brennan and Cao (1997, 2005) show that informational asymmetries may generate countercyclical fluctuations of portfolio home bias. Specifically, they consider a framework where agents receive both private and public signals, but the private signal is more precise for domestic investors. Foreign investors then attach a relative large weight to the public signal, and they tend to increase their positions relative to domestic investors after observing a positive realization of this signal (e.g., the stock market return or the stance of the business cycle).

On the empirical side, the information-based theories of portfolio home bias have been tested using a gravity model. In particular, Portes and Rey (2005) find that cross-border equity flows depend negatively on measures of distance that proxy for information costs (e.g., volume of telephone call traffic, index of foreign bank penetration, time zone differences).<sup>35</sup> Aviat and Coeurdacier (2007) show that cross-border asset positions tend to be larger among trading partners, where the degree of information asymmetries is arguably lower.<sup>36</sup> Interestingly, Portes et al. (2001) find that the effect of distance on cross-border flows differs across classes of assets. In particular, an increase in the distance between two countries is associated with a much larger decline in the trade flows of information-intensive assets, such as equities and corporate bonds, compared to more homogenous products such as treasury bonds.

How do theories based on information frictions and asymmetries square with our empirical results? The repatriation of debt documented in Table 1 is consistent with an increase of information asymmetries in times of crisis, as conjectured by Brennan and Cao (1997, 2005). When comparing across classes of assets, however, we would expect a stronger repatriation for private debt, since information asymmetries seem to affect especially private borrow-

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<sup>35</sup>Using data from the Coordinated Portfolio Investment Survey (CPIS) of the IMF, Faruqee et al. (2004) find similar results when estimating a gravity model using cross-border positions instead of cross-border flows.

<sup>36</sup>See also Lane and Milesi Ferretti (2008). Rose and Spiegel (2004) provide a different interpretation of the positive association of bank lending and bilateral trade in goods based on the classic sovereign debt literature.

ers (see Portes et al (2001)). In other words, the coefficient on  $Crisis_{b,t} * Own_{c,b} * Publ_s$  should be negative.<sup>37</sup> It thus seems fair to say that theories based only on informational asymmetries are not well suited to explain the excess repatriation of public debt.

**Hedging Motives.** Standard hedging motives represent another potential determinant of portfolio home bias if local assets provide insurance against key risks faced by local investors. Particularly, the desire to hedge *real exchange rate risk* can induce home bias in portfolio shares if the returns on local assets are high in times when the relative price of local goods increases. This argument is traditionally applied to the equity portfolio: given that equity prices of producers of non-tradable goods correlate positively with local agents' expenditure on non-tradable goods, a home bias in equities can naturally arise (see Lucas 1982 and Serrat 2001). These effects, however, are quite sensitive to the elasticity of substitution between tradable and non-tradable goods, as well as to individuals' preferences for consumption smoothing. Also, the empirical validity of this explanation is questioned (see, e.g., Lewis 1999 and Pesenti and van Wincoop 2002).

Relating our empirical findings to this theory, we need to assess whether the repatriation of debt was possibly generated by underlying hedging motives. To scrutinize the role of (real) exchange rate risk, we restrict our sample to the countries within the Euro Area, where the nominal exchange rate is fixed and only minor differences in inflation occurred over the period considered.<sup>38</sup> Table 3 reports the estimation results for the restricted sample. The estimates largely confirm the earlier findings: the coefficients on  $Crisis_{b,t} * Own_{c,b}$  and  $Crisis_{b,t} * Own_{c,b} * Publ_s$  have similar magnitude and statistical significance compared to the full sample. Specifically, the tendency to repatriate public debt relative to private debt in the sample of Euro Area countries is in line with the one observed in the full sample. This result prompts us to rule out (real) exchange rate risk as a driver of the relative increase of domestic positions in the height of the crisis.

Another extensively-studied hedging motive concerns non-tradable income risk, typically read as labor income. Individuals bias their portfolios towards local assets whenever returns to these assets (relative to foreign assets) correlate negatively with local labor in-

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<sup>37</sup>Notice that this prediction is diametrically opposite to the one of the secondary market theory.

<sup>38</sup>Moreover, within the sample of Euro Area countries, regulatory incentives and differences in valuation are unlikely to play a major role in explaining the difference between domestic and foreign banks, as these countries share, to some extent, a unified supervisory framework.

come. Empirically, there is some evidence for a negative (conditional) correlation between labor income and local equity (see Julliard 2002 and Coeurdacier and Rey 2011), yet severe doubts remain concerning the importance of this explanation (see Massa and Simonov 2006). Recently, Coeurdacier, Kollmann and Martin (2010) and Coeurdacier and Gourinchas (2011) have argued that portfolios allocation of different asset classes cannot be analyzed separately. Using a standard portfolio model with multiple asset classes, they show that contemporaneous trading in bonds and equities affect the hedging properties of each of the two assets. Bonds will be used to hedge fluctuations in the real exchange rate. Equities will be used to hedge non-tradable income risk, conditionally on bond returns. According to this logic, the repatriation of debt in crisis countries cannot be explained by the hedging of non-tradable income risk. A conclusive answer, however, can come at best from a fully calibrated model of portfolio investment.

Applying a less rigorous but simpler logic, we observe that the major risks of crisis countries - in particular, income risk and sovereign risk - have become more alienated in crisis-stricken countries. We then find it hard to sustain that the strong repatriation of public debt in crisis countries may have been driven by hedging motives, especially when related to local labor income. More generally, recent literature has shown that this specific channel has mixed or little empirical support (see Coeurdacier and Rey 2010).

### 4.3 Robustness Checks

In order to provide additional evidence for the patterns exhibited so far, we run two more set of robustness checks. In the first one, we repeat the estimations of Columns I and III with the entire sample of countries, but replacing the crisis dummy with the log of corresponding bond yields. Specifically, we replace our previous specification (2) with the following model,

$$y_{s,c,b,t} = \beta_0 \cdot Yield_{b,t} * Own_{c,b} + \beta_1 \cdot Yield_{b,t} * Own_{c,b} * Publ_s + \gamma \cdot Controls_{s,c,b,t} + \epsilon_{s,c,b,t} \quad (3)$$

where the set of controls include the individual terms  $Yield_{b,t}$  and  $Yield_{c,t}$ .<sup>39</sup> This specification has the virtue that it captures marginal effects: it captures the effect of moderate increases in a country's risk of default beyond or below the critical threshold of 700 basis

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<sup>39</sup>Recall that the definitions of  $Yield_{x,t}$  are based on quarter-averages.



points on the allocation of government bonds. In addition, it allows us to avoid using a discrete definition of crisis, which is difficult to apply to countries as heterogeneous as Greece and Mexico (both countries enter our sample). Thus, the notion of crisis is replaced by *Yield*. Since the set of countries includes non-Euro Area countries, the reallocation of debt from crisis countries towards Euro Area countries is meaningless. We therefore drop the interaction terms involving the variable  $EUR_c$ .

Table 4, Columns I and II reports the corresponding results. The coefficients on  $Yield_{b,t} * Own_{c,b}$  and  $Yield_{b,t} * Own_{c,b} * Publ_s$  are always positive, though not jointly significant. Together, these results indicate that the repatriation of public debt is always significant, but it is stronger than the repatriation of private debt only in the specification reported in Column II.

The clear downside of a specification including bond yields is that the estimated coefficients may suffer of a reverse causality bias. Specifically, we observe that an exogenous drop in the foreign demand for a country's bonds could potentially induce a relative increase of local positions and, simultaneously, a rise of the corresponding yields. The magnitude of the rise of bond yields, in turn, depends on the ability or willingness of local investors to absorb the excess supply generated by foreign sales. In principle, the potential endogeneity of bond yields could affect the estimates in a direction that is difficult to predict.<sup>40</sup>

To overcome the endogeneity problem, we adopt an instrumental variable (IV) approach that allows us to predict the value of bond yields based on a small number of macroeconomic indicators, which are typically taken as orthogonal to reallocations of debt positions. Specifically, our set of instruments includes the level of GDP, the central government's balance and debt (both as ratio of GDP), the growth rate of GDP, the current account balance as ratio of GDP and the inflation rate.<sup>41</sup> These variables appear regularly among the main determinants of sovereign bond yields (see for example Borenzstein and Panizza (2006)) and their large predictive power for debt distress episodes have led some observers to derive simple "rule of thumbs" to identify future defaults based on these indicators (see Manasse and Roubini (2005)). Consistent with the findings in these studies, our first-stage panel

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<sup>40</sup>In theory, the shift towards local bond holdings might actually even lower the yield when local demand for bonds is perfectly elastic since, domestic bond holdings would reduce the default risk, making bonds more secure investment.

<sup>41</sup>The data source for each variable is reported in the notes to Table A4 in the Appendix.

estimation indicates that these variables explain more than 60 percent of the variation of bond yields.<sup>42</sup>

Table 4, Columns III and IV, report the IV estimates of model (3). In the specification reported in Column III, the coefficients on  $Yield_{b,t} * Own_{c,b}$  and  $Yield_{b,t} * Own_{c,b} * Publ_s$ , which capture the repatriation of private and public debt, are significant at the 10 percent and at the one percent confidence level, respectively. In Column IV, the coefficient on  $Yield_{b,t} * Own_{c,b}$  is insignificant, while the one on  $Yield_{b,t} * Own_{c,b} * Publ_s$  is significant on the one percent level. Overall, the main and most robust pattern emerging from the specification involving *Yields* is that, as a country enters a crisis, public debt is repatriated.

As the second and final robustness check, we re-run our estimations with a definition of the variable *Crisis* based on two different thresholds - 600 and 500 bp of bond yields. The according results, presented in Table 5 are similar to those presented in Table 2 and show that the results presented so far do not hinge on the specific definition of the crisis. In particular, the estimated coefficient on  $Crisis * Own_{c,b} * Publ_s$  is positive and significant at least on the 5 percent level. The estimated coefficient on  $Crisis_{b,t} * EUR_c * Publ_s$  is still positive but largely insignificant.

Overall, we have presented evidence on strong patterns regarding the geographical allocation of debt in the Euro Crisis. Specifically, those countries which enter an acute state of crisis have a tendency to repatriate their debt and this tendency is especially strong for public debt. An additional, albeit somewhat weaker, pattern emerged, showing that public debt of crisis countries was reallocated to those Euro Area countries with higher political weight.

We argue that existing theories of home bias can explain some, but not all of the robust empirical findings. Specifically, we do not rule out informational frictions (and increases in the asymmetry of information) as an explanation of the general trend to repatriate debt. We do argue, however, that these theories fail to explain why the repatriation affected mainly public debt positions. Conversely, the secondary market theory is the only theory

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<sup>42</sup>To perform the first-stage estimations, we use the same sample of countries used in all other estimations. However, we slightly extend the time sample to encompass the period between 2001:Q1 and 2011:Q4. The results are shown in Table A4 in the Appendix. All coefficients have the expected sign except for the coefficient on the current account balance. We don't have a clear explanation for the sign of the latter coefficient, although we think it is possible that the yield responds with a lag to external adjustments.

consistent with the observed repatriation of sovereign debt in crisis countries. In addition, it is consistent with the observed inflow of public debt to Euro Area countries of high political weight.

In sum, having read our empirical results in light of various relevant theories, the overall picture leads us to conclude that the findings presented in this section constitute strong support for the secondary market theory.

## 5 Discussion

Some concerns must be addressed when mapping our findings to the secondary market theory. A first source of concern is whether it is possible to test the predictions of this theory using data on banks' balance-sheet positions. Specifically, by observing end-of-quarter positions we cannot separate between transactions in the secondary market and in the primary market. The relative increase in domestic bond positions could then come about without an active transfer of positions among investors, but simply as a result of lower purchases by foreign investors in the primary market.

A militant interpretation of the secondary market theory, however, would hold that the reallocation of sovereign debt should take the form of actual secondary market transactions between foreign and domestic investors. We forcefully disagree with such a narrow interpretation of the theory. We argue, instead, that as long as domestic and foreign banks have equal access to both primary and secondary markets, the exact form in which debt is reallocated between investors is irrelevant.<sup>43</sup>

To clarify this idea, we use the following example. Consider a government, which has issued a short-term bond maturing Today and a long-term bond maturing Tomorrow. Today the government must roll over the short-term bond until Tomorrow. Before doing that, however, the country is hit by a shock that will inevitably lead to a sovereign default under the prevailing allocation of debt. The predictions of the secondary market theory are

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<sup>43</sup>An additional requirement is that the government either defaults on all its debt at the same time, or does not default at all. Clearly, if the government could default separately on different bond tranches, the secondary market theory would predict that the repatriation of debt should involve all existing bond tranches. We should then necessarily observe trade flows in the secondary market. We deem the condition that governments default separately across bond tranches as highly counterfactual. For example, in March 2012 private investors in Greek government bonds had to accept a 53.5% nominal write-off on their positions. This agreement affected privately held debt of all maturities of which only about 7% (14.4 billion EUR) fell due the same month.

that we should observe a market reallocation of the country’s debt from foreign to domestic investors. However, as long as there is an increase in the relative positions of domestic investors, the reallocation of debt can equivalently involve secondary market transactions of the long-term bond or primary market purchases of the short-term bond. We thus conclude that we can test the predictions of the secondary market theory using data on investor (i.e., on bank) positions.

Another potential drawback of our analysis is the fact that we need to rely only on positions of banks that report to the BIS and the IFS. In fact, one may be concerned that non-bank financial institutions exhibited entirely different investment patterns. To address this concern, we show that the repatriation of public debt occurred not only through the bond purchases of banks but also through those of non-bank financial institutions and non-financial investors. Figure 6 reports the share of public debt held by three broad categories of investors in the PIIGS countries: domestic banks, non-bank domestic residents and foreign residents. These shares are computed using annual data from the Government Finance Statistics published by the ECB, which reports (consolidated) general government debt by type of bond holders.<sup>44</sup> The vertical line indicates the year 2009, which is taken as the beginning of the Euro Crisis.<sup>45</sup> The graphs clearly reveal a tendency of both bank and non-bank domestic agents to increase their holdings of public debt relative to foreign investors. In particular, domestic bank did not play a dominant role among domestic investors in the repatriation of debt. While in Portugal and Greece domestic banks increased their positions of public debt relative to other non-bank domestic investors, the opposite is true in Spain and Italy.<sup>46</sup> We read this evidence as an indication of a general flight-to-

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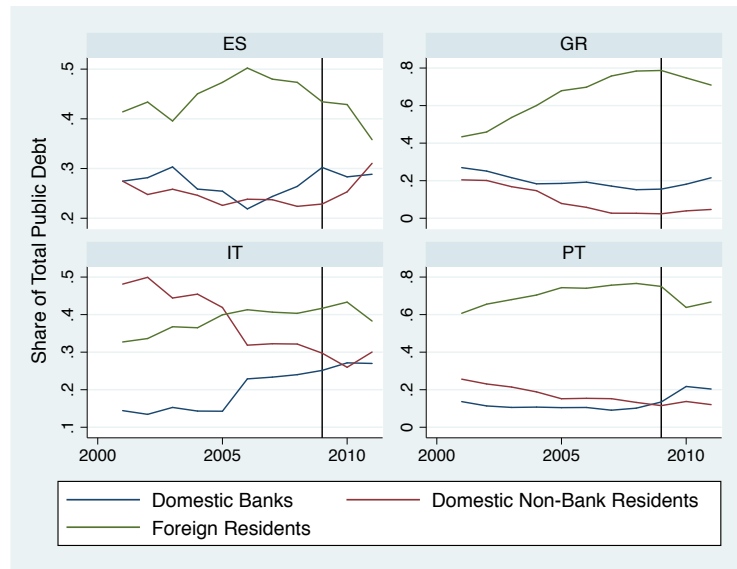
<sup>44</sup>The original data classify holdings of government debt by five types of holders: Central Bank, Other Monetary and Financial Institutions, Other Financial Institutions, Domestic Sectors excluding Financial Corporations and General Government, Rest of the World. The definition of Other Monetary and Financial Institutions includes all resident credit institutions (except for the central bank) and all other resident financial institutions “whose business is to receive deposits and/or close substitutes for deposits from entities other than MFIs”. This definition corresponds to the definition of banks applied in the Locational Banking Statistics of the BIS and in the International Financial Statistics of the IMF, except for the inclusion of money market funds. We re-label this category as “banks”. To measure positions of non-bank domestic residents we add the positions of Other Financial Institutions and of Domestic Sectors excluding Financial Corporations and General Government. We then use data on total government debt, also from the Government Finance Statistics of the ECB, to compute the share of public debt held by each type of investor. Finally, we are forced to exclude Ireland due to lack of observations in the data.

<sup>45</sup>More precisely, the vertical line indicates the end of 2009, as the ECB data report end-of-year positions.

<sup>46</sup>In Italy, the relative increase in the debt holdings of non-bank investors is particularly strong between 2010 and 2011, a period in which the concern about debt sustainability intensified in the country.

resident effect, and not simply of a flight-to-domestic banks effect. The distinction between these two effects is important to assess the predictions of the secondary market theory. Had the repatriation of debt involved only bond purchases by banks, one may have wondered whether such tendency could have been explained by bank-specific incentives, which are not directly addressed in the secondary market theory. It is, indeed, plausible that banks were induced to purchase government bonds by the expectation of a bail out in the case of sovereign default. Alternatively, one may argue that domestic banks were forced to purchase local debt by their respective governments. However, the fact that repatriation of debt took place across all domestic investors suggests that it was determined by other than purely bank-specific incentives.

Figure 6: **Share of Domestically Held Debt - Public and Private Debt**



Debt holdings by each investor group relative to the total general government debt. The reported debt shares do not add up to one, as we exclude the share of debt held by central banks. Source: Government Finance Statistics (ECB).

A number of specific aspects of the secondary market theory deserve further discussion. The theory predicts a reallocation of debt to local investors only if an adverse shock makes the outstanding level of debt no longer sustainable. In particular, foreign investors will flee the local bond market only if they can expect a default under the prevailing allocation of debt. If this assumption is violated, the theory is inconclusive about the direction of

bond flows. Given our definition of a crisis, however, it appears reasonable to assume that investors were indeed worried about imminent sovereign default or restructuring: bond yields above 7 percent did reflect concrete and severe fears among investors.

Another concern that relates to the country's default temptations would contend that some crisis countries like Greece defaulted on their debt regardless of the reallocations of its sovereign bonds. Reading the theory with a grain of salt, however, we can apply the argument at the margin, suggesting that in the absence of bond reallocation the eventual haircut could have been even larger. Alternatively, one may think of a setup where secondary markets operate in presence of some uncertainty about future economic conditions and the reallocation of sovereign debt merely reduces the probability of default without eliminating it. Describing such a scenario, BMV write that “[i]f enough trading takes place before maturity, the government no longer gains much from defaulting on foreign debts and ends up enforcing them. Default has been averted. If not enough trading takes place before maturity, the government still has sizable gains from defaulting on foreign debts and decides not to enforce them. Default takes place, and the debt renegotiation phase starts.” In such a setup, local investors will purchase their own sovereign's debt only at a discount that compensates them for a possible default. Indeed, bonds of crisis countries were traded at heavy discounts in secondary markets, which underpins this interpretation of the model.

Finally, we observe that the Euro Area, with its deep (secondary) bond markets and its high level of financial integration, provides an ideal setting for the secondary market theory to apply. It is, therefore, debatable whether the strong bond reallocations we estimate for the Euro Crisis can also be found in previous sovereign debt crises. Looking forward, however, we expect that as bond markets will develop further, the forces uncovered by the secondary market theory will be increasingly at play.

## 6 Conclusion

This paper has uncovered strong empirical patterns of the geographical allocation of debt during the Euro Crisis. First, those countries which enter an acute state of crisis have a tendency to repatriate their debt. Second, this tendency is especially strong for public debt. As a third, somewhat weaker, pattern, public debt of crisis countries is reallocated to those Euro Area countries of higher political weight. These patterns survive when controlling for

a wide range of country-specific effects and trends in a large number of specifications.

Conventional theories of portfolio allocation and home bias are consistent with only the first of these findings. By contrast, the broader picture is consistent with the secondary market theory recently proposed by Broner, Martin and Ventura (2010). Starting from the premise that sovereigns care more about domestic than foreign creditors, the theory predicts that an adverse shock to the government's temptation to default will be associated with a repatriation of debt. Domestic investors, indeed, will rationally buy sovereign bonds from foreign investors, knowing that the government will be re-incentivized to pay back its debt as the repatriation proceeds.

The theory thus predicts that sovereign debt flows back to the originating country when a default is looming. It also predicts a stronger repatriation of public debt compared to private debt. Enforcement problems and strategic default, indeed, are less severe in the case of private debt. Finally, extending the logic to a collective choice setting, the third prediction of the theory is that the debt of crisis countries should flow towards all those countries that participate in the default decision. These are exactly the patterns we observe in our empirical analysis.

The recent fragmentation of European financial markets has troubled policymakers. These trends may indeed seem worrying, given that integrated markets grant an efficient allocation of capital and a proper transmission of a common monetary policy (see ECB 2012). From the vantage point of the secondary market theory, however, the situation appears less alarming. In particular, the increasing market fragmentation is not a sign of panic but reflects the rational response of investors to adverse shocks to sovereign solvency. Read from this perspective, our paper offers a slightly more comforting outlook, suggesting that the financial disintegration may reverse as soon as risks of sovereign defaults abate.

# A A Model of Debt Repatriation in Crisis Periods

In this section, we present a simple model of international borrowing by a small open economy, characterized by the existence of sovereign risk and of a secondary markets for the country's debt. Our goal is to characterize the response of secondary markets to solvency shocks to the economy.

## A.1 Model Setup

We consider a small open economy that lasts two periods, indexed by  $t = 0, 1$ . The economy is inhabited by a continuum of private agents with unit measure, who are indexed by  $i \in [0, 1]$ . There is a single homogenous good that can be used for consumption and cannot be stored.

In the first period, at date 0, private agents have zero endowments of the consumption good. In the second period, there are two possible states of nature. In the good state, each agent receives  $y_h$  units of the good, whereas he receives  $y_l$  units in the bad state, where  $y_h > y_l > 0$ . We denote the probability of the good and the bad state as  $\pi$  and  $1 - \pi$ , respectively.

Each agent has preferences represented by the utility function

$$U(i) = u(c_0(i)) + \pi u(c_{1,h}(i)) + (1 - \pi)u(c_{1,l}(i)) \quad (4)$$

where the function  $u(\cdot)$  is strictly increasing and concave. For simplicity there is no discounting. Here,  $c_0(i)$  denotes consumption of agent  $i$  at date 0 and  $c_{1,s}(i)$  the corresponding state-dependent consumption at date 1.

In order to smooth consumption intertemporally, each domestic agent can trade a non-contingent bond with competitive and risk-neutral foreign lenders. As domestic agents have no endowment at date 0, they will want to borrow from abroad to smooth consumption. The budget constraint of each agent at date 0 is given by

$$c_0(i) = q_0 b(i) \quad (5)$$

where  $b(i)$  denotes the quantity of bonds issued by agent  $i$  at date 0 at the price  $q_0$ . The consumption goods acts as the numeraire. In absence of frictions to international asset trade, the bond price equals the inverse of the foreign gross interest rate, which will be throughout normalized to one.



Finally, there is a domestic government, whose only role is to decide whether to enforce financial contracts. Enforcement frictions represent a key aspect of this model.

## A.2 Timeline

We assume that, upon maturity of bonds, the domestic government can decide to enforce repayment of the bond issued at date 0. There is no other role for the government in this model.

The specific timeline is as follows. At date 0, domestic agents borrow and consume. Then, at the start of date 1, nature decides on the endowment shock of domestic individuals. Thereafter, a market opens for bonds that were issued at date 0. This market is called the secondary market. Next, the government makes his enforcement decision and finally domestic agents service their debt, provided they are obliged to, and consume.

## A.3 Secondary Markets and Enforcement

Secondary markets enable domestic and foreign agents to trade the bonds issued at date 0 by the domestic agents in the primary market. We denote by  $x_s(i)$  the quantity of bonds issued by other domestic agents at date 0 and purchased by agent  $i$  in the secondary market, and by  $x_s(-i)$  the quantity of bonds issued by agent  $i$  at date 0 and purchased by other domestic agents in period 1. The subscripts  $s$  indicate that these quantities are state-dependent.

When financial contracts are enforced, the budget constraint of each domestic agent at date 1 is

$$c_{1,s}(i) = y_s + [x_s(i) - q_{1,s}x_s(i)] - [b(i) - x_s(-i)] - x_s(-i) \quad s = h, l \quad (6)$$

where  $q_{1,s}$  denote the market price of domestic bonds at date 1, conditional of state  $s$ . This bond price is equal for all bonds.<sup>47</sup> Looking at the right hand side of this equation, the term in the first squared brackets represents the return on the bonds purchased by agent  $i$  at date 1, the term in the second squared brackets is the amount of debt owed by agent  $i$  to foreign creditors at the end of period 1, while the last term is amount owed to other domestic agents.

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<sup>47</sup>Indeed, the bond price depends on the government's enforcement decisions and the government cannot discriminate by issuer, i.e. by domestic agents at the moment of enforcement.

Financial contracts, however, may not be enforced. More precisely, when the government chooses whether to enforce contracts, it may choose to enforce the repayment of foreign and domestic creditors separately. In other words, enforcement is discriminatory between foreign and domestic claimants in this model.<sup>48</sup> For simplicity, however, we will just focus on a case where the government can choose to not enforce the repayment to foreign creditors.

When financial claims of foreigners are not enforced the economy suffers a loss. Specifically, we follow a standard assumption of the sovereign debt literature and consider that, in the event of a default on foreigners, the income of each domestic agent drops by a constant fraction  $\alpha \in (0, 1)$ . This assumption reflects a general drop in output that could result from a wide range of different penalties applicable by foreign creditors (e.g. trade sanctions, financial markets exclusion). Thus, if the repayment of foreign creditors is not enforced, the corresponding budget constraint at date 1 is

$$c_{1,s}(i) = (1 - \alpha)y_s + [x_s(i) - q_{1,s}x_s(i)] - x_s(-i) \quad s = h, l. \quad (7)$$

Following the extensive sovereign debt literature, we assume that the government maximizes the average utility of domestic agents. Thus, the government's choice concerning the enforcement of financial contracts depends on the size of the penalty relative to the debt owed to foreigners. More precisely, since the government decides in the second period, its decision depends on the levels of domestic welfare in the second period under enforcement and non-enforcement, which, in turn, depend on the realization of the endowment shock.

With expressions (6) and (7) it is easy to compare the respective domestic welfare. In case of debt enforcement, the second's period aggregate welfare is

$$W^r = \int_0^1 u(c_{1,s}(i)) di, \quad (8)$$

where the individual consumption is given by equation (6).

When debt contracts are not enforced, however, the output penalty applies and the

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<sup>48</sup>Several papers in the sovereign risk literature take the opposite assumption of non discrimination. As justification for this assumption is the presence of well functioning secondary markets for debt. As we will show in the remainder of the paper, even in the presence of discriminatory enforcement, the existence of a secondary market implies that foreign and domestic agents will in fact be able to redeem the bond at the same value. There is thus no difference between the assumption of discriminatory enforcement with secondary markets and non-discriminatory redemption of debt.

value of the second's period aggregate welfare is, according to (6)

$$W^d = \int_0^1 u\left((1 - \alpha)y_s + (x_s(i) - q_{1,s}x_s(i)) - x_s(-i)\right) di. \quad (9)$$

In the following, we will focus on symmetric equilibria, i.e. on equilibria, in which domestic agents all purchase the same amount of bonds in the secondary market. These equilibria are characterized by  $x_s(i) = x_s(-i)$ .<sup>49</sup>

We have now completed the description of the model setup. Next, we analyze the effects of an adverse shock to domestic output ( $y_s = y_l$ ) on the allocation of debt between domestic and foreign agents. Doing so, we need to proceed by steps. We start from a benchmark case with full enforcement, i.e. a world where the domestic government has no choice but to enforce financial contracts.

### A.3.1 Perfect Enforcement

When financial contracts are always enforced, the arrival of new information at date 1 about the state of the economy has no effect on secondary markets. Anticipating enforcement of debt contracts in any state  $s$ , foreign bondholders do not sell bonds at less than the face value. Thus, in equilibrium  $q_{1,s}^* = q_0^* = 1$  for any  $s$ . At this price, domestic agents have no incentive to buy and, assuming that the volume of transactions is minimized in equilibrium, there is no change in the allocation of debt. Thus,  $x_s^*(i) = x_s^*(-i) = 0$  for any  $i$ .

We now solve for the quantity of bonds issued by each agent  $i$  at date 0. All individuals are identical and we can consider a representative agent, omitting the index  $i$ . With (5), (6) and  $x_s^*(i) = x_s^*(-i) = 0$ ,  $q_{1,s}^* = q_0^* = 1$ , the first-order conditions of the agent's problem yield

$$u'(c_0) = \pi u'(c_{1,h}) + (1 - \pi)u'(c_{1,l}) \quad (10)$$

Together, these equations are sufficient to characterize the equilibrium. In search of a closed-form solution, we assume a quadratic utility function, i.e.  $u(c) = \alpha c - \frac{\beta}{2}c^2$  with  $\alpha, \beta > 0$ .<sup>50</sup> We can thus rewrite (10) as

$$c_0 = \pi c_{1,h} + (1 - \pi)c_{1,l}.$$

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<sup>49</sup>We show below that individuals have no incentive to deviate from the symmetric investment strategies in symmetric equilibria.

<sup>50</sup>Assume  $\beta < \frac{\alpha}{y_h}$  to ensure that the marginal utility from consumption is always positive.

Substituting this condition into the agent's intertemporal budget constraint, the value of date 0 consumption is

$$c_0^* = \frac{1}{2}[\pi y_h + (1 - \pi)y_l]. \quad (11)$$

As the agent has zero endowment at date 0, this level of consumption equals the quantity of bonds issued by the agent at date 0 ( $b^* = c_0^*$ ). Finally, the consumption in each of the two states of date 1 is

$$c_{1,s}^* = y_s - \frac{1}{2}[\pi y_h + (1 - \pi)y_l] \quad s = h, l.$$

Throughout, we will refer to  $c_0^*$  and  $c_{1,s}^*$  as the *full-enforcement* consumption allocation. Likewise,  $b^*$  and  $x_s^*$  characterize the asset allocation with full enforcement.

We have now characterized the equilibrium under perfect enforcement. In the next section, we will analyze strategic enforcement, assuming that the government can decide whether or not to enforce repayment. Doing so, we will first consider a world free of secondary markets.

### A.3.2 Strategic Enforcement without Secondary Markets

We switch off trade in secondary market by setting  $x_s(i) = x_s(i) = 0$  for all  $i$ . After observing the realized state and the allocation of debt at the beginning of date 1, the government chooses whether to enforce debt contracts or not by solving

$$\max\{W^r, W^d\},$$

where  $W^r$  and  $W^d$  denote the aggregate welfare with and without enforcement, as defined in (8) and (9). Clearly, the government will enforce contracts if and only if enforcement dominates default ( $W^r \geq W^d$ ). Exploiting the symmetry across individuals, the condition for enforcement is thus

$$y_s - b \geq (1 - \alpha)y_s. \quad (12)$$

We shall now distinguish between normal times, where the economy output is large and the cost of the penalty offsets the gain from default, and crisis times, characterized by the opposite situation. We thus need to impose that, when the agent's debt is equal to the full-enforcement value, repayment is not incentive compatible in the bad state of the economy, ( $y_s = y_l$ ). Substituting for  $b^* = c_0^*$  from (11) in (12), this is ensured by

$$\alpha < \bar{\alpha} \equiv \frac{1}{2} \frac{\pi y_h + (1 - \pi)y_l}{y_l}. \quad (13)$$

We impose a second condition on  $\alpha$ , assuming that

$$\alpha > \underline{\alpha} \equiv \frac{1}{2} \frac{\pi y_h + (1 - \pi) y_l}{y_h}. \quad (14)$$

This condition requires that, if bonds are issued at zero premium, the government prefers to enforce contracts under high output. Notice, however, that the conditionality is strong, since bonds must be issued at premium as long as default occurs with positive probability.

In the next section, we show that in the presence of secondary markets a low realization of output will be associated with a reallocation of debt between domestic and foreign creditors, which will avert default. The premium on bonds will thus be zero, making condition (14) sufficient to guarantee that in the good state there is no trade in secondary markets.

### A.3.3 Strategic Enforcement with Secondary Markets

Assume now that foreign and domestic agents can trade bonds in a secondary market at date 1, after observing the state of the economy. Suppose that the initial value of debt held by foreign creditors is incentive-compatible only in the state of the world with high output. Intuitively, low output triggers a rush by foreign creditors to sell the bond at any price, anticipating that the government prefers a default at the prevailing debt allocation.

Consider now an arbitrary domestic agent. Given that the government can discriminate across domestic and foreign contracts and given that domestic debt contracts are always enforced, the agent can profit from purchasing the bond at a low price from foreign agents and redeem it at face value upon maturity. Since domestic agents are competitive, in equilibrium the price of bonds in the secondary market must satisfy  $q_{1,l} = 1$ .

The reallocation of debt will continue until the value of debt held by foreign agents reaches the value of the penalty, which a default would impose on the borrowing country. Once this point is reached, foreigners will have no reason to sell the bond and, maintaining the assumption that the volume of transactions is minimized in equilibrium, the activity of the secondary market will stop. Specifically, the equilibrium is reached when  $W^r = W^d$ . Rearranging (6) and (7) at the respective bond prices under repayment ( $q_{1,l} = 1$ ) and default ( $q_{1,l} = 0$ ) and focusing on a symmetric allocation of debt across domestic individuals, we can write this condition as

$$y_l - (b - x_l) = (1 - \alpha)y_l, \quad (15)$$

where  $x_l$  denotes the quantity of debt purchased by the representative domestic agent from foreign creditors. We can further compute with (5), (13), (15) and  $q_0 = 1$  that the equilibrium amount of domestic repurchased debt is positive:

$$x_l = \frac{1}{2}[\pi y_h + (1 - \pi - 2\alpha)y_l] > 0.$$

Thus, conditions (13) and (14) on the cost of default,  $\alpha$ , guarantee that there will be a reallocation of debt only after low output:

$$x_s = \begin{cases} 0 & \text{if } s = h \\ \frac{1}{2}[\pi y_h + (1 - \pi - 2\alpha)y_l] & \text{if } s = l \end{cases} .$$

Overall, we have thus shown that the equilibrium with strategic enforcement and secondary markets is, in terms of real allocation and the amount of borrowing at date 0, equivalent to the equilibrium with full enforcement. More importantly, the model predicts that sovereign debt should flow back into the originating country when a shock adversely affects the country's solvency. Such reallocation will continue until the incentives of the government to enforce financial contracts are restored.

**Table 1 - Panel Regression Total Bilateral Debt Positions**

	I	II	III	IV	V	VI
<b>Dependent Variable: Total Bilateral Debt Position</b>						
	<i>Panel Regression</i>			<i>PPML Panel regression</i>		
<i>Crisis<sub>b,t</sub>*Own<sub>c,b</sub></i>	0.914*** [0.167]	0.980*** [0.168]	0.835*** [0.198]	0.456*** [0.062]	0.513*** [0.064]	0.374*** [0.113]
<i>Crisis<sub>b,t</sub>*Euro<sub>c</sub></i>		1.674*** [0.550]	1.828*** [0.561]		0.523* [0.288]	0.627** [0.285]
<i>Crisis<sub>b,t</sub>*Crisis<sub>c,t</sub></i>			0.193 [0.140]			0.177 [0.126]
Observations	6024	6024	6024	6024	6024	6024
Country-pair fe	yes	yes	yes	yes	yes	yes
Creditor-time fe	yes	yes	yes	yes	yes	yes
Borrower-time fe	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.962	0.963	0.963	.	.	.

Note: The dependent variable is  $\log(1+x)$  in Columns I-III and it is  $x$  in Columns IV-VI, where  $x$  denotes the holdings of total non-bank debt of country  $b$  (borrower) by banks of country  $c$  (creditor). End-of-quarter positions between 2006:Q1 and 2011:Q4. Crisis is a dummy variable that equals one if the bond yield exceeds 7 percent and the corresponding country belongs to the Euro Area. Countries are: Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States. Standard errors in brackets. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Table 2 - Panel Regression Bilateral Debt Positions by Sector**

	I	II	III	IV	V	VI
<b>Dependent Variable: Sectorial Bilateral Debt Position</b>						
	<i>Panel Regression</i>			<i>PPML Panel regression</i>		
<i>Crisis<sub>b,t</sub> *Publ<sub>s</sub></i>	-0.313*** [0.089]	-0.481*** [0.119]	-0.394*** [0.125]	-0.353*** [0.071]	-1.081*** [0.113]	-1.030*** [0.116]
<i>Crisis<sub>c,t</sub> *Publ<sub>s</sub></i>	0.649*** [0.089]	0.659*** [0.089]	0.710*** [0.091]	0.112 [0.139]	0.141 [0.138]	0.144 [0.139]
<i>Crisis<sub>b,t</sub> *Own<sub>c,b</sub></i>	0.805*** [0.200]	0.856*** [0.204]	0.962*** [0.303]	0.506*** [0.055]	0.447*** [0.061]	1.192*** [0.079]
<i>Crisis<sub>b,t</sub> *Own<sub>c,b</sub> *Publ<sub>s</sub></i>	0.607** [0.280]	0.728** [0.286]	1.426*** [0.416]	0.778*** [0.173]	1.386*** [0.174]	1.124*** [0.154]
<i>Crisis<sub>b,t</sub> *Euro<sub>c</sub></i>		0.739 [0.670]	0.667 [0.682]		-0.427 [0.304]	-0.518* [0.307]
<i>Crisis<sub>b,t</sub> *Euro<sub>c</sub> *Publ<sub>s</sub></i>		1.927** [0.905]	1.537* [0.920]		4.152*** [0.541]	3.860*** [0.548]
<i>Crisis<sub>b,t</sub> *Crisis<sub>c,t</sub></i>			-0.112 [0.260]			-0.770*** [0.097]
<i>Crisis<sub>b,t</sub> *Crisis<sub>c,t</sub> *Publ<sub>s</sub></i>			-0.822** [0.356]			0.215 [0.205]
Observations	8928	8928	8928	8904	8904	8904
Cred-borr-sect fe	yes	yes	yes	yes	yes	yes
Creditor-time fe	yes	yes	yes	yes	yes	yes
Borrower-time fe	yes	yes	yes	yes	yes	yes
Sector-time fe	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.952	0.952	0.952	.	.	.

Note: The dependent variable is  $\log(1+x)$  in Columns I-III and it is  $x$  in Columns IV-VI, where  $x$  denotes the holdings of debt of type  $s$  (sector) issued by country  $b$  (borrower) and held by banks of country  $c$  (creditor). End-of-quarter positions between 2006:Q1 and 2011:Q4. Crisis is a dummy variable that equals one if the bond yield exceeds 7 percent and the corresponding country belongs to the Euro Area. Countries are: Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States. Standard errors in brackets. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .



**Table 3 - Panel Regression Bilateral Debt Positions by Sector; Euro Area Counties**

	I	II	III	IV	V	VI
<b>Dependent Variable: Sectorial Bilateral Debt Position</b>						
	<i>Panel Regression</i>			<i>PPML Panel regression</i>		
<i>Crisis<sub>b,t</sub> *Publ<sub>s</sub></i>	-0.385*** [0.088]	-0.819*** [0.137]	-0.686*** [0.150]	-0.311*** [0.070]	-1.130*** [0.122]	-1.046*** [0.122]
<i>Crisis<sub>c,t</sub> *Publ<sub>s</sub></i>	0.706*** [0.090]	0.745*** [0.090]	0.803*** [0.094]	0.348*** [0.131]	0.388*** [0.129]	0.392*** [0.130]
<i>Crisis<sub>b,t</sub> *Own<sub>c,b</sub></i>	0.504*** [0.171]	0.486*** [0.181]	0.576** [0.252]	0.537*** [0.051]	0.451*** [0.061]	1.133*** [0.080]
<i>Crisis<sub>b,t</sub> *Own<sub>c,b</sub> *Publ<sub>s</sub></i>	0.608** [0.238]	0.935*** [0.250]	1.429*** [0.341]	0.507*** [0.167]	1.186*** [0.172]	1.112*** [0.156]
<i>Crisis<sub>b,t</sub> *Euro<sub>c</sub></i>		-0.255 [0.679]	-0.406 [0.718]		-0.570* [0.318]	-0.685** [0.322]
<i>Crisis<sub>b,t</sub> *Euro<sub>c</sub> *Publ<sub>s</sub></i>		3.722*** [0.899]	3.086*** [0.946]		4.598*** [0.571]	4.160*** [0.571]
<i>Crisis<sub>b,t</sub> *Crisis<sub>c,t</sub></i>			-0.109 [0.231]			-0.718*** [0.098]
<i>Crisis<sub>b,t</sub> *Crisis<sub>c,t</sub> *Publ<sub>s</sub></i>			-0.662** [0.311]			-0.005 [0.205]
Observations	4752	4752	4752	4752	4752	4752
Cred-borr-sect fe	yes	yes	yes	yes	yes	yes
Creditor-time fe	yes	yes	yes	yes	yes	yes
Borrower-time fe	yes	yes	yes	yes	yes	yes
Sector-time fe	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.960	0.961	0.961	.	.	.

Note: The dependent variable is  $\log(1+x)$  in Columns I-III and it is  $x$  in Columns IV-VI, where  $x$  denotes the holdings of debt of type  $s$  (sector) issued by country  $b$  (borrower) and held by banks of country  $c$  (creditor). End-of-quarter positions between 2006:Q1 and 2011:Q4. Crisis is a dummy variable that equals one if the bond yield exceeds 7 percent and the corresponding country belongs to the Euro Area. Countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain. Standard errors in brackets. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Table 4 - Panel Regression Bilateral Debt Positions by Sector; Yields**

	I	II	III	VI
<b>Dependent Variable: Sectorial Bilateral Debt Position</b>				
	<i>Panel regression</i>		<i>Instrumented Yields</i>	
$Yield_{b,t} * Publ_s$	-0.040*** [0.008]	-0.016 [0.011]	0.106* [0.064]	0.709*** [0.176]
$Yield_{c,t} * Publ_s$	0.082*** [0.009]	0.107*** [0.012]	0.078 [0.061]	0.661*** [0.170]
$Yield_{b,t} * Own_{c,b}$	0.078*** [0.020]	0.035 [0.030]	0.223* [0.122]	0.065 [0.125]
$Yield_{b,t} * Own_{c,b} * Publ_s$	0.018 [0.028]	0.118*** [0.042]	0.676*** [0.171]	0.803*** [0.174]
$Crisis_{b,t} * Crisis_{c,t}$		0.003* [0.001]		0.163*** [0.029]
$Crisis_{b,t} * Crisis_{c,t} * Publ_s$		-0.006*** [0.002]		-0.133*** [0.036]
Observations	8928	8928	7914	7914
Cred-borr-sect fe	yes	yes	yes	yes
Creditor-time fe	yes	yes	yes	yes
Borrower-time fe	yes	yes	yes	yes
Sector-time fe	yes	yes	yes	yes
Adjusted R-squared	0.952	0.952	0.953	0.953

Note: The dependent variable is  $\log(1+x)$ , where  $x$  denotes the holdings of debt of type  $s$  (sector) issued by country  $b$  (borrower) and held by banks of country  $c$  (creditor). End-of-quarter positions between 2006:Q1 and 2011:Q4. Columns III-IV report IV estimates based on a first-stage panel regression of bond yields GDP per capita, real GDP growth, government debt to GDP, government balance to GDP, current account balance to GDP, inflation rate and country-fixed effects. Countries are: Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States. Standard errors in brackets. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Table 5 - Panel Regression Bilateral Debt Positions by Sector**

	I	II	III	IV	V	VI
<b>Dependent Variable: Sectorial Bilateral Debt Position</b>						
	<i>600 bp threshold</i>			<i>500 bp threshold</i>		
<i>Crisis<sub>b,t</sub>*Publ<sub>s</sub></i>	-0.296*** [0.083]	-0.415*** [0.109]	-0.349*** [0.115]	-0.183*** [0.068]	-0.248*** [0.088]	-0.254*** [0.094]
<i>Crisis<sub>c,t</sub>*Publ<sub>s</sub></i>	0.547*** [0.084]	0.554*** [0.084]	0.601*** [0.088]	0.282*** [0.066]	0.285*** [0.066]	0.280*** [0.070]
<i>Crisis<sub>b,t</sub>*Own<sub>c,b</sub></i>	0.712*** [0.185]	0.747*** [0.188]	0.700*** [0.250]	0.399*** [0.149]	0.403*** [0.150]	0.251 [0.174]
<i>Crisis<sub>b,t</sub>*Own<sub>c,b</sub>*Publ<sub>s</sub></i>	0.604** [0.260]	0.675** [0.264]	1.087*** [0.345]	0.658*** [0.209]	0.684*** [0.210]	0.661*** [0.241]
<i>Crisis<sub>b,t</sub>*Euro<sub>c</sub></i>		0.619 [0.618]	0.633 [0.626]		0.128 [0.501]	0.248 [0.505]
<i>Crisis<sub>b,t</sub>*Euro<sub>c</sub>*Publ<sub>s</sub></i>		1.390* [0.830]	1.160 [0.839]		0.775 [0.666]	0.790 [0.670]
<i>Crisis<sub>b,t</sub>*Crisis<sub>c,t</sub></i>			0.062 [0.203]			0.213* [0.125]
<i>Crisis<sub>b,t</sub>*Crisis<sub>c,t</sub>*Publ<sub>s</sub></i>			-0.513* [0.277]			0.033 [0.169]
Observations	8928	8928	8928	8928	8928	8928
Cred-borr-sect fe	yes	yes	yes	yes	yes	yes
Creditor-time fe	yes	yes	yes	yes	yes	yes
Borrower-time fe	yes	yes	yes	yes	yes	yes
Sector-time fe	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.952	0.952	0.952	0.946	0.946	0.946

Note: The dependent variable is  $\log(1+x)$ , where  $x$  denotes the holdings of debt of type  $s$  (sector) issued by country  $b$  (borrower) and held by banks of country  $c$  (creditor). End-of-quarter positions between 2006:Q1 and 2011:Q4. Countries are: Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States. Standard errors in brackets. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Table A1. Foreign Assets of Local Banks – Summary Statistics**

ccode	Mean		St.Dev.		Corr(IFS,BIS)
	IFS	BIS	IFS	BIS	
at	12.6984	12.4923	0.5094	0.6059	0.9911
be	13.3981	13.4182	0.4123	0.4020	0.9995
br	10.2419	10.5986	0.4991	0.5961	0.9759
de	14.6856	14.6178	0.4183	0.3955	0.9916
dk	11.9029	11.7715	0.4636	0.4557	0.9931
es	13.0246	12.7994	0.4682	0.4988	0.9985
fi	11.5263	11.3789	0.5982	0.7222	0.9380
fr	14.4540	14.3319	0.4911	0.5209	0.9942
gr	11.5164	11.4504	0.7180	0.6664	0.9947
ie	13.6422	13.1939	0.5649	0.5979	0.9926
it	12.9775	12.8399	0.4364	0.4688	0.9758
jp	14.1640	14.4255	0.3264	0.3374	0.9681
mx	10.0190	9.5474	0.5339	0.4093	0.7055
nl	13.5607	13.5317	0.4338	0.4425	0.9966
pt	11.7688	11.5404	0.4261	0.3692	0.9968
se	12.1783	12.1655	0.5847	0.6781	0.9979
us	14.2059	14.5717	0.3675	0.4301	0.9918

Banks' claims to non-residents (line 31 minus line 11 ) from IFS (IMF) and external positions of banks vis-a-vis all sectors (Table 2a) from Locational Banking Statistics (BIS). Period: 2001:Q1 – 2011:Q4. Data are logged.

**Table A2. Banks' Positions of Public Debt – Summary Statistics, by Country**

Country	Share of Total Public Debt held by Banks (averages 2006-2011)	Share of Total Bank-Held Debt (averages 2006-2011)		Value of Banks' Positions (growth rates 2009 – 2011)		
	All Banks (domestic plus foreign)	Domestic Banks	Foreign Banks (aggregates)	Domestic Banks	Foreign Banks (bilateral positions)	
					Average	St. Deviation
<b>PIIGS</b>						
es	0.51	0.76	0.24	0.25	-0.14	1.07
gr	0.31	0.49	0.51	0.31	-0.53	0.77
ie	0.22	0.50	0.50	1.49	-0.48	1.36
it	0.34	0.69	0.31	0.09	-0.63	1.05
pt	0.30	0.40	0.60	0.90	-0.52	0.93
average	0.33	0.57	0.43	0.61	-0.46	1.04
<b>Non-PIIGS</b>						
at	0.36	0.63	0.37	0.09	0.09	0.54
be	0.35	0.76	0.24	0.12	0.28	0.68
br	0.66	0.99	0.01	0.34	0.56	1.21
de	0.60	0.84	0.16	0.15	0.13	0.90
dk	0.33	0.88	0.12	0.02	-0.19	1.27
fi	0.24	0.53	0.47	0.38	0.02	0.76
fr	0.31	0.89	0.11	-0.06	0.21	0.76
nl	0.29	0.75	0.25	0.19	-0.23	1.02
se	0.29	0.87	0.13	0.42	1.28	1.35
us	0.06	0.89	0.11	0.08	0.10	1.22
average	0.35	0.80	0.20	0.17	0.23	0.97
<b>All countries</b>						
average	0.34	0.72	0.28	0.32	0.00	0.99

The first column reports the share of total public debt held by banks, defined as the sum of public debt positions of domestic and foreign banks, divided by the gross debt of the central government. The second and third column report the share of total bank-held public debt held by domestic banks and foreign banks, respectively. The positions of foreign banks refer to the aggregate holdings of a country's public debt over all possible foreign creditors. The fourth and fifth column report the growth rate of the positions of public debt held by domestic and foreign banks, respectively. The growth rate is defined as the log deviation between the average holdings in 2011 and the average holdings in 2009. The sixth column reports the standard deviation of the growth rate of foreign banks' positions across all foreign creditors. Source: IFS (IMF), Locational Banking Statistics (BIS), Consolidated Banking Statistics (CBS) and Public Sector Debt Database (World Bank).

**Table A3. Banks' Positions of Private Non-Bank Debt – Summary Statistics, by Country**

Country	Share of Total Bank-Held Debt (averages 2006-2011)		Value of Banks' Positions (growth rates 2009 – 2011)		
	Domestic Banks	Foreign Banks (aggregates)	Domestic Banks	Foreign Banks (bilateral positions)	
				Average	St. Deviation
<b>PIIGS</b>					
es	0.95	0.05	-0.03	-0.17	0.61
gr	0.95	0.05	0.14	-0.34	0.62
ie	0.68	0.32	-0.20	-0.27	0.43
it	0.96	0.04	0.12	-0.42	0.51
pt	0.94	0.06	0.05	-0.10	1.15
average	0.90	0.10	0.02	-0.26	0.66
<b>Non-PIIGS</b>					
at	0.95	0.05	0.01	-0.01	1.18
be	0.89	0.11	0.01	0.24	0.45
br	0.97	0.03	0.50	0.26	0.64
de	0.97	0.03	-0.03	0.00	1.06
dk	0.96	0.04	-0.03	0.33	1.25
fi	0.91	0.09	0.08	-0.09	0.54
fr	0.96	0.04	0.06	-0.07	0.77
nl	0.84	0.16	-0.02	-0.17	0.45
se	0.94	0.06	0.23	-0.08	0.97
us	0.97	0.03	-0.06	-0.17	0.92
average	0.94	0.06	0.08	0.03	0.83
<b>All countries</b>					
average	0.92	0.08	0.06	-0.07	0.77

The first and second column report the share of total bank-held public debt held by domestic banks and foreign banks, respectively. The positions of foreign banks refer to the aggregate holdings of a country's public debt over all possible foreign creditors. The third and fourth column report the growth rate of the positions of private debt held by domestic and foreign banks, respectively. The growth rate is defined as the log deviation between the average holdings in 2011 and the average holdings in 2009. The fifth column reports the standard deviation of the growth rate of foreign banks' positions across all foreign creditors. Source: IFS (IMF), Locational Banking Statistics (BIS) and Consolidated Banking Statistics (CBS).

**Table A4. First-Stage IV Estimation**

<b>Dependent Variable: Bond Yield</b>	
GDP	-0.000*** [0.000]
GDP Growth	-0.045*** [0.014]
GOVT Debt	1.331*** [0.261]
GOVT Balance	-0.169 [0.833]
Inflation	1.713 [6.250]
CA	0.073*** [0.019]
Observations	627
Adjusted R-squared	0.606
Country fe	yes

Note: Dependent variable is the yield on 10 years government bonds. Quarterly averages, 2001:Q1 – 2011:Q4. The regressors are: the level of GDP, the growth rate of GDP, government's debt and balance over GDP, the growth of the GDP deflator and the current account over GDP. All variables are from OECD statistics, except for government variables. Data on government debt are from the Public Sector Debt Database of the World Bank. The government's balance is defined as the change in the level of debt. All data have quarterly frequency. Countries are: Austria, Belgium, Brazil, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Mexico, Netherlands, Portugal, Spain, Sweden, United States. Standard errors in brackets. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

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