Online Appendix for "Inspecting the Mechanism: Leverage and the Great Recession in the Eurozone"

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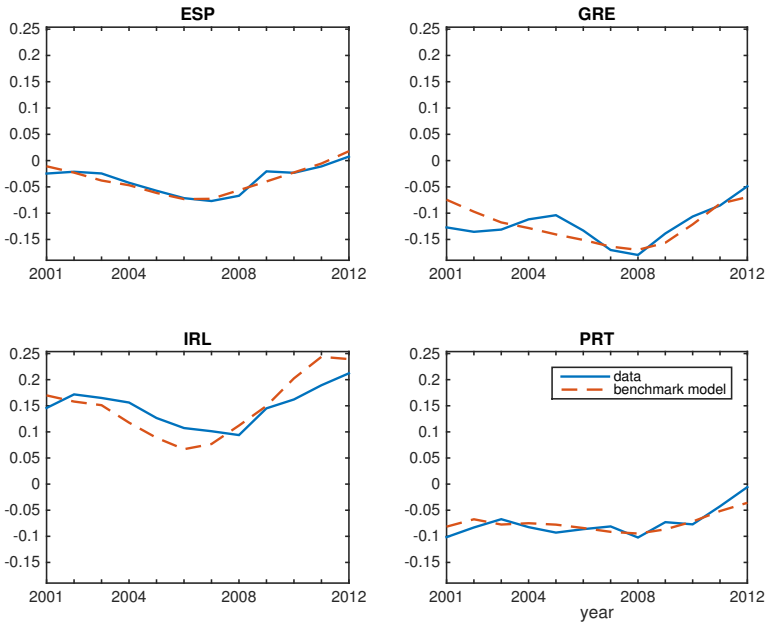
A Model and Simulation Appendix

A.1 Simulation of the model (in the published paper)

In addition to the comparison of the actual and predicted series for nominal GDP, employment, public debt and funding costs, in the main text, we show observed and simulated net exports in figure (1).

Figure 1: Net Exports



A.2 The Three Channels of Spreads in the Model

There are three channels through which spreads affect the economy:

Table 1: Impact of Spreads on macro variables: change in 2012 relative to benchmark

Change relative to benchmark model		x_s	y	n
No fiscal response to spreads	ESP	-0.1%	+3.4%	+4,0%
	GRE	-1.5%	+11.5%	+14.2%
Reduced response of savers spending to spreads	ESP	+4.8%	+1.9%	+1.1%
	GRE	+18.7%	+7.7%	+3.2%
No credit cycle	ESP	-0.0%	+0.9%	+1.0%
	GRE	+0.0%	+1.2%	+1.7%

1. via the fiscal rule because higher spreads constrain the government to reduce spending. This channel also matters for borrowers because a reduction in fiscal transfers reduces their spending

2. via the savers' Euler equation as higher spreads reduce savers spending;

3. via the credit cycle and borrowers' debt limit (which goes down when spreads go up);

Table 1 reports three experiments where we shut down or limit these three channels one at a time, for Spain and Greece. We report the difference between the benchmark model and each experiment in 2012 on savers expenditures, GDP and employment.

1. To analyze the fiscal channel we set $\gamma^{\rho} = 0$ in the fiscal rule instead of -1.8. The impact of shutting down the fiscal channel of spreads is very large in both countries especially in Greece where the increase in spreads is higher. Hence, the fiscal policy response to spreads is a major channel of the model and it explains why the early ECB intervention is so powerful to stabilize employment. There is very little impact on savers expenditures.

2. To gauge the channel of savers spending we increase the CRRA coefficient to 5 (we use 1 in the model). We see that savers spending is much larger in 2012 as expected. GDP and employment are also higher. However, the change in the elasticity of inter-temporal substitution also changes the coefficient of the Phillips curve and makes inflation more responsive to output. This means that this experiment cannot precisely pinpoint the exact quantitative importance of this channel. We however conclude that this channel is present but the experiment suggests it is smaller than the fiscal channel.

3. To analyze the impact of spreads through the credit cycle, we remove the impact of spreads on private debt in equation (14) by setting $\lambda^{\rho,h} = 0$ (rather than -1.8 as estimated). There is no impact on savers consumption which is intuitive. The impact of the spreads through the credit cycle is present on GDP and employment but smaller than the fiscal channel and the saver's expenditures channel.

Hence, we conclude that all three channels are present in the model but that the most important channel is the one that works through the fiscal rule.

A.3 Fiscal Devaluation

In this counterfactual we ask the following question: what would have happened if periphery countries had been able to engineer a fiscal devaluation during the bust in order to recoup part of the competitiveness they had lost during the boom years? This is close to a "flexible" exchange rate counterfactual, but it is not identical because a fiscal devaluation does not impact the net foreign asset position.[1]For this experiment, we use the model with a simpler Phillips curve as described in an earlier version of this article (see Martin and Philippon (2014). We define a fiscal devaluation as the combination of a VAT tax on domestic expenditures (private and public) and a payroll subsidy. Let $p^h_{j,t}$ be the price of home goods for domestic consumers, and $p^*_{j,t}$ be the price of home goods for foreign consumers. $\tau_{v,j,t}$ is the VAT so that the government collects $\tau_{v,j,t}\left(\chi_j x_{b,j,t} + (1-\chi_j)\, x_{s,j,t} + g_{j,t}\right)$. The VAT is paid by firms and rebated to exporters. $\lambda_{j,t}$ is the payroll subsidy so the government pays $\lambda_{j,t} w_{j,t} n_{j,t}$ to firms. Profit maximization implies the following prices:

$$(1-\tau_{v,j,t})\, p^h_{j,t} = p^*_{j,t} = (1-\lambda_{j,t})\, w_{j,t},$$

and foreign demand becomes $\frac{f_{j,t}}{(1-\tau_{v,j,t})p^h_{j,t}}$. Given that the VAT is imposed on imported goods, importers (assuming flexible prices for foreign firms as for domestic firms) increase the price of their imports to compensate for the VAT, so we have $p^f_{j,t} = \frac{p^f_t}{1-\tau_{v,j,t}}$ where $p^f_{j,t}$ is the domestic price of foreign goods in country$j$ and p^f_t is the foreign price of foreign goods. With log preferences, this leads to a one for one drop in the quantity of imported foreign goods, while the spending shares remain the same. For simplicity we further assume that the VAT rate and payroll subsidies are equal, $\tau_{v,j,t} = \lambda_{j,t}$ so that $p^h_{j,t} = w_{j,t}$, $y_{j,t} = w_{j,t} n_{j,t} = p_{j,t} n_{j,t}$ and domestic prices to domestic consumers are unchanged. We also assume $\mathbb{E}_t\left[\tau_{v,j,t+1}\right] = \tau_{v,j,t}$. The government budget constraint, is then:

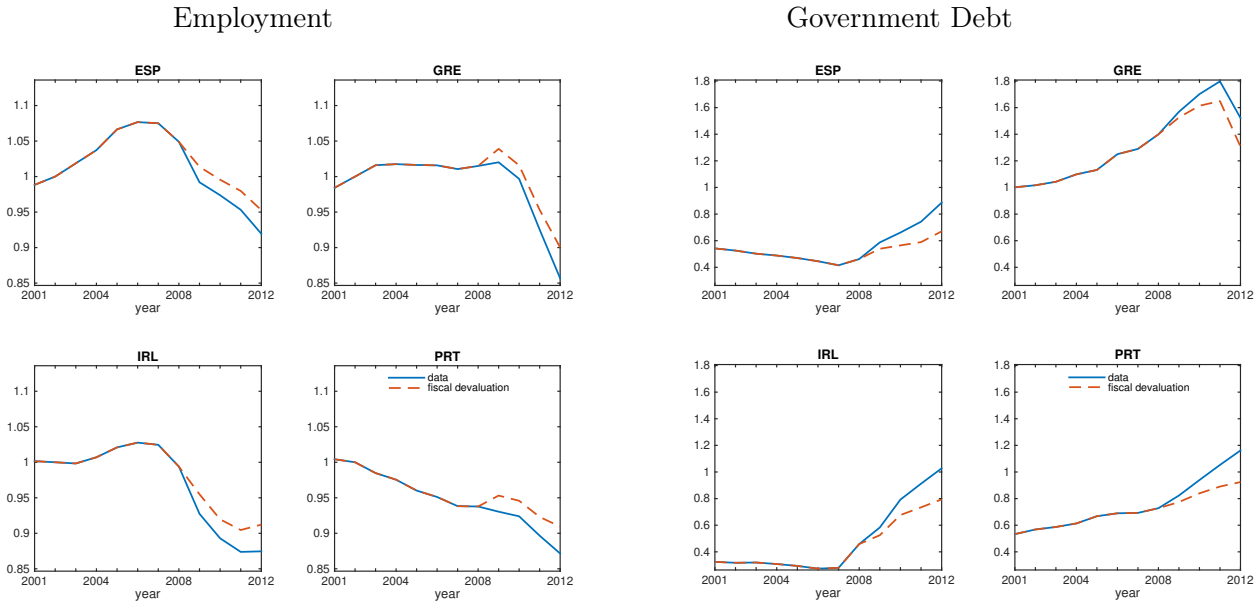
$$\beta \frac{b^g_{j,t+1}}{1+\rho_{j,t}} + (\tau_{j,t} - \tau_{v,j,t})\, w_{j,t} n_{j,t} + \tau_{v,j,t}(\chi_j x_{b,j,t} + (1-\chi_j)\, x_{s,j,t} + g_{j,t}) = g_{j,t} + t_{j,t} + \Gamma_{j,t} + b^g_{j,t},$$

where $\Gamma_{j,t}$ is a lump sum transfer to households. We set this transfer so that the fiscal devaluation is neutral for the government budget constraint in the sense that the revenues from the VAT equal the cost of the payroll subsidy and the transfer. However, the indirect effects on income tax revenues that arise from the stimulative effects of a fiscal devaluation on output remain as would be the case of an exchange rate devaluation. So the lump sum transfer is:

$$\Gamma_{j,t} = \tau_{v,j,t}(\chi_j x_{b,j,t} + (1-\chi_j)\, x_{s,j,t} + g_{j,t}) - \tau_{v,j,t} w_{j,t} n_{j,t}.$$

[1]See Franco (2013) and Farhi et al. (2014) for conditions under which a fiscal devaluation is equivalent to an exchange rate adjustment.

Figure 2: Fiscal Devaluation Experiment



The fiscal devaluation is applied starting in 2009. We set the VAT rate at 10% so that export volumes increase by the same amount. The increase in exports attenuates the fall in employment in all countries as shown in Figure (2). This comes directly but also because both borrowers and savers consume more following the increase in foreign demand. Another effect of the fiscal devaluation is that the improved employment figures induce governments to cut spending and transfers. Because of this and because of the stimulative effect of the fiscal devaluation on income taxes the trajectory of public debt is improved, as shown in Figure (2). This improvement in the debt dynamics is quite large in all countries: in 2012 public debt is for example lower by around 20 percentage points of GDP in Ireland. This suggests that a condition for a successful fiscal adjustment is that countries can benefit from such a change in relative prices. In a fixed exchange rate regimes, this can come quickly only through a fiscal devaluation. In all countries, because of the reduction in public debt, funding costs are a bit lower.

B Data Appendix

B.1 Eurozone

Most economic data for eurozone countries (employment, population, GDP, consumption, government debt, expenditures, EU transfers...) comes from Eurostat. We use data for 11 eurozone countries from 2000 to 2012. Austria, Belgium, Germany, Spain, Finland, France, Greece, Ireland, Italy, Netherlands and Portugal. We excluded Luxembourg for which household debt data is

available only starting in 2005 and other countries that joined in 2007 and later.

The data on household debt comes from the BIS which itself compiled the data from national central banks. This is debt of household and non-profit institutions serving households. Credit covers all loans and debt securities and comes from both domestic and foreign lenders. The series capture the outstanding amount of credit at the end of the reference quarter.

We call government expenditures total government expenditures net of transfers, interest payments and bank recapitalization. The data on spending on bank recapitalization comes from Eurostat. It includes interest payable, capital injections recorded as deficit-increasing (capital transfer) and calls on guarantees and is net of revenues generated by bank recapitalization (guarantee fees, interest and dividends). Transfers is the addition of direct social benefits and of social transfers in kind.

Wages and prices, equal in the model, are proxied by the average of unit labor costs and consumer prices. Both come from Eurostat and the former are defined as the ratio of labor costs to labor productivity. For exports we measure the domestic value added that is associated with final consumption in the rest of the world, which corresponds to value added based exports. We use the data from the OECD-WTO Trade in Value-Added (TiVA) initiative to measure domestic value added embodied in gross exports. Data is available only in 2000, 2005, 2008 and 2009. For missing years, we use the ratio of gross exports (from Eurostat) to value added gross exports of the nearest year and multiply this ratio by the gross exports of the missing year to obtain an approximation of value added exports of the missing years.

We use annual averages of 10 year government bond rates as long term rates. The source is OECD. For the loans rates for SMEs and deposit rates, we use ECB data. SME loans are up to one million euros. Data is missing for Belgium (2003-2005), Greece, Ireland, Italy, Portugal (2000-2002) and Portugal (2007-2010). The deposit rates have maturity of up to one year. Irish data is missing. For the other countries, it starts in 2003. For 5 year CDS we use IMF data which starts only in 2008.

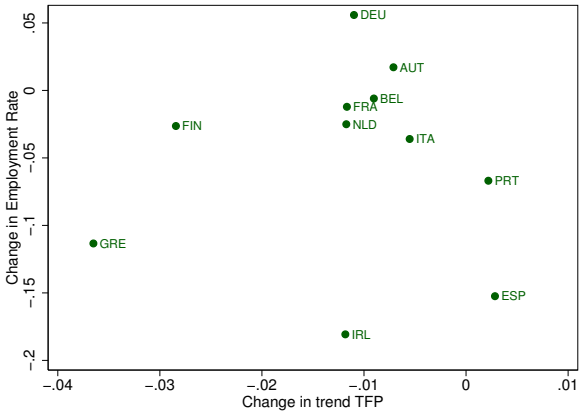
The source for the TFP in Figure (3) is the Conference Board.

B.2 United States

Data for the United States comes from the BEA, the Flow of Funds (FoF), and from the FRBNY Consumer Credit Panel. BEA and FoF data are standard and widely used so we do not discuss them.

The FRBNY Consumer Credit Panel is described in Lee and van der Klaauw (2012). It is a new longitudinal database with detailed information on consumer debt and credit. This panel is a random sample from consumer credit reports. It is available from 1999 onwards. Credit reporting agencies compile and maintain credit histories for all U.S. residents who have applied for or taken out a loan. Credit bureaus continuously collect information on individual consumers' debt and credit from lenders and creditors. Most individuals begin building a credit history when they first obtain and use a credit or retail card or take out a student loan, usually when they are at least 18

Figure 3: Changes in Trend TFP Do Not Explain the Eurozone Crisis



Notes: Horizontal Axis is average TFP growth during 2008-2012 minus average TFP growth during 2000-2007 (source: Conference Board). Vertical Axis is change in employment rate between 2008 and 2012.

years of age. New immigrants with little or no credit history from their home country are often older when a credit file is first created for them. The sample design implies that the target population consists of all US residents with a credit history. In addition to most individuals younger than 18, who had little need or opportunity for credit activity, the target population excludes individuals who have never applied for or qualified for a loan.

The data at the State level is available in three data sets on the FRBNY web site:

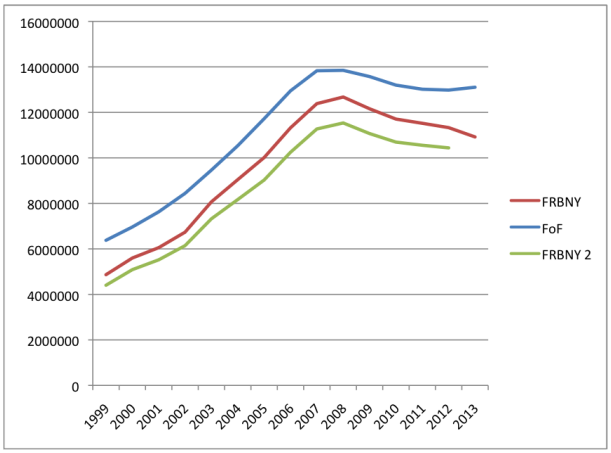
- State level data for all States from 1999 to 2012, annual data for Q4 only.
- Selected states from 1999 to 2003, quarterly data.
- Selected states from 2003 to 2014, quarterly data.

Lee and van der Klaauw (2012) argue that household debt estimates based on the FRBNY Consumer Credit Panel are similar to estimates reported in the Board of Governors' Flow of Funds Accounts. There are differences, however. First, the household debt measures in the Flow of Funds are not based on direct data but instead are derived as residual amounts. Total mortgage debt and non-mortgage debt in the second quarter of 2010 were respectively $9.4 and $2.3 trillion, the comparable amounts in the FoF for the same quarter were $10.2 and $2.4 trillion, respectively.

Second, the FoF measure of household mortgage debt includes some mortgage debt held by nonprofit organizations (churches, universities, etc.). On the other hand, FRBNY estimates exclude some debt held by individuals without social security numbers. There may also be differences in the speed at which changes in various types of debt are recorded, where new mortgage accounts usually appear on credit reports with some delay, making some direct comparisons difficult. The comparison is shown in Figure (4).

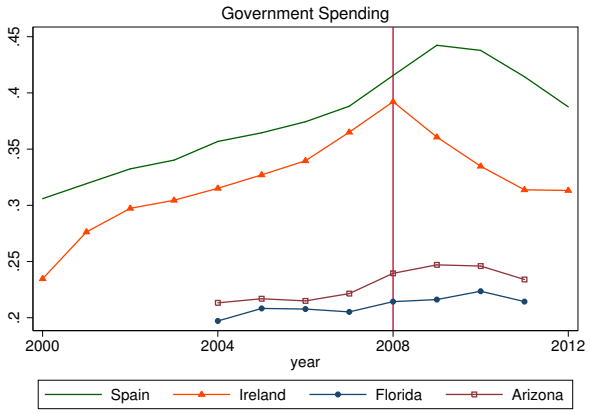
Local Fiscal Policy One potential issue is whether fiscal policy was not also active in the US. Perhaps private debt bubbles were associated with large fiscal revenues and large spending. This

Figure 4: Comparison of Household Debt Measures



probably happened to some extent, but compared to the Eurozone, these effects are small (of course we are only talking about cross-sectional variation in government spending). Figure (5) shows this for two states and two countries. A regression for all the states and all the countries shows that the link between private debt and government spending was at least four times smaller in the US than in Europe.

Figure 5: Government Spending



We therefore argue that the US provides a benchmark for private deleveraging without sudden stops, and with relatively neutral (cross-sectional) fiscal policy.

B.3 Scaled data

The scaled data for household and public debt, government expenditures and transfers, ten-year government bonds, foreign demand, and spreads and our scaled measure of $\rho_{j,t}$ are shown in Figures

(6), (7), (8) and (9) respectively.

Figure 6: Household and Public Debt

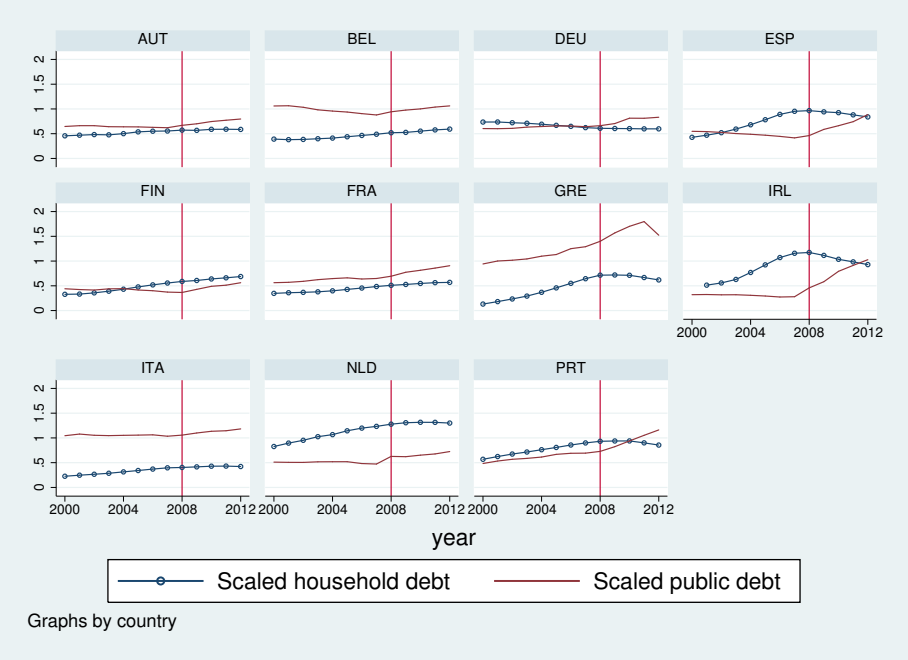


Figure 7: Government Expenditures and Transfers

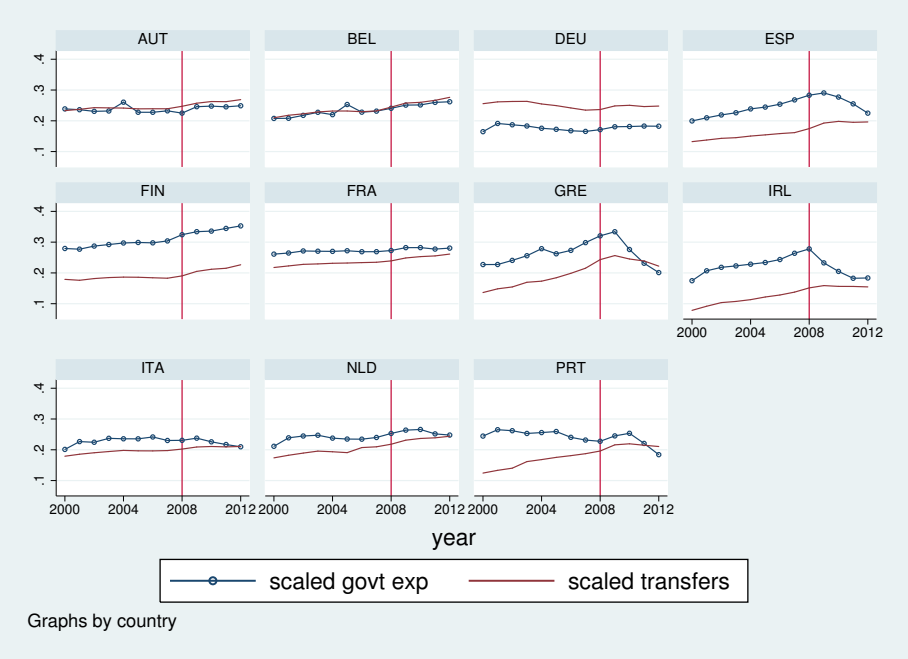


Figure 8: Value Added Based Exports

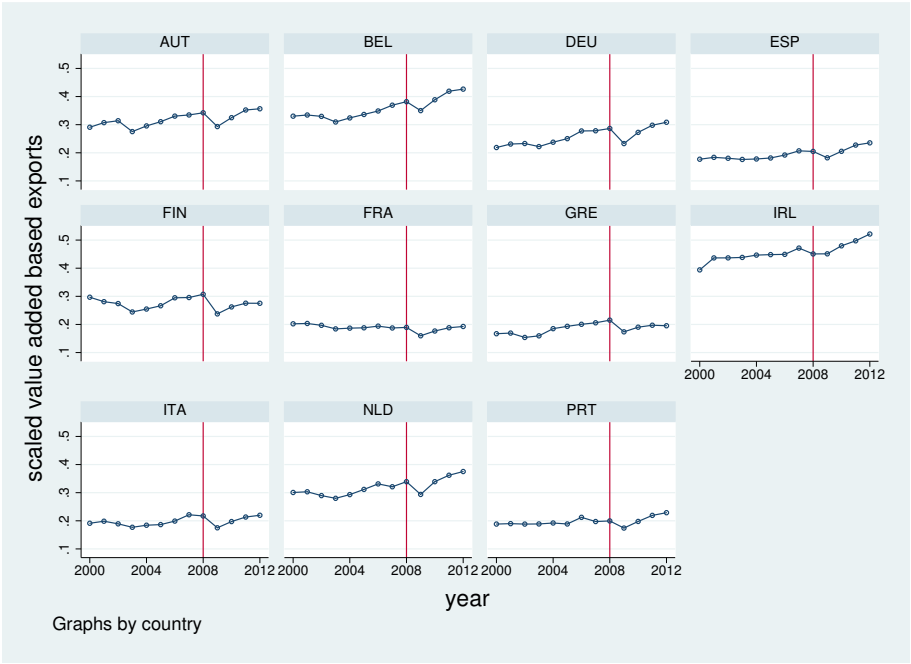
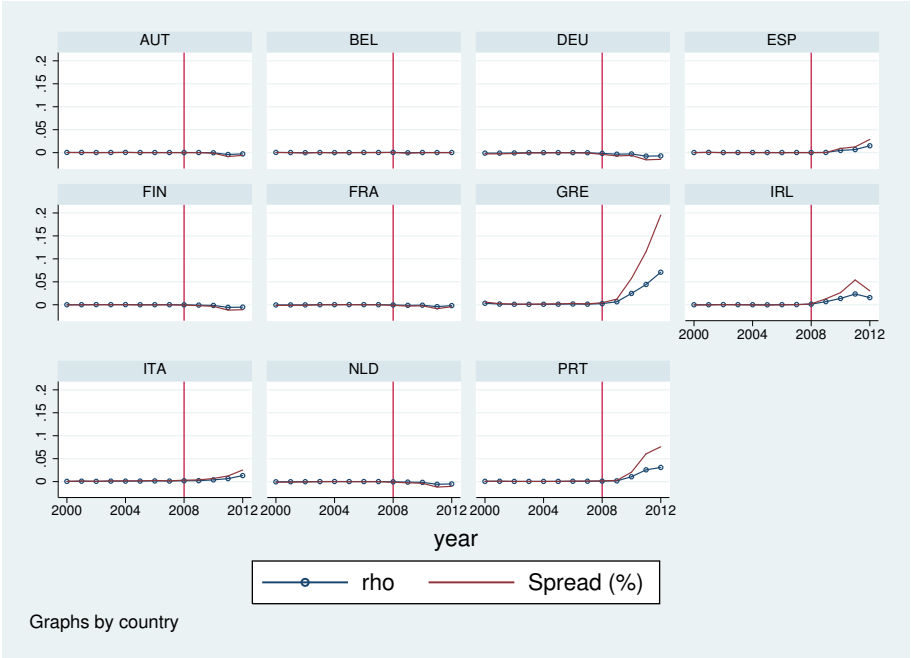


Figure 9: Spreads (Ten-Year Government Bonds) and $\rho_{j,t}$



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