ESSAYS ON INTERNATIONAL FINANCE

A Dissertation

Presented to

The Faculty of the Department

of Economics

University of Houston

in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

by

Emiliano Luttini

May 2014

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ABSTRACT

In the first article of this dissertation I estimate the effect of supply shocks to bank-lending on Argentinean region's real activity. Supply shocks to bank-lending are identified through a procedure which exploits the geographical distribution of bank's assets and liabilities. Using regional Value Added Tax receipts for 1998–2004, I find that a region facing a negative 1% supply shock to total bank-lending suffers a 1.6% output loss. In the data these shocks can explain a staggering output contraction of up to 9%. I document that the bulk of this result is accounted for by the contraction on the service sector.

In the second chapter, using a variance decomposition of shocks to GDP, my co-authors and I quantify the role of international factor income, international transfers, and saving in achieving risk sharing during the recent European crisis. We focus on the sub-periods 1990–2007, 2008–2009, and 2010 and consider separately the European countries hit by the sovereign debt crisis in 2010. We decompose risk sharing from saving into contributions from government and private saving and show that fiscal austerity programs played an important role in hindering risk sharing during the sovereign debt crisis.

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To my family

Contents

List of Figures

List of Tables

Chapter 1

Supply Shocks to Bank-Lending and Real Activity: Evidence from Argentinean Regions

1.1 Introduction

While there is considerable evidence on the effect of supply shocks to bank-lending, i.e. the existence of a bank-lending channel, macroeconomic evidence connecting those shocks to aggregate activity is rather scarce.[1] From a microeconomic perspective, Bernanke et al. (1996) provide evidence that bank-lending affects firm's spending, production, and investment. Amiti and Weinstein (2011) show that trade credit determines sales on an exporter firm. Amiti and Weinstein (2013) also show that supply shocks to bank-lending are determinant of listed companies' investment. At the macroeconomic level, on the contrary, the evidence is less conclusive. For instance, Driscoll (2004) and Ashcraft (2006) conclude that shocks affecting the supply of bank-lending, in spite of being important for small firms, are not significant determinant of output.

Using borrowing data from Argentinean regions for the period 1998–2004, first I identify variation in the data generated by supply shocks to bank-lending. Second, I quantify the importance of these shocks in accounting for regional borrowing. Finally, I assess whether these shocks have significant effects on regional activity.[2]

My main results, presented in Section 1.4, are as follows. I find that regional supply shocks to bank-lending account for 11% of idiosyncratic regional borrowing growth. Moreover, I find that these shocks are highly associated with output. A negative 1% regional supply shock to bank-lending (in terms of region's output) is associated with a 1.6% contraction in region's output.[3] Finally, I provide evidence that this finding is mostly driven by the effect of regional supply shocks to bank-lending on the region's service sector.

[1] The literature about the bank-lending channel takes a narrower definition of supply shocks to bank-lending than the one considered in this paper (notable exceptions are Amiti and Weinstein (2013) Khwaja and Mian (2008)). In particular, this literature exclusively focuses on changes in monetary policy that shifts the supply of bank-lending, whereas I consider any supply shocks that affects bank-lending.

[2] Argentinean regions are defined by the boundaries of each province.

[3] Argenitnean region's gross product is known as Gross Regional Product.

For inquiring on the effect of regional supply shocks to bank-lending on real activity, I use region's Value Added Tax receipts (VAT) as output measure. The previous literature (Driscoll (2004) and Ashcraft (2006)) tried to quantinfy the effect of the bank-lending channel into regional activity by using State Personal Income. However, using State Personal Income is problematic because it includes sources of income (e.g. property income and current transfers) from differents states than the state where the bank-lending channel is calculated.

In US states property income and current transfers move to insure states' consumption against output fluctuations (Asdrubali et al. (1996) and Becker and Hoffman (2006)), partially offseting such fluctuations. For this reason, if supply shocks to bank-lending were a determinant of aggregate activity, State Personal Income would underestimate any effect.[4]

Regional VAT data reported by the Argentinean Federal Administration of Public Revenue (FAPR) is an aggregate measure constructed according to the address of firms' headquarters. In particular, this criterion of imputation matters for firms whose production takes places in more than one region. For them, production is allocated in accordance with firms' headquarter address as opposed to the region where the production takes place. For the purpose of this work such method of aggregation is the best suited to consider the effect of regional supply shocks to bank-lending on regional activity, because financial shocks affecting firms' headquarters region are the ones that matters for firms' overall production.

The big issue, however, is the identification problem involved in measuring supply shocks to bank-lending. Lending growth is jointly determined by the demand and supply of loans, i.e. aggregate and banking activity. To come up with reliable estimations that circumvent this problem, the data must be purged of any source of variation that can be attributed to

[4] The Bureau of Economic Analysis defines State Personal Income as income that is received by, or on behalf of, persons who live in the state. It is calculated as the sum of wage and salary disbursements, supplements to wages and salaries, proprietors' income with inventory valuation adjustment and private capital consumption adjustment, rental income of persons with capital consumption adjustment, personal dividend income, personal interest income, and personal current transfer receipts, less contributions for government social insurance. Estimates of State Personal Income are presented by the place of residence of the income recipients.

regions, otherwise supply shocks to bank-lending would be contaminated by the market's demand side. Once this procedure is carried out, by definition, the leftover variation is attributed to banks.

Building upon Amiti and Weinstein (2013), I provide a new methodology to identify supply shocks to bank-lending. Identification is achieved by exploiting the heterogeneity in the geographical distribution of bank's assets and liabilities, plus bank-to-region lending data. I identify the supply shock to lending of a given bank as the common component of bank's lending across all regions in which it operates. Moreover, the common component to lending of banks operating in a certain region is considered as the demand shock to regional-borrowing.

With the aim of quantifying the significance of regional supply shocks to bank-lending in accounting for regional borrowing, using regions and years as my units of analysis, I decompose the variance of regional borrowing growth into common, idiosyncratic, region, and bank specific components. The latter one is the supply shock to bank-lending.

In Section 1.2.3 I explain the methodology to estimate the impact of supply shocks to bank-lending on output. I isolate the effect of supply shocks to bank-lending on economic activity by mean of purging all components that are common within the country; thereby, the measure of banking innovations is not contaminated by the country's business cycle. Moreover, I also rule out bias coming from time invarying dependence between supply shocks to bank-lending and regions' fixed characteristics, by including in the empirical exersice region fixed effects.

1.2 Methodology

This Section explains the steps I follow to come up with estimates about the effect of supply shocks to bank-lending on output. Section 1.2.1 explains the approach I pursue for identifying supply shocks to bank-lending. Section 1.2.2 describes the framework I use for decomposing the variance of regional borrowing growth into common, idiosyncratic, region and bank specific components. Section 1.2.3 discusses the empirical procedure for analyzing the effect of supply shocks to bank-lending on output.

1.2.1 Supply Shocks to Bank-Lending: Identification

Real lending is the market of loanable funds equilibrium outcome; as such, it is determined by supply and demand forces. Identification of supply shocks to bank-lending invloves taking away out of lending growth any source of variation that can be regarded as demand specific. The leftover variation, by definition, is attributed to the supply side of the market. Using bank-to-region lending data I identify the supply shock to lending of bank b as the common component of such bank across all regions in which it operates. The common component to all banks operating in region j is considered the demand shock to regional-borrowing.

Defining π_j and β_b as the demand shock common to all banks operating in region j and the bank-specific component to all regions in wich bank b operates, respectively, bank b to region j lending at time t is

$$\frac{\Delta\text{Lending}_{jbt}}{\text{Deposits}_{jbt-1}} = \pi_{jt} + \beta_{bt} + \epsilon_{jbt}\,, \tag{1.1}$$

where ϵ_{jbt} captures the irregular component of bank-to-lending data, and Δx_t means $x_t - x_{t-1}$.

Borrowing in region j is the sum of bank-lending to region j across all banks operating in such region. Bank b total lending, similarly, is the sum of regional-borrowing to bank b across all regions in which such bank operates. Hence, borrowing in region j and bank b total lending can be expressed as

$$\frac{\Delta\text{Borrowing}_{jt}}{\text{GRP}_{jt-1}} = \sum_{b\in B^j} \frac{\Delta\text{Lending}_{jbt}}{\text{Deposits}_{jbt-1}} \frac{\text{Deposits}_{jbt-1}}{\text{GRP}_{jt-1}}, \tag{1.2}$$

$$\frac{\Delta\text{Lending}_{bt}}{\text{Deposits}_{bt-1}} = \sum_{j\in J^b} \frac{\Delta\text{Lending}_{jbt}}{\text{Deposits}_{jbt-1}} \frac{\text{Deposits}_{jbt-1}}{\text{Deposits}_{bt-1}}, \tag{1.3}$$

where GRP, B^j, J^b stand for Gross Regional Product, set of banks operating in region j, and set of regions in which bank b operates, respectively.[5]

For ease of notation it is convenient to define the following terms, $\mathcal{b}_{bt}$ is $\frac{\Delta\text{Borrowing}_{bt}}{\text{Deposits}_{bt-1}}$, ℓ_{jt} is $\frac{\Delta\text{Lending}_{jt}}{\text{GRP}_{jt-1}}$, ρ_{jt} is $\frac{\text{Deposits}_{jt}}{\text{GRP}_{jt}}$, θ_{jbt} is $\frac{\text{Deposits}_{jbt}}{\text{GRP}_{jt}}$, and ϕ_{jbt} is $\frac{\text{Deposits}_{jbt}}{\text{Deposits}_{it}}$. Plugging equation 1.1 into equations 1.2 and 1.3, I obtain

$$\mathcal{b}_{jt} = \rho_{jt-1}\pi_{jt} + \sum_{b\in B^j} \theta_{jbt-1}\beta_{bt} + \sum_{b\in B^j} \theta_{jbt-1}\epsilon_{jbt}\,, \tag{1.4}$$

$$\ell_{bt} = \beta_{bt} + \sum_{j\in J^b} \phi_{jbt-1}\pi_{jt} + \sum_{j\in J^b} \phi_{jbt-1}\epsilon_{jbt}\,, \tag{1.5}$$

where j spans from 1 to the amount of Argentinean regions (J) and b from 1 to the number of financial institutions operating in Argentina (B).

Equations 1.4 shows that borrowing in region j consists of a demand shock plus the sum of weighted supply shocks by the market share of each bank in the region. Equations 1.5, in a like manner, shows that bank b lending consists of a supply shock plus the sum of weighted regional shocks by the share of each region into total bank's deposits.

Equations 1.4 and 1.5 define a system of $J+B$ equations on $J+B$ variables. This system can be rewritten as

$$\begin{bmatrix} \mathcal{B}_t^J \\ \mathcal{L}_t^B \end{bmatrix} = \begin{bmatrix} \mathbf{P}_{t-1}^{J\times J} & \mathbf{\Theta}_{t-1}^{J\times B} \\ \mathbf{\Phi}_{t-1}^{B\times J} & \mathbf{I}^{B\times B} \end{bmatrix} \times \begin{bmatrix} \mathbf{\Pi}_t^J \\ \mathbf{B}_t^B \end{bmatrix} + \begin{bmatrix} \mathbf{\Theta}_{t-1}^{J\times B} & \mathbf{0}^{J\times J} \\ \mathbf{0}^{B\times B} & \mathbf{\Phi}_{t-1}^{B\times J} \end{bmatrix} \times \begin{bmatrix} \mathbf{E}_t^B \\ \mathbf{E}_t^J \end{bmatrix}, \tag{1.6}$$

[5] Region j borrowing to bank b is the same as bank b lending to region j

where $\mathcal{B}$ and $\mathcal{L}$ are matrices whose components are regions' borrowing and banks' lending data, respectively. $\mathbf{B}$ and $\mathbf{\Pi}$ are matrices whose components are supply shocks to bank-lending and demand shocks to regional-borrowing, respectively. $\mathbf{P}$, $\mathbf{\Theta}$, and $\mathbf{\Phi}$ are the corresponding matrices of shares. $\mathbf{I}$ is the identity matrix, $\mathbf{0}$ is a matrix of zeros, and $\mathbf{E}$ is a matrix of irregular components. Finally, matrices' dimensions are on its exponents.

In order to identify supply shocks to bank-lending and demand shock to regional-borrowing, I look for solutions to system 1.6 such that $J + B$ orthogonality conditions are satisfied. In particular, these solutions imply that matrices of shares $\mathbf{\Theta}^{J\times B}$ and $\mathbf{\Phi}^{B\times J}$ are orthogonal to matrices of irregular components $\mathbf{E}^{B}$ and $\mathbf{E}^{J}$, respectively. "Absolute" solutions for $\mathbf{B}$ and $\mathbf{\Pi}$ to system of equations 1.6, however, are not uniquely determined; notwithstanding, Amiti and Weinstein (2013) proved that normalized solutions of the form $\mathbf{B}^{*} + k$ and $\mathbf{\Pi}^{*} - k$ can be obtained by choosing k equal to any variable of the system.[6]

Using normalized solutions, normalized regional supply shocks to bank-lending j is defined as

$$\text{FS}_{jt}^{\text{Normalized}} = \sum_{b\in B^j} \theta_{jbt-1}\beta^{*}_{bt} - k_t \,,$$

more importantly, this implies that the idiosyncratic component of such variable, defined as

$$\widetilde{\text{FS}}_{jt} = \text{FS}_{jt}^{\text{Normalized}} - \overline{\text{FS}_{t}^{\text{Normalized}}} = \sum_{b\in B^j} \theta_{jbt-1}\beta^{*}_{bt} - \overline{\sum_{b\in B^j} \theta_{jbt-1}\beta^{*}_{bt}} \,,$$

(where $\overline{x}$ means the time specific mean of x) is independent of the normalization variable k_t.

[6]Any column of the system of equations 1.6 can be written as a linear combination of all other columns, hence the system admits infinite solutions.

1.2.2 Borrowing Growth Variance Decomposition

In this Section I provide a procedure to quantify the significance of regional supply shocks to bank-lending in determining regional borrowing. To do so I decompose the variance of borrowing growth into common and idiosyncratic components. Moreover, the latter one is further decomposed into regional and bank specific components. The share of the bank specific component is my metric for assessing the significance of regional supply shocks to bank-lending in accounting for regional borrowing.

Equation 1.4 can be expressed as the sum of common and idiosyncratic components, i.e., $b_{jt} = \overline{b_{jt}} + \widetilde{b_{jt}}$, where region's j idiosyncratic borrowing component, $\widetilde{b_{jt}}$, is defined in a similar manner to the normalized regional supply shock to bank-lending, $\widetilde{\text{FS}}_{jt}$. Using this breakdown, in Appendix A, I show that the the variance of regional borrowing, b, can be decomposed in the following fashion,

$$1 = \gamma_{\text{OLS}}^{b,\overline{b}} \frac{\text{var}\left(\overline{b}\right)}{\text{var}\left(b\right)} + \gamma_{\text{OLS}}^{b,\widetilde{b}} \frac{\text{var}\left(\widetilde{b}\right)}{\text{var}\left(b\right)}, \tag{1.7}$$

where $\gamma_{\text{OLS}}^{b,\overline{b}}$ and $\gamma_{\text{OLS}}^{b,\widetilde{b}}$ are the OLS estimates of the next equations,

$$b_{jt} = \alpha + \gamma_{\text{OLS}}^{b,\overline{b}} \overline{b_t} + \epsilon_{jt}^{b,\overline{b}},$$

$$b_{jt} = \alpha + \gamma_{\text{OLS}}^{b,\widetilde{b}} \widetilde{b_t} + \epsilon_{jt}^{b,\widetilde{b}}.$$

Interestingly, this decomposition highlights two factors that determine the contribution of each variable to the variance of borrowing growth, namely, the ratio of variances, i.e., $\frac{\text{var}(\overline{b})}{\text{var}(b)}$ and $\frac{\text{var}\left(\widetilde{b}\right)}{\text{var}(b)}$, and the unconditional response of borrowing (b) to common $(\overline{b})$ and idiosyncratic $(\widetilde{b})$ components. That is, the ratio of variances in itself is uninformative of the extent to which, for instance, the idiosyncratic component accounts for the variance of borrowing growth, insofar as the unconditional response of borrwing to the idiosyncratic component is not consider.

Idiosyncratic region's j borrowing growth can be broken down into the sum of regional and bank specific components, i.e. $\widetilde{b_{jt}} = \rho_{\widetilde{t-1}}\pi_t + \widetilde{\text{FS}_t}$. Hence, the variance of idiosyncratic regional borrowing growth, $\widetilde{b}$, is broken down into

$$1 = \gamma_{\text{OLS}}^{\widetilde{b},\widetilde{\rho\pi}} \frac{\text{var}\left(\widetilde{\rho\pi}\right)}{\text{var}\left(\widetilde{b}\right)} + \gamma_{\text{OLS}}^{\widetilde{b},\widetilde{\text{FS}}} \frac{\text{var}\left(\widetilde{\text{FS}}\right)}{\text{var}\left(\widetilde{b}\right)}, \tag{1.8}$$

where $\gamma_{\text{OLS}}^{\widetilde{b},\widetilde{\rho\pi}}$, and $\gamma_{\text{OLS}}^{\widetilde{b},\widetilde{\text{FS}}}$ are the OLS estimations of the next equations,

$$\widetilde{b_{jt}} = \alpha + \gamma_{\text{OLS}}^{\widetilde{b},\widetilde{\rho\pi}} \widetilde{\rho\pi_{jt}} + \epsilon_{jt}^{\widetilde{b},\widetilde{\rho\pi}}, \tag{1.9}$$

$$\widetilde{b_{jt}} = \alpha + \gamma_{\text{OLS}}^{\widetilde{b},\widetilde{\text{FS}}} \widetilde{\text{FS}_{jt}} + \epsilon_{jt}^{\widetilde{b},\widetilde{\text{FS}}}. \tag{1.10}$$

1.2.3 Regional Supply Shocks to Bank-Lending and Region's Output.

Once the bank-lending channel has been calculated, the next step is inquiring on its effect on aggregate activity. However, a thorough discussion on regional outcomes that are likely to be affected by supply shocks to bank-lending is needed first.

In Argentina, data on regional borrowing is constructed as the sum of bank-lending across all banks operating in a given region. Considering regional outcomes likely to be affected by shocks taking place beyond the boundaries of a given region do not seem appropriate, since one would like to isolate activity affected by supply shocks to bank-lending within a region.

Gross Regional Product, for instance, does not satisfy the aforesaid condition. In particular, since Gross Regional Product is constructed using a locational criterion, its final outcome is determined not only by shocks taking place within the same location as a firm's plant, but by shocks affecting the firm's headquarters location. Hence, by construction, Gross Regional Product is not properly suited for answering whether supply shocks to bank-lending affect output.[7]

State Personal Income, an aggregate measure used in studies focusing on US states, is not clear why should be foremost affected by the bank-lending channel of the region under consideration. Since property income and current transfers across US states consistently move as if they were insuring states' consumption against output fluctuations (Asdrubali et al. (1996) and Becker et al. (2006)), property income and current transfers are likely to depend upon factors beyond the bank-lending channel. Hence, if the bank-lending channel was an important determinant of aggregate output fluctuations, State Personal Income would understimate any effect on aggregate activity.

The best suited aggregate variable for considering the effect of supply shocks to bank-lending on regional activity is Investment, since it is a measure built on a residency criterion. Unfortunately, aggregate investment at the region-level is unavailable for Argentina.

The FAPR keeps consistent statistics on the VAT in each Argentinean region. Taxes collected are imputed to each Argentinean region based on the firm's headquarters address. This implies that all the VAT coming from firms that their headquarters are located in region j are imputed to such region, regardless the location where the production took place. Hence, if shocks affecting the market of loanable funds supply side of region j matter for regional aggregate activity, regional VAT should be determined by these shocks as well. Thus, VAT is a relevant aggregate to assess whether the bank-lending channel determines regional activity.

[7]Gross Regional Product is constructed according to the System of National Account criteria used for calculating Gross Domestic Product.

The baseline regression I use for assesing the relation between the bank-lending channel and output is

$$\frac{\Delta \text{VAT}_{jt}}{\text{GRP}_{jt-1}} = \omega_0 + \omega_{-1}\frac{\Delta \text{VAT}_{jt-1}}{\text{GRP}_{jt-2}} + \omega_1 \text{FS}_{jt} + \tau_t + \epsilon_{jt}^{\text{VAT}} , \tag{1.11}$$

This equation estimates the effects of the bank-lending channel on output conditioning on time fixed effects (τ_t) accross the country. Controlling for common shocks is necessary in order to rule out the possibility that the bank-lending channel is capturing movements in the nationwide business cycle that contaminate the OLS estimator of ω_1.[8]

Next, in order to dig deeper into the effects of the bank-lending channel to more dissagregate levels, I decompose the coefficient ω_1 into sectoral contributions.[9]

Combining the fact that VAT_{jt} is the sum accross all economic sector of VAT, in region j, at time t (that is $\text{VAT}_{jt} = \sum_{p \in P} \text{VAT}_{pjt}$, where p is a given economic sector) and that the OLS estimator for ω_1 is

$$\omega_1^{\text{OLS}} = \frac{\sum_{jt} \left(\text{VAT}_{jt} - \text{VAT}_t\right)\left(\text{FS}_{jt} - \text{FS}_t\right)}{\sum_{jt} \left(\text{FS}_{jt} - \text{FS}_t\right)^2} ,$$

then the following equations are true

[8]As I explained in Section 1.2.1Including time time fixed effects is also necessary to remove the common component induced by the solution method to the system equations 1.6

[9]The derivation is based on $\frac{\text{VAT}_{jt}}{\text{GRP}_{jt-1}} = \omega_0 + \omega_1 \text{FS}_{jt} + \tau_t + \epsilon_{jt}^{\text{VAT}}$, being straighforward its extension to equation 1.11.

$$\omega_1^{\text{OLS}} = \sum_{p\in P} \frac{\sum\limits_{jt}\left(\text{VAT}_{pjt} - \text{VAT}_{pt}\right)\left(\text{FS}_{jt} - \text{FS}_t\right)}{\sum\limits_{jt}\left(\text{FS}_{jt} - \text{FS}_t\right)^2},$$

$$= \sum_{p\in P} \omega_p^{\text{OLS}},$$

ω_p^{OLS} comes from estimating the following system of P equations

$$\frac{\Delta\text{VAT}_{pjt}}{\text{GRP}_{jt-1}} = \omega_{p0} + \omega_p\text{FS}_{jt} + \tau_{pt} + \epsilon_{pjt}^{\text{VAT}}, \tag{1.12}$$

then the coefficient that measures the overall effect of the banking shock on regional activity, ω_1, can be decomposed into contributions of each economic sector by estimating the aforementioned system of P equations.

1.3 Data

Banking data is from the Argentinean Central Bank (ACB). The department of Financial and Monetary Statistics collects quarterly data on the distribution of loans and deposits along all Argentinean regions for all financial institutions. Data on loans includes demand deposit overdrafts, negotiable instruments, mortgage, pledge, personal, credit card, and any cash loan not included in the previous categories.[10] Data on deposits comprises checking, savings, and any certified deposit accounts.[11] [12]

[10]Data on loans does not include neither bonds nor loans of financial assets nor those guaranteed with them.

[11]Neither deposits of bonds nor financial assets are included.

[12]Lending and Deposits do not include interests or adjustment accrued.

The Report on Financial Institutions, prepared by the department of Information Dissemination, contains several data sets used throughout this work. The Technical Accounting Information data set contains dissagregated data of each balance sheet accounting line for all financial institutions under the supervision of the ACB. The disaggregation of the data allows identifying loans denominated in foreign currency. In the context of the present work this point matters because an exchange rate depreciation produces an increase in the bank's stock of loans purely accounted by the former one. Hence, movements on lending attributed to pure valuation effects are taken away from the data, since they cannot be attributed to shocks to banks' supply of funds.

The Geographical Distribution data set comprises monthly data on banks' geographical distribution of deposits and branches along all Argentinean regions from December 1998 to June 2003.[13]

Proper treatment of banks' mergers and acquisitions (M&A) is required for preventing wrongly computed growth rates. To this end, I use information on each financial institution historical evolution included in the homonym data set. This data set permits to consolidate accounting records of all financial institutions involved in a M&A operation a period earlier than the actual operation takes place, avoiding overestimates of growth rates.

Two variables are used for measuring the effects of supply shocks to bank-lending on regional outcomes, namely, VAT and Gross Regional Product. VAT is from the FAPR Statistics department; VAT's suitability for the study comes from its allocation procedure. Taxes collected are allocated to each region according to the address of firms' administrative offices. Presumably, firms keep tighter ties with banks operating in the same region as its administrative offices, thereby firms' overall output is determined by shocks affecting to banks operating in the same region as firms' headquarters.[14] Data on Gross Regional Product is

[13]Data on the geographical distribution of bank-lending is also available but with considerable missing information.

[14]Taxes collected from large national taxpayers are allocated to Ciudad Autonoma de Buenos Aires.

from the Federal Investment Council database. Since Gross Regional Product is computed following a locational criterion, regional supply shocks to bank-lending are likely to not affect Gross Regional Product.

1.4 Results

1.4.1 Variance Decomposition

Table 1.2 shows results of decomposing the variance of regional borrowing into common and idiosyncratic components. The common component accounts for 68% of the movement on regional borrowing. Moreover, there still is a sizable 32% owing to the region's idiosyncratic component.

Table 1.3 displays results of decomposing the variance of idiosyncratic regional borrowing, into region and bank specific components. The region specific component accounts for 89% of the idiosyncratic regional borrowing variance. The remaining 11% is accounted for by regional supply shocks to bank-lending. The latter one is further decomposed into what can be explained by nationwide and local banks.[15] Remarkably, only supply shocks coming from nationwide banks are important enough to account for a share of regional borrowing, whereas local banks accounts for none. The intuition behind this result can be gained from Figures 1.1a and 1.1b, and equations 1.8, 1.9, and 1.10. In spite of regional supply shocks to local banks being more volatile than those coming from nationwide banks, the lack of relation between the first ones and regional borrowing turns regional supply shocks to local banks uninformative on the movements of regional borrowing.

In spite of its inability to explain movements of idiosyncratic regional borrowing growth,

[15] Nationwide banks were defined as those with branches in at least 15 regions. Regional banks were defined as all the other ones.

Figure 1.2 shows that supply shocks to local banks are negatively correlated with movements in the region's specific component. However, I do not have available evidence to support any claim that can explain this pattern.

1.4.2 The Bank-Lending Channel and Output: Evidence

The core of my results are presented in Figures 1.3a, 1.3b, and Table 1.4. Figure 1.3a shows the partial correlation plot (netting out the lagged dependent variable, time and region fixed effects) between the change on VAT, expressed in units of lagged Gross Reigonal Product, and supply shocks to bank-lending. The plot shows a strong positive relationship between the two variables.

Figure 1.3b shows that there is no relationship between Gross Regional Product and the bank-lending channel. This result is in line with the findings of Driscoll (2004) and Ashcraft (2006); I do not interpret it, however, as evidence against any relation between supply shocks to bank-lending and real activity. Most likely, the absence of relationship between Gross Regional Product and the bank-lending channel is due to the fact that plants operating in a given location are affected by shocks affectiong to its headquarter's location. Thereby, this lack of relation is uninformative of the actual relation between the bank-lending channel and output.

Table 1.4 shows the results of estimating equation 1.11. I find a positive and statistically significant effect of the bank-lending channel on aggregate activity. In particular, a 1% supply shock to bank-lending is associated with a 1.6% increase in output.[16]

Finally, Table 1.5 shows the result of decomposing ω_1 into sectoral contributions. I find that around 75% of the relation between output and the bank-lending channel is explained

[16]In order to interpret the results of Table 1.4 in terms of units of output, I multiply 0.022 and 0.02 by $\frac{\text{GRP}_{jt-1}}{\text{VAT}_{jt-1}}$ (for any j and t) then I average each series over j and t, obtaining results interpretables in units of VAT.

by the service sector. The remaining 25%, is mostly accounted for by the manufacture sector, though the coefficient is not always significant.

This result, however, cannot be interpreted as evidence against the bank-lending channel for other sectors than the service one. Properly interpreted, this result just states that the bank-lending channel induced by banks operating in a given region, mostly affects output through the service sector. Large companies are likely to be affected by financial shocks that takes place outside the region (most likely, in financial centers).

All in all, the results from this Section provide grounds for the view that there is tight relation between the bank-lending channel and real activity, and that such relation is mostly explained by the service sector.

1.4.3 Financial Depth: Evidence

Arguably one might expect that those regions which were using more extensively its financial system are the ones which suffer by the most from any financial turbulence. I test for such hypothesis by mean of an augmented version of equation 1.11. Specifically, I interact the bank-lending channel with a measure of financial depth, namely, the ratio lending to Gross Regional Product at the beginning of the sampling period,

$$\begin{aligned}\frac{\Delta \text{VAT}_{jt-1}}{\text{GRP}_{jt-1}} &= \omega_0 + \omega_{0\kappa}\kappa_{j\text{Fin Depth}} + \omega_{-1}\frac{\Delta \text{VAT}_{jt-1}}{\text{GRP}_{jt-1}} + \omega_{-\kappa}\text{FS}_{jt} \\ &\quad + \omega_{\kappa}\left(\text{FS}_{jt} - \text{FS}_{j}\right) \times \left(\kappa_{j\text{Fin Depth}} - \kappa_{\text{Fin Depth}}\right) + \epsilon_{jt}^{\text{VAT}} ,\end{aligned}$$

where $\kappa_{j\text{Fin Depth}} = \frac{\text{Lending}_{1997}}{\text{GRP}_{1997}}$ and $\omega_{-\kappa}$ has the same interpretation as ω_1 in equation 1.11 (i.e.

the response of $\frac{\Delta \text{VAT}_{jt}}{\text{GRP}_{jt-1}}$ to $(\text{FS}_{jt} - \text{FS}_{j})$ conditioning on $\kappa_{j\text{Fin Depth}} = \kappa_{\text{Fin Depth}}$).[17]

Table 1.6 shows the results of the augmented regressions. There is no evidence that this measure of financial depth implies a tighter relation between the bank-lending channel and output.[18]

1.5 Relation to the literature

My work complements three strands in the literatute of the bank-lending channel. In regards to estimates of the bank-lending channel, papers such as Peek and Rosengren (1997), Kashyap and Stein (2000), and Paravisini (2008) present strong evidence on the existence of a bank-lending channel. However, Bernanke and Lown (1991), using the US recession of early nineteen nineties, show that contractions in lending growth might be accounted for by demand's factor. One contribution of my paper is jointly estimating the bank-lending and regional-borrowing channels and quantifying the individual contribution of each to the overall variance of lending growth.

Driscoll (2004) and Ashcraft (2006) find no relation between the bank-lending channel and output across US states. Peek and Rosengren (2000), provide causal evidence that loan supply shocks affect the real estate sector. Peek et al. (2003), using aggregate data for the US, support the same hypothesis for the GDP. Ashcraft (2005) finds for Texan's counties that bank closures have important effects on output. Using data on VAT, my results support the view that the bank-lending channel has an important effect on output.

Oliner and Rudebusch (1996) and Khwaja and Mian (2008) show that the bank-lending channel affects small firms by the most. This is in consistent with my finding that the service sector, populated by small firms, accounts for the bulk of the relation between the

[17] For a thorough discussion of regressions with interaction effects see Balli and Sørensen (2013).

[18] However, this result is reather preliminary and more measures are being under study.

bank-lending channel and output.

For Argentina, I find that nationwide-banks account for the bulk of the bank-lending channel. As in Amiti ans Weinstein (2013), this finding is in line with the hypothiesis that the banking sector is granular.

1.6 Final Remarks

Using annual data from Argentinean regions for 1998–2004, I provided evidence that supply shocks to bank-lending are highly associated with real activity. Indeed, a 1% increase in the supply of loans (in terms of region's output) is associated with an increase on output of 1.6%. Moreover, the service sector accounts for the bulk (75%) of this result.

I assessed the importance of regional supply shocks to bank-lending into regional borrowing. Common shocks to Argentinean regions explain 68% of the variance of lending growth, while 32% is idiosyncratic to the region. The variance of the latter one is mostly explained (89%) by demand's side factors, but there still is 11% of variation accounted for by regional supply shocks to bank-lending. Lastly, regional supply shocks to bank-lending are fully accounted for by nationwide-banks, providing evidence of granularity in the Argentinean banking sector.

Future work includes extending the present project in two dimensions. First, carrying out instrumental variable estimations for obtaining the causal effect of regional supply shocks to bank-lending on real activity; preliminary results are consistent with the findings discussed in this paper. Second, linking supply shocks to bank-lending to the Argentinean crisis of 2001.

Out of the scope of the present project, a fruitful area for future research is applying the methodology of this work to other developed and developing economies. In particular, assessing the contribution of supply shocks to bank-lending during financial crises seems relevant.

Table 1.1: Descriptive Statistics—Region Level.

Region.	Size.	VAT Share.	$\frac{SD(VAT)}{Mean(VAT)}$.
Buenos Aires	58.9	6.58	13.0
Catamarca	0.70	0.78	32.3
Chaco	0.89	2.02	21.0
Chubut	1.20	1.52	15.1
Córdoba	8.19	3.00	17.1
Corrientes	1.32	0.97	35.9
Entre Ríos	2.06	2.36	15.4
Formosa	0.56	0.75	29.4
Jujuy	0.85	1.03	33.6
La Pampa	0.85	2.37	23.7
La Rioja	0.60	1.71	27.6
Mendoza	3.50	2.05	23.5
Misiones	1.34	1.64	13.1
Neuquén	1.96	1.13	12.2
Río Negro	1.31	1.47	12.0
Salta	1.13	1.34	9.03
San Juan	0.97	1.41	23.4
San Luis	1.16	2.12	18.8
Santa Cruz	1.23	0.63	23.4
Santa Fe	8.19	3.40	15.2
Santiago Del Estero	0.91	0.92	13.2
Tierra Del Fuego	0.74	0.80	32.8
Tucumán	1.27	2.55	9.20
Average (excluding Buenos Aires)	1.86	1.63	20.8

Notes: Size is the ratio between time averages of Gross Regional Product and the aggregate Gross Regional Product. VAT Share is the ratio between the region time averages of the VAT raised and its Gross Regional Product. $\frac{SD(VAT)}{Mean(VAT)}$ is the ratio between the standard deviation of the regional VAT raised and its mean. All the values were calculated for the period 1998-2004. The VAT raised data is from the Federal Administration of Public Revenue Statistics department and the Gross Regional Product is from the database of the Council of Federal Investment. Buenos Aires includes the Ciudad Autónoma of Buenos Aires.

Source: Author's ows calculation based on the Federal Administration of Public Revenue and the Council of Federal Investment data.

Table 1.2: Lending Growth: Variance Decomposition.

Common Component.	Idiosyncratic Component.
68	32

Notes: Variance decomposition of lending growth. Common and Idiosyncratic component are calculated as $\gamma_{\text{OLS}}^{\ell,\overline{\ell}} \frac{\text{var}\left(\overline{\ell}\right)}{\text{var}(\ell)}$ and $\gamma_{\text{OLS}}^{\ell,\widetilde{\ell}} \frac{\text{var}\left(\widetilde{\ell}\right)}{\text{var}(\ell)}$, respectively, where $\gamma_{\text{OLS}}^{\ell,\overline{\ell}}$ and $\gamma_{\text{OLS}}^{\ell,\widetilde{\ell}}$ are the OLS estimates of a regression of ℓ on $\overline{\ell}$ and ℓ on $\widetilde{\ell}$, respectively. ℓ is the change on region lending expressed in terms of Gross Regional Product, $\overline{\ell}$ is the time specific mean of ℓ, and $\widetilde{\ell}$ is $\ell - \overline{\ell}$. Region data on Lending is from the Argentinean Central Bank and Gross Regional Product is from the Council of Federal Investment.

Table 1.3: Idiosyncratic Lending Growth: Variance Decomposition.

Region-Borrowing Channel. (1)	Bank-Lending Channel. (2)	
89	11	
	Nationwide Banks. (a)	Region. (b)
	13	–2

Notes: Variance decomposition of idiosyncratic lending growth. Column (1) is $\gamma_{\text{OLS}}^{\widetilde{\mathscr{b}},\widetilde{\rho\pi}} \frac{\text{var}\left(\widetilde{\rho\pi}\right)}{\text{var}\left(\widetilde{\mathscr{b}}\right)}$, column (2) is the sum of column (2)(a) and column (2)(b). Column (2)(a) and (2)(b) are $\gamma_{\text{OLS}}^{\widetilde{\mathscr{b}},\widetilde{\text{FS}_{\text{N}}}} \frac{\text{var}\left(\widetilde{\text{FS}_{\text{N}}}\right)}{\text{var}\left(\widetilde{\mathscr{b}}\right)}$ and $\gamma_{\text{OLS}}^{\widetilde{\mathscr{b}},\widetilde{\text{FS}_{\text{R}}}} \frac{\text{var}\left(\widetilde{\text{FS}_{\text{R}}}\right)}{\text{var}\left(\widetilde{\mathscr{b}}\right)}$, respectively. $\widetilde{x}$ is $x - \overline{x}$ and $\overline{x}$ is the time specific mean of x. $\mathscr{b}$ is the change on region lending expressed in terms of Gross Regional Product, $\rho\pi$ is the region-borrowing channel, FS_{N} and FS_{R} are the bank-lending channel of banks with nationwide and regional presence, respectively (for details on their constructions see the text). Region data on Lending is from the Argentinean Central Bank and Gross Regional Product is from the Council of Federal Investment.

Table 1.4: Banking Shocks and Aggregate Activity.

	Year Fixed Effects	Year and Region Fixed Effects
Panel A: Dependent Variable: $\frac{\Delta \text{VAT}_{jt}}{\text{GRP}_{jt-1}}$.		
Banking Shock	0.0218***	0.0198**
	(3.17)	(2.51)
Observations	126	126

Notes: Regression coefficient of regressing $\frac{\Delta \text{VAT}_{jt}}{\text{GRP}_{jt-1}}$ on FS_{jt} (after controlling for the lagged dependent variable and year fixed effect, column 1, the lagged dependent variable,year, and region fixed effects, column 2). FS_{jt} is defined as the banking shock (for details on its construction see the text), VAT_{jt} is value added tax raised, and GRP_{jt-1} is the Gross Regional Product, .

t statistics, calculated with robust standard errors, are in parentheses. ***,**, and * denote significance at the 1, 5, and 10 percent levels. respectively.

Table 1.5: Banking Shocks and Aggregate Activity: Sectorial Decomposition—OLS Estimation.

		Year Fixed Effects	Year and Region Fixed Effects
Panel A: Dependent Variable: $\frac{\Delta \text{VAT}_{jt}}{\text{GRP}_{jt-1}}$.			
Service		.0145***	.0134***
		(3.05)	(2.81)
Production		.00588*	.00502
		(1.73)	(1.41)
	Panel A.1: Production Decomposition.		
	Manufactures	.00317	.00420*
		(1.44)	(1.79)
	Construction	−.000130	−.000505
		(−.20)	(−.75)
	Others	.00272	.00115
		(1.25)	(.50)
Observations:		123	

Notes: Regression coefficients of estimating the parameters of equations $\frac{\Delta \text{VAT}_{pjt}}{\text{GRP}_{jt-1}} = \omega_{p0} + \omega_{p-1}\frac{\text{VAT}_{jt-1}}{\text{GRP}_{jt-2}} + \omega_p \text{FS}_{jt} + \tau_{pt} + \epsilon^{\text{VAT}}_{pjt}$ where p belongs to {SERVICE, PRODUCTION, MANUFACTURES, CONSTRUCTION, OTHERS}. Rows 1 to 5 show coefficients ω_p in the same order as they appear in the curly brackets. In column 1, coefficients were estimated controlling for year fixed effect. In Column 2 both year and region fixed effects were included in regressions.

t statistics, calculated with robust standard errors, are in parentheses. ***,**, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 1.6: Banking Shocks, Aggregate Activity and Financial Dependence—OLS Estimations.

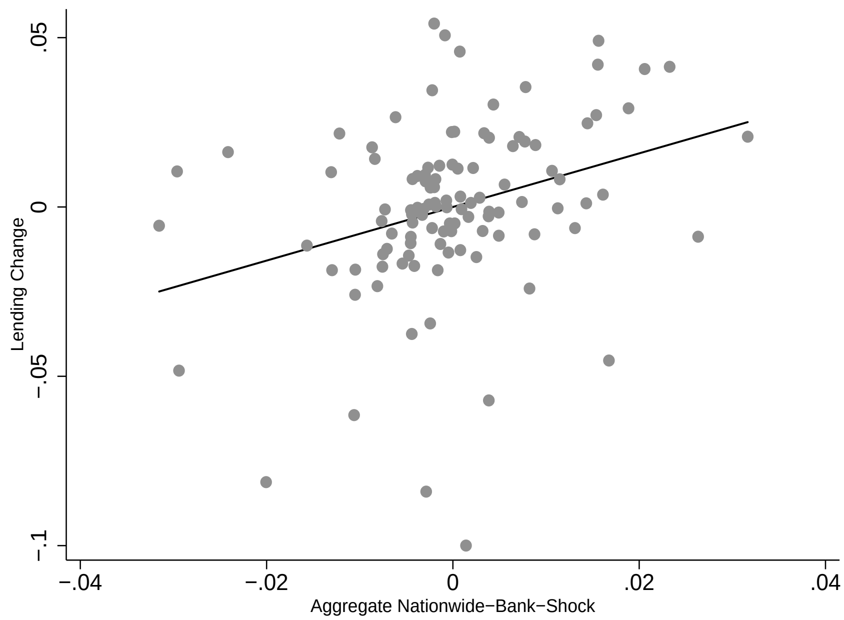
	Year Fixed Effects	Year and Region Fixed Effects
Panel A: Dependent Variable: $\frac{\Delta \text{VAT}_{jt}}{\text{GRP}_{jt-1}}$.		
Banking Shock × Initial-Lending	–.151	–.148
	(–1.56)	(–1.32)
Financial Depth	–.00237	.
	(–0.64)	.
Banking Shock	.0180**	.0193*
	(2.05)	(1.86)
Observations:	132	

Notes: Regression coefficients of estimating the parameters of equations $\frac{\text{GRP}_{jt-1}}{\text{VAT}_{jt-1}} = \omega_0 + \omega_{0\kappa}\kappa_{j\text{Fin Depth}} + \omega_{-1}\frac{\text{VAT}_{jt-1}}{\text{GRP}_{jt-2}} + \omega_{-\kappa}\text{FS}_{jt} + \omega_{\kappa}(\text{FS}_{jt} - \text{FS}_j) \times (\kappa_{j\text{Fin Depth}} - \kappa_{\text{Fin Depth}}) + \epsilon_{jt}^{\text{VAT}}$ after controlling for year fixed effect, column 1, and year and region fixed effects, column 2. Row 1, 2, and 3 show coefficients ω_κ, $\omega_{0\kappa}$, and $\omega_{-\kappa}$, respectively. FS_{jt} is defined as the bank-lending supply shock (for details on its construction see the text), VAT_{jt} is value added tax raised, GRP_{jt-1} is Gross Regional Product and $\kappa_{j\text{Fin Depth}}$ is $\frac{\text{Lending}_{1997}}{\text{GRP}_{1997}}$.

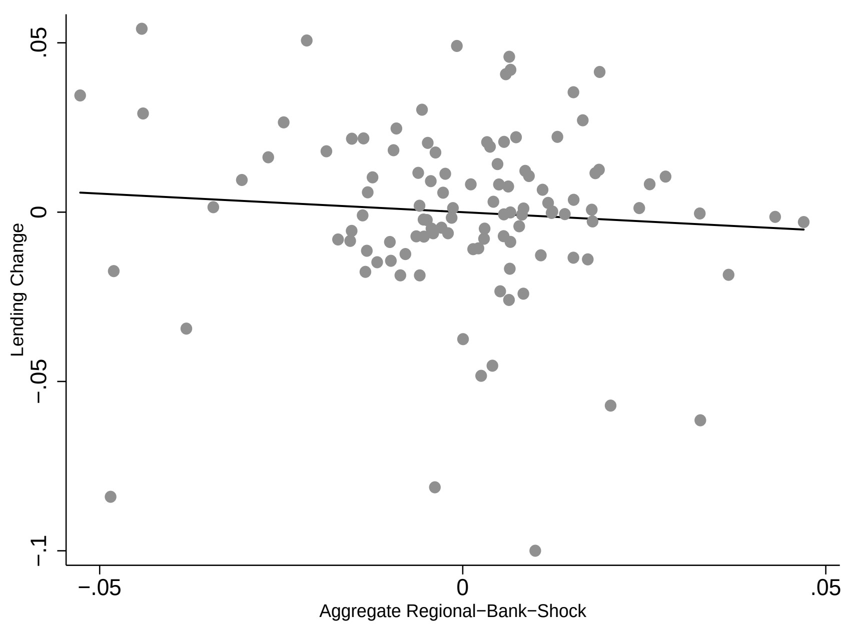
t statistics, calculated with robust standard errors, are in parentheses. ***,**, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Figure 1.1: Partial Correlation: (Changes on) Lending and Aggregate Banking Shocks.

(a) Nationwide-Bank-Shocks.

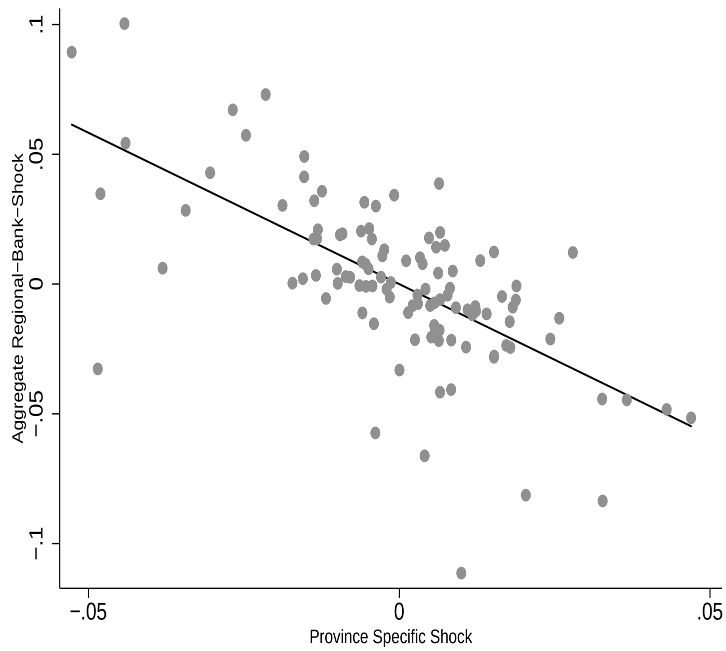


(b) Regional-Bank-Shocks.



Notes: Partial correlations plot (netting out time and region fixed effects) of the change on lending against (a) Aggregate Regional-Bank-Shocks; and (b) Nationwide-Bank-Shocks. All units are expressed in terms of Gross Regional Product. Nationwide-Banks are defined as those operating in at least 15 regions, while Regional-Banks are all the others. Region's data on Lending is from the Argentinean Central Bank and Gross Regional Product is from the Council of Federal Investment. For how the Aggregate Regional and Nationwide-Bank-Shocks were constructed see the text. Source: Author's own calculations based on Argentinean Central Bank and Council of Federal Investment data.

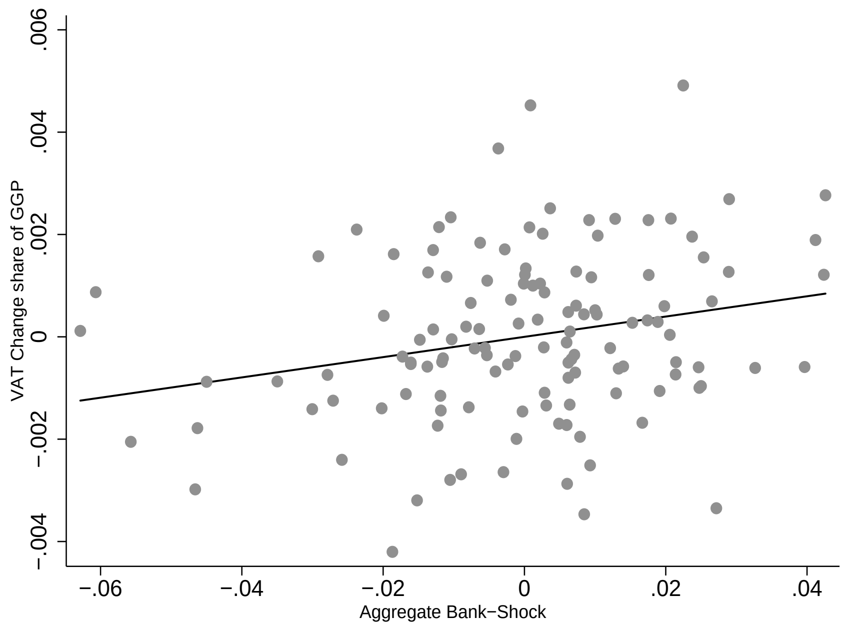
Figure 1.2: Partial Correlation: Region Specific Shocks and Aggregate Regional-Bank-Shocks.



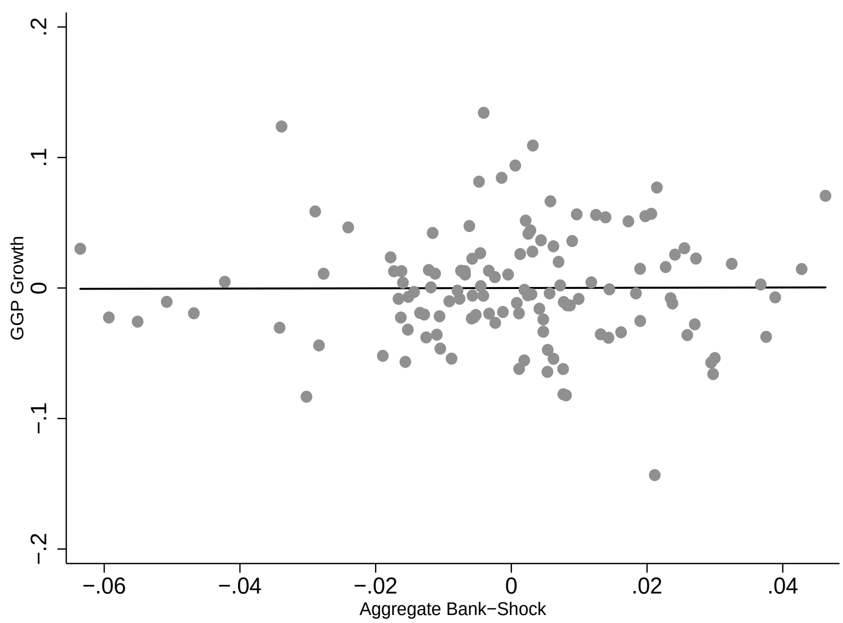
Notes: Partial correlation plot (netting out time and region fixed effects) of Region Specific Shocks against Aggregate Regional-Bank-Shocks. All units are expressed in terms of Gross Regional Product. Regional-Banks are defined as those banks with presence in less than 15 regions. For how the Region Specific Shock and the Aggregate Regional-Bank-Shocks were constructed see the text.

Figure 1.3: Partial Correlation: Output-Banking Shocks.

(a) Change on VAT in terms of Gross Regional Product.



(b) Gross Regional Product Growth.



Notes: Partial correlations plot (netting out time and region fixed effects) of the (a) Change on VAT raised (in terms of Gross Regional Product) on aggregate banking shocks; (b) Gross Regional Product growth on aggregate banking shocks. Gross Regional Product is from the Council of Federal Investment and the VAT raised data is from the Federal Administration of Public Revenue Statistics department. Aggregate banking shocks (in the text FS) is constructed as explained in the text.

Appendix

1.A Variance Decomposition

In this appendix I show the derivation of equation 1.7 and I discuss its relation to the variance decomposition $\text{var}\,(\mathscr{b}) = \text{var}\left(\overline{\mathscr{b}}\right) + \text{var}\left(\widetilde{\mathscr{b}}\right) + 2\,\text{covar}\left(\overline{\mathscr{b}}, \widetilde{\mathscr{b}}\right)$.

Considering

$$\mathscr{b}_{jt} \;=\; \overline{\mathscr{b}_t} + \widetilde{\mathscr{b}_{jt}}\,, \tag{1.A.1}$$

applying the covariance operator to both sides of the equality and after some algebra one obtains

$$\begin{aligned}
\text{var}\,(\mathscr{b}) &= \text{covar}\left(\overline{\mathscr{b}}, \mathscr{b}\right) + \text{covar}\left(\widetilde{\mathscr{b}}, \mathscr{b}\right)\,, \\
1 &= \frac{\text{var}\left(\overline{\mathscr{b}}\right)}{\text{var}\,(\mathscr{b})} \frac{\text{covar}\left(\overline{\mathscr{b}}, \mathscr{b}\right)}{\text{var}\left(\overline{\mathscr{b}}\right)} + \frac{\text{var}\left(\widetilde{\mathscr{b}}\right)}{\text{var}\left(\widetilde{\mathscr{b}}\right)} \frac{\text{covar}\left(\widetilde{\mathscr{b}}, \mathscr{b}\right)}{\text{var}\,(\mathscr{b})}\,,
\end{aligned}$$

which can be written as,

$$1 \;=\; \gamma_{\text{OLS}}^{\mathscr{b},\overline{\mathscr{b}}}\ \frac{\text{var}\left(\overline{\mathscr{b}}\right)}{\text{var}\,(\mathscr{b})} + \gamma_{\text{OLS}}^{\mathscr{b},\widetilde{\mathscr{b}}}\ \frac{\text{var}\left(\widetilde{\mathscr{b}}\right)}{\text{var}\,(\mathscr{b})}\,, \tag{1.A.2}$$

where $\gamma_{\text{OLS}}^{b,\overline{b}}$ and $\gamma_{\text{OLS}}^{b,\widetilde{b}}$ are the OLS estimates of the next equations.

$$b_{jt} \;=\; \alpha + \gamma_{\text{OLS}}^{b,\overline{b}} \; \overline{b}_t + \epsilon_{jt} \, ,$$

$$b_{jt} \;=\; \alpha + \gamma_{\text{OLS}}^{b,\widetilde{b}} \; \widetilde{b}_{jt} + \epsilon_{jt} \, .$$

Equation 1.A.2 relates to the decomposition $\text{var}\,(b) = \text{var}\left(\overline{b}\right) + \text{var}\left(\widetilde{b}\right) + 2\,\text{covar}\left(\overline{b}, \widetilde{b}\right)$ in the following manner.

Arbitrarily allocating shares of $2\,\text{covar}\left(\overline{b}, \widetilde{b}\right)$ to $\overline{b}$ and $\widetilde{b}$, the variance of b turns out

$$\text{var}\,(b) \;=\; \left(\text{var}\left(\overline{b}\right) + \alpha\,2\,\text{covar}\left(\overline{b}, \widetilde{b}\right)\right) + \left(\text{var}\left(\widetilde{b}\right) + (1-\alpha)\,2\,\text{covar}\left(\overline{b}, \widetilde{b}\right)\right) \, .$$

Applying covariance operator's properties and using Equation 1.A.1, the variance of b is

$$\begin{aligned} \text{var}\,(b) &= \text{covar}\left(\overline{b}, \overline{b} + \alpha\,2\,\widetilde{b}\right) + \text{covar}\left(\widetilde{b}, \widetilde{b} + (1-\alpha)\;2\,\overline{b}\right) \\ &= \text{covar}\left(\overline{b}, b - (1-\alpha\,2)\widetilde{b}\right) + \text{covar}\left(\widetilde{b}, b + (1-\alpha\,2)\,\overline{b}\right) . \end{aligned}$$

Finally, applying back covariance operator's properties, one obtains

$$\text{var}\,(b) = \text{covar}\left(\overline{b}, b\right) - (1-\alpha\,2)\text{covar}\left(\overline{b}, \widetilde{b}\right) + \text{covar}\left(\widetilde{b}, b\right) + (1-\alpha\,2)\,\text{covar}\left(\widetilde{b}, \overline{b}\right) . \quad (1.A.3)$$

Hence, whenever α is not chosen equal to $\frac{1}{2}$, the actual weight of both $\widetilde{b}$ and $\overline{b}$ on b are arbitrarily modified by the choice of α. Thus, the only value of α consistent with quation 1.A.2 is $\frac{1}{2}$.

Chapter 2

Supply Shocks to Bank-Lending and Real Activity: Evidence from Argentinean Regions (with Sebnem Kalemli-Ozcan and Bent Sørensen)

2.1 Introduction

"The weather soon turned cold. All the food lying in the field was covered with a thick white blanket of snow that even the grasshopper could not dig through. Soon the grasshopper found itself dying of hunger. He staggered to the ants' hill and saw them handing out corn from the stores they had collected in the summer. He begged them for something to eat. What! cried the ants in surprise, haven't you stored anything away for the winter? What in the world were you doing all last summer? I didn't have time to store any food, complained the grasshopper; I was so busy playing music that before I knew it the summer was gone." Aesop.

Economic agents often rely on pro-cyclical saving to smooth consumption. As Aesop's fable suggests, lack of saving in good times may hamper consumption smoothing in bad times. This article attempts to quantify if, and how, aggregate consumption in EU countries was buffered from output fluctuations in the 1990–2010 period, with a focus on the recent European crisis.

We provide a metric for risk sharing, which we also refer to as consumption smoothing, starting from the Arrow-Debreu one-good benchmark model of consumers with identical Constant Relative Risk Aversion utility functions having access to complete financial markets. The benchmark model's key prediction is that consumption in each country is a constant share of aggregate world consumption.[1] An implication is that consumption growth rates in all countries are equal to the growth rate of world consumption and we take this implication as the definition of perfect risk sharing in this paper. Under perfect risk sharing, the consumption growth of individual countries should be orthogonal to other factors, conditional on world consumption growth.

Starting with Mace (1991), who consider households, the literature generally tests whether or not consumption growth rates are orthogonal to income growth of income conditional on

[1]See Obstfeld and Rogoff (1996) for a lucent exposition.

aggregate consumption. At the country level, Obstfeld (1994) perform similar regressions, testing whether consumption is orthogonal to GDP growth and other variables, conditional on world consumption growth, while a parallel literature, starting with the influential work of Backus, Kehoe, and Kydland (1992), compares correlations of consumption growth and output growth with those derived from a more general model with labor-leisure choice and investment and similarly concludes that the complete markets model does not match the empirical data.[2]

The early literature tests the existence of full risk sharing against the null of none while we are interested in evaluating the amount of risk sharing. To do so, we follow the methodology of Asdrubali, Sørensen, and Yosha (1996) and Sørensen and Yosha (1998), who undertake a variance decomposition of shocks to GDP in order to discover the amount of risk sharing achieved via various channels, such as governments versus markets.[3] We calculate how much of a shock to GDP is absorbed by various components of saving, in particular government saving, and other channels, such as net foreign factor income for the sub-periods 1990–2007, 2008–2009, and 2010. We find that, overall, risk sharing in the EU was significantly higher during 2008–2009 than it was during the earlier period, but total risk sharing more or less collapsed in 2010.[4]

We study how the crisis affected risk sharing for "PIIGS" countries (Portugal, Ireland, Italy, Greece, and Spain), which were at the center of the sovereign debt crisis, compared to

[2]See Lewis (1996) and Coeurdacier and Rey (2012) for extensive reviews of this literature.

[3]It is possible to translate the deviations from full risk sharing into measures of welfare lost, see Van Wincoop (1999) and Kalemli-Ozcan, Sørensen, and Yosha (2001); however, such measures are extremely sensitive to the degree of persistence in output shocks, which is hard to estimate precisely.

[4]Sørensen and Yosha (1998) find country-level risk sharing provided by markets to be low 1966-1990 while Asdrubali, Sørensen, and Yosha (1996), who are the first to decompose risk sharing into channels such as market-provided and government-provided risk sharing, find that markets provide more risk sharing (about 40 percent) than the federal government (about 15 percent) for U.S. states 1963–1990. Kalemli-Ozcan, Sørensen, and Yosha (2003) show that markets provide a similar amount of risk sharing within European countries (such as regions of Italy and regions of Germany), but much less (around 5 percent) between EU countries before the introduction of euro. Kalemli-Ozcan, Sørensen, and Yosha (2005) show that risk sharing among European Union (EU) countries increased in step with the introduction of the euro for the Euro-zone countries.

non-PIIGS countries (Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom).[5] For 1990–2009, risk sharing was mainly due to procyclical government saving but the amount of risk sharing from government saving turned negative in 2010 for the PIIGS-countries: government saving increased at the same time as GDP decreased. For these countries our measure of overall risk sharing turns negative because (conditional on world consumption growth) the decline in GDP in 2010 was accompanied by a more than proportional decline in consumption. This mirrors the behavior of emerging economies where government saving typically is counter-cyclical as shown by Kaminsky, Reinhart, and Végh (2005).

If Ricardian equivalence holds, with private saving off-setting government saving one-to-one, the distinction between government and private saving should not matter. We do not rigorously test if Ricardian equivalence holds, but if consumption smoothing from private saving does not fully offset changes in consumption smoothing from government saving, it indicates that it does not hold.[6]

We present the methodology in Section 2, followed by a description of the data in Section 3. Section 4 reports on the empirical analysis and Section 5 concludes.

[5]Ireland is in some dimensions different, with government deficits mainly the results of banking failures, and hence a previous version of the paper did not include Ireland among the PIIGS; however, the results are broadly robust to this choice.

[6]Ricardian equivalence holds under quite restrictive assumptions—non-distortionary lump-sum taxes, fully developed financial markets, infinite horizons, and full information about future levels of income, government spending and rates of return as highlighted in Barro (1999). Barro (1999) mentions, in addition to distortionary taxes, that a key reason why equivalence may fail is the existence of a large amount of debt which can influence governments' incentives to default on outstanding obligations, disconnecting saving decisions between private and government sectors. Both of these conditions are relevant for Europe. Loayza, Schmidt-Hebbel, and Serven (2000) reject Ricardian equivalence for a wide range of countries.

2.2 Methodology: Measuring Channels of Risk-Sharing

Following Sørensen and Yosha (1998), we perform an accounting exercise which quantifies the fractions of cross-sectional variance in GDP absorbed by wedges between GDP and consumption. We take GDP growth to be exogenous although this is not crucial because our regressions are not structural.[7]

Consider the identity

$$\mathbf{GDP}_i = \frac{\mathbf{GDP}_i}{\mathbf{GNI}_i}\,\frac{\mathbf{GNI}_i}{\mathbf{NI}_i}\,\frac{\mathbf{NI}_i}{\mathbf{NNDI}_i}\,\frac{\mathbf{NNDI}_i}{\mathbf{CONS}_i}\,\mathbf{CONS}_i\ , \tag{2.2.1}$$

where **GNI** (gross national income) is GDP plus net factor income from abroad, **NI** (net national income) is gross national income minus depreciation, **NNDI** (net disposable income) is net national income plus net transfers from abroad, while **CONS** (total consumption, private plus government) is net disposable income minus saving. All the magnitudes are in per capita terms, and i is an index of countries. To stress the cross-sectional nature of our derivation, we suppress the time index.

Defining GDP_{it}, GNI_{it}, NI_{it}, NNDI_{it}, and CONS_{it} as the log of country i's year t per capita GDP, gross national income, net national income, net national disposable income, and consumption, respectively. By taking logs and differences, multiplying by Δ_{GDP} (minus its mean), and taking the cross-sectional average on both sides of equation 2.2.1, we obtain the variance decomposition

$$\begin{aligned}\text{var}\{\Delta_{\text{GDP}}\} \quad = \quad & \text{cov}\{\Delta_{\text{GDP}} - \Delta_{\text{GNI}}, \Delta_{\text{GDP}}\} \\ & + \ \text{cov}\{\Delta_{\text{GNI}} - \Delta_{\text{NI}}, \Delta_{\text{GDP}}\} \\ & + \ \text{cov}\{\Delta_{\text{NI}} - \Delta_{\text{NNDI}}, \Delta_{\text{GDP}}\}\end{aligned}$$

[7]This approach is similar to that of growth and development accounting which parse GDP growth into contributions from physical and human capital as suggested by Solow (1957).

$$+ \ \mathrm{cov}\{\Delta_{\mathrm{NNDI}} - \Delta_{\mathrm{CONS},\,\Delta\mathrm{GDP}}\}$$

$$+ \ \mathrm{cov}\{\Delta_{\mathrm{CONS},\,\Delta\mathrm{GDP}}\}\ .$$

In this equation, "var{X}" and "cov{X,Y}" denote the statistics $\frac{1}{N}\sum_{i=1}^{N}(\mathrm{X}_i - \bar{\mathrm{X}})^2$ and $\frac{1}{N}\sum_{i=1}^{N}(\mathrm{X}_i - \bar{\mathrm{X}})(\mathrm{Y}_i - \bar{\mathrm{Y}})$, respectively, where N is the number of countries in the sample. Dividing by $\mathrm{var}\{\Delta_{\mathrm{GDP}}\}$ we get

$$1 = \beta_f + \beta_d + \beta_\tau + \beta_s + \beta_u\ ,$$

where, for example,

$$\beta_f = \frac{\mathrm{cov}\{\Delta_{\mathrm{GDP}} - \Delta_{\mathrm{GNI}}, \Delta_{\mathrm{GDP}}\}}{\mathrm{var}\{\Delta_{\mathrm{GDP}}\}}\ ,$$

is the ordinary least squares estimate of the slope in the cross-sectional regression of $\Delta_{\mathrm{GDP}} - \Delta_{\mathrm{GNI}}$ on Δ_{GDP}, and similarly for β_d, β_τ, and β_s. The last coefficient in the decomposition is given by

$$\beta_u = \frac{\mathrm{cov}\{\Delta_{\mathrm{CONS},\Delta\mathrm{GDP}}\}}{\mathrm{var}\{\Delta_{\mathrm{GDP}}\}}\ ,$$

which is the ordinary least squares estimate of the slope in the cross-sectional regression Δ_{CONS} on Δ_{GDP}.

If there is full risk sharing, $\mathrm{cov}\{\Delta_{\mathrm{CONS},\,\Delta\mathrm{GDP}}\} = 0$, and hence $\beta_u = 0$. If full risk sharing is not achieved, consumption in country i varies positively with idiosyncratic shocks to country i's output and $\beta_u > 0$. A cross-sectional regression of consumption on output, controlling for fluctuations in world consumption is, therefore, a test of full risk sharing.[8] The other coefficients quantify the role of the relevant wedges in bringing consumption closer to the Arrow-Debreu benchmark and we will use the more intuitive terminology that these coefficients measure the contributions from various "channels of consumption smoothing." "Smoothing" from depreciation, which is mainly imputed, is not very interesting but be-

[8]This is precisely the test suggested by Mace (1991).

cause it is the wedge between gross national income and net national income, it is included in order to have a full decomposition. We show below that saving is the main channel of consumption smoothing, as found for an earlier sample of European countries by Sørensen and Yosha (1998), and one focus of the present article is to decompose the contribution from saving into contributions from private (corporate plus household) saving and government saving. Government saving provides risk sharing if it increases when GDP increases and decreases when GDP decreases and the same holds for private saving.

We perform panel regressions of the form:

$$\begin{aligned}
\Delta \text{GDP}_{it} - \Delta \text{GNI}_{it} &= \alpha_f^t + \beta_f \Delta \text{GDP}_{it} + \epsilon_{itf} , \\
\Delta \text{GNI}_{it} - \Delta \text{NI}_{it} &= \alpha_d^t + \beta_d \Delta \text{GDP}_{it} + \epsilon_{itd} , \\
\Delta \text{NI}_{it} - \Delta \text{NNDI}_{it} &= \alpha_\tau^t + \beta_\tau \Delta \text{GDP}_{it} + \epsilon_{it\tau} , \\
\Delta \text{NNDI}_{it} - \Delta \text{CONS}_{it} &= \alpha_s^t + \beta_s \Delta \text{GDP}_{it} + \epsilon_{its} , \\
\Delta \text{CONS}_{it} &= \alpha_u^t + \beta_u \Delta \text{GDP}_{it} + \epsilon_{itu} .
\end{aligned}$$

As shown by Asdrubali, Sørensen, and Yosha (1996), the coefficients estimated in the panel regression with time fixed effects equal weighted averages of the coefficients of year-by-year cross-sectional regressions and the coefficients therefore have the interpretation outlined in the variance decomposition. The first regression, to pick one, can alternatively be written as

$$-\Delta \log(1 + \frac{\mathbf{NFI}_{it}}{\mathbf{GDP}_{it}}) = \alpha_f^t + \beta_f \Delta \text{GDP}_{it} + \epsilon_{itf} ,$$

which highlights how income smoothing, if positive, is obtained through counter-cyclical foreign net factor income ($\mathbf{NFI} = \mathbf{GNI} - \mathbf{GDP}$), while the next-to-last equation can be written as

$$\Delta \log(1 + \frac{\mathbf{S}_{it}}{\mathbf{CONS}_{it}}) = \alpha_s^t + \beta_s \Delta \text{GDP}_{it} + \epsilon_{its} ,$$

which highlights how consumption smoothing, if positive, is obtained through pro-cyclical total saving (**S** = **NNDI** −**CONS**).

It is hard to benchmark the optimal degree of saving in the face of the shocks which materialized in the Great Recession. Saving in good times and dis-saving in bad times is a form of "self-insurance" against consumption fluctuations but the optimal amount of saving depends, from the point of view of models of forward-looking consumers, on the persistence of income shocks. The standard PIH model implies that it is optimal to not smooth random walk shocks while i.i.d. (temporary) income shocks should be mainly absorbed by saving. In this paper, we are agnostic about why saving does or does not smooth consumption.[9]

If consumption (gross national income, etc.) is measured with error, this error may migrate to GDP (and other national account components) leading to upward bias in the coefficient to consumption; i.e., to an underestimate of risk sharing. We believe that this is not a serious issue as GDP to a large extent is measured from the income side, and we believe that government saving, which is one of our main foci, is not measured with error because government budgets are public and subject to outside scrutiny.

The coefficient β_f measures risk sharing from net income from abroad, with a negative estimate indicating dis-smoothing, β_d measures risk sharing from depreciation, β_f measures risk sharing from international transfers, and β_s measures risk sharing from net saving. β_u measures the fraction of GDP shocks reflected in consumption; i.e., the fraction of risk un-smoothed. The regressions all have the same regressor and therefore constitute a SURE

[9]Models such as those of Blundell, Pistaferri, Preston (2008) and Heathcote, Storesletten, Violante (2012), typically allow for income as being composed of a mix of random walk shocks and i.i.d. shocks. More complicated models which allow for credit constraints and large non-divisible durables such as housing, predict a more gradual adjustment to random walk shocks; see Luengo-Prado and Sørensen (2008). However, it is hard to sort out the degree of persistence of shocks in a short panel of aggregate data. As in Attanasio and Davis (1996), a long time dimension is needed to sort out the structure of income shocks. Using the same framework as the present article and much longer time series, Asdrubali, Sørensen, and Yosha (1996) show that U.S. states with more persistent income shocks rely more on smoothing via capital markets and less on smoothing via saving. This pattern agrees with the broad predictions of forward looking consumer models.

regression, where single equations estimation gives the same result as a system regression. We can therefore "zoom in" on, in particular, saving by estimating the impact of saving, or saving components, alone without changing any interpretation of the results.

We estimate panel data regressions with GDP shocks interacted with dummy variables for particular time periods in order to examine if the coefficients vary over time. We display the regression equations for consumption only (other equations follow the same approach in an obvious fashion):

$$\Delta\text{CONS}_{it} = \alpha_u^t + \beta_u^{90-07}\,\Delta\text{GDP}_{it} \times \text{P}^{90-07} + \beta_u^{08-09}\,\Delta\text{GDP}_{it} \times \text{P}^{08-09} + \beta_u^{10}\,\Delta\text{GDP}_{it} \times \text{P}^{10} + \epsilon_{itu}\ ,$$

where the dummy variables P^{90-07}, P^{08-09}, and P^{10} take the value unity for the years 1990–2007, 2008–2009, and 2010, respectively, and zero otherwise.

We further allow the coefficient to vary between PIIGS and non-PIIGS, by estimating the regression

$$\begin{aligned}\Delta\text{CONS}_{it} = {} & \alpha_u^t + \alpha_u^{\text{PIIGS}}\text{D}^{\text{PIIGS}} + \alpha_u^{\text{NPIIGS}}\text{D}^{\text{NPIIGS}} + \beta_u^{\text{PIIGS}\ 90-07}\,\Delta\text{GDP}_{it} \times \text{P}^{90-07} \times \text{D}^{\text{PIIGS}} + \\ & + \beta_u^{\text{PIIGS}\ 08-09}\,\Delta\text{GDP}_{it} \times \text{P}^{08-09} \times \text{D}^{\text{PIIGS}} + \beta_u^{\text{PIIGS}\ 10}\,\Delta\text{GDP}_{it} \times \text{P}^{10} \times \text{D}^{\text{PIIGS}} + \\ & + \beta_u^{\text{NPIIGS}\ 90-07}\,\Delta\text{GDP}_{it} \times \text{P}^{90-07} \times \text{D}^{\text{NPIIGS}} + \beta_u^{\text{NPIIGS}\ 08-09}\,\Delta\text{GDP}_{it} \times \text{P}^{08-09} \times \text{D}^{\text{NPIIGS}} + \\ & + \beta_u^{\text{NPIIGS}\ 10}\,\Delta\text{GDP}_{it} \times \text{P}^{10} \times \text{D}^{\text{NPIIGS}} + \epsilon_{itu}\ ,\end{aligned}$$

where D^{PIIGS} takes the value unity for Portugal, Ireland, Italy, Greece, and Spain and zero otherwise, while D^{NPIIGS} takes the value unity for Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom, and zero otherwise.

The amount of smoothing obtained from pro-cyclical saving, β_s, can be broken down into smoothing obtained via government and private (personal plus corporate) saving. In order to make the breakdown independent of the order in which we consider these components of saving, we linearize. The OLS formula for the coefficient is $\beta_s = \frac{\text{cov}(\Delta_{\text{NNDI}} - \Delta_{\text{CONS}}; \Delta_{\text{GDP}})}{\text{var}(\Delta_{\text{GDP}})}$. Now consider

$$\Delta_{\text{NNDI}} - \Delta_{\text{CONS}} = \Delta \log \left(1 + \frac{\mathbf{s}}{\mathbf{CONS}}\right) \approx \frac{\mathbf{s}}{\mathbf{CONS}} \ ,$$

Define $\mathbf{s}^{\text{Priv}}$ and $\mathbf{s}^{\text{Gov}}$ as private and government net saving, respectively, then $\mathbf{s} = \mathbf{s}^{\text{Priv}} + \mathbf{s}^{\text{Gov}}$ and

$$\beta_s \approx \frac{\text{cov}\left(\Delta \frac{\mathbf{s}}{\mathbf{CONS}}; \Delta_{\text{GDP}}\right)}{\text{var}\left(\Delta_{\text{GDP}}\right)} \ ,$$

$$= \frac{\text{cov}\left(\Delta \frac{\mathbf{s}^{\text{Priv}}}{\mathbf{CONS}}; \Delta_{\text{GDP}}\right)}{\text{var}\left(\Delta_{\text{GDP}}\right)} + \frac{\text{cov}\left(\Delta \frac{\mathbf{s}^{\text{Gov}}}{\mathbf{CONS}}; \Delta_{\text{GDP}}\right)}{\text{var}(\Delta_{\text{GDP}})} \ ,$$

$$= \beta_{Priv} + \beta_{Gov} \ .$$

where β_{Priv} and β_{Gov} estimate the fraction (of GDP shocks) insured through pro-cyclical private and government saving, respectively. We estimate those coefficients by running the following panel data regressions with time-fixed effects:

$$\Delta \frac{\mathbf{s}_{it}^{\text{Priv}}}{\mathbf{CONS}_{it}} = \alpha_{Priv}^{t} + \beta_{Priv} \Delta_{\text{GDP}_{it}} + \epsilon_{itPriv} \ ,$$

$$\Delta \frac{\mathbf{s}_{it}^{\text{Gov}}}{\mathbf{CONS}_{it}} = \alpha_{Gov}^{t} + \beta_{Gov} \Delta_{\text{GDP}_{it}} + \epsilon_{itGov} \ .$$

2.3 Data

The main source of data for this study is the OECD. GDP, gross national income, net national disposable income, (government plus private) consumption, and private and government saving are from the annual national accounts main aggregates, detailed tables, and simplified accounts sections; CPI and nominal exchange rates are from the prices and purchasing power parities statistics, while the population of the countries are from the demography and population statistics. In order to make our data comparable across countries and time, GDP, national income, disposable income, consumption, and private and government saving are transformed to real per capita 2005 dollars.

Net government and external debt are from the World Economic Outlook (WEO) and the European Central Bank (ECB). In particular, government debt is net government debt (percentage of GDP) from the WEO, where this variable is defined as gross debt of the general government sector minus its financial assets in the form of debt instruments.[10] External debt is the outstanding amount on the financial account of the balance of payments statistics at the end of the fourth quarter of each year from the ECB data warehouse.[11]

[10]The WEO defines general government gross debt as all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future (this includes debt liabilities in the form of SDRs, currency and deposits, debt securities, loans, insurance, pensions and standardized guarantee schemes, and other accounts payable). In addition, financial assets in the form of debt instruments include currency and deposits, debt securities, loans, insurance, pension, and standardized guarantee schemes, and other accounts receivable.

[11]The series were incomplete for France and Belgium, in both cases we fill the missing values with data from Lane and Milesi-Ferretti (2007) (http://www.philiplane.org/EWN.html).

2.4 Empirical Analysis

2.4.1 Descriptive Statistics

Table 2.1 shows net government and net external debt by country. As expected, the PIIGS are heavily indebted, with Greece having government debt equal to 144 percent of GDP and Italy having debt roughly similar to GDP in 2010. Spain's net debt is lower than that of many non-PIIGS. This indicates that the level of debt is just one of several factors determining sovereign debt crises as also highlighted by Reinhart and Rogoff (2009). Net external debt is at the level of GDP for Greece, Portugal, and Spain, but much lower at 24 percent for Italy. Ireland has external debt of about 84 percent of GDP in 2010 but had low government debt before the crisis hit: 21 percent pre-2008 and 33 percent in 2008–2009; however, Irish net government debt ballooned to 75 percent of GDP in 2010 because of large government bailouts of banks. The level of net government debt varies widely between the non-PIIGS from –65 percent of GDP in Finland in 2010 to 79 percent in Belgium in 2010. Net external debt is low for all non-PIIGS, with Belgium's net foreign assets (negative debt) at 64 percent of GDP in 2010.

2.4.2 Graphical exposition

Our story can roughly be told from figures. Figures 2.1a and 2.1b consider PIIGS and non-PIIGS, respectively, for the years after 2000. We display GDP growth in percent year-by-year and split it into the change in consumption (as a share of GDP), which we with a slight abuse of language interpret as risk not shared, and the remainder, which we interpret as the fraction of GDP risk shared. The figures do not literally tell a story about risk sharing because there is no adjustment for the aggregate non-insurable component, but the prima facie evidence displayed holds up in the empirical analysis in the next sub-section.

From the figures, most risk is not shared, although non-PIIGS countries shared a non-negligible amount of risk during 2000–2007 while the PIIGS shared little risk in those years: in the good year 2005, consumption increased faster than GDP leading to "negative risk sharing." In 2008 and 2009 the major amount of GDP risk is shared for non-PIIGS with low consumption growth rates in spite of large drops in GDP, with the amount of risk shared in 2008 over 100 percent (positive consumption growth in spite of negative GDP growth). For the PIIGS, consumption declined very little in 2008 in spite of a large drop in GDP, while the drop in GDP in 2009 clearly led to declining consumption and, in 2010, consumption fell by almost as much as GDP, indicating little risk sharing.

Figures 2.2a and 2.2b decompose GDP growth into changes in foreign net factor income, private saving, government saving, and consumption—all as shares of GDP, so that these components add up to GDP. Shares which are on the same side of the X-axis as GDP growth contributes to consumption smoothing. We see, for non-PIIGS, the dominant role of government saving in smoothing consumption, with negative saving during 2001–2003 and 2008–2009, and positive saving 2004–2007. Government saving is positive in 2010, reflecting budget tightening in response to heavy government debt burdens, but very close to zero. Private saving visibly buffered GDP shocks for the non-PIIGS countries during 2008–2009 and absorbed most of the GDP growth in 2010. For the PIIGS, almost all risk sharing during 2008 and 2009 was provided by governments, which increased deficits while private saving increased in 2009 dis-smoothing GDP shocks. In 2010, where GDP growth was negative for the PIIGS, the sovereign debt crisis forced government saving to dis-smooth as the governments tightened budgets dramatically and risk sharing was basically only provided by private saving in 2010. For PIIGS, net foreign factor income also provided some consumption smoothing in 2010.

Figures 2.3a and 2.3b display the evolution of net government debt and net external (foreign) debt for PIIGS and non-PIIGS. It is immediately apparent that the governments of PIIGS countries have been more heavily indebted for the full period and, in particular since

2007, the indebtedness of PIIGS has increased rapidly. Regarding net external debt, the two groups of countries were at similar debt levels in year 2000 but, while net foreign debt has dwindled to nil for the non-PIIGS, it has steadily increased for the PIIGS. In 2010, government debt of PIIGS is over 90 percent and net foreign debt is about 80 percent. This is a typical sovereign debt scenario where a heavy government debt burden is reflected in heavy net foreign indebtedness.

Figures 2.4a and 2.4b show how international capital flows (defined here as minus the current account balance), for PIIGS in particular, are dominated by debt flows. It is clear that before the crisis, during 2001–2007, the increased degree of financial integration helped channel funds from the European core to, in particular, Portugal, Ireland, Greece, and Spain as these countries experienced booms in productivity. However, most of the capital flows were in the form of debt. When the Great Recession hit, capital flows declined while government debt flows ballooned.

2.4.3 Regression analysis

Table 2.2 reports on channels of risk sharing by the chosen sub-periods. The top panel displays averages across all countries while the bottom panel displays results for PIIGS and non-PIIGS. For the 1990–2007 period, net factor income from abroad in the top panel is insignificant at 5 percent. Net factor income is a function of cross-ownership of financial assets—the type of risk sharing that matches up best with the stylized Arrow-Debreu model. We do not here separate out interest payments on government debt from dividends and private interest income, but we believe that the lack of private ownership across national borders results in low risk sharing among the members the European Monetary Union in contrast to U.S. states for which income smoothing is very significant at about 40 percent and increasing slowly over time according to Asdrubali, Sørensen, and Yosha (1996). At the country level, Sørensen and Yosha (1998) similarly find no significant risk sharing from net factor income flows pre-1990. Splitting the sample into PIIGS and non-PIIGS, factor income flows significantly smoothed consumption for PIIGS before 2007 while providing insignificant risk sharing for non-PIIGS. This likely reflects that the PIIGS had relatively high growth before 2007 at the same time that dividends and interest payments from the PIIGS were high as a result of large inflows of capital after these countries joined the Euro zone.[12]

Our point estimates indicate that net factor income provides economically important (12 percent) positive risk sharing for non-PIIGS since 2007 although the sample is too short to obtain statistical significance. For the PIIGS, net factor income flows provided little smoothing during 2008–2009 but the estimate turns negative at 13 percent for 2010—this point estimate is not statistically significant, reflecting that the estimate is based on 5 observations, but it is believable that higher interest payments on government debt held abroad led to an unwelcome outflow of capital income at a time where GDP declined.[13]

Depreciation provides a fair amount of dis-smoothing, in that depreciation is an expense which is roughly constant so when GDP goes up this expense becomes a smaller fraction of GDP, which our metric measures as dis-smoothing and *vice versa* when GDP goes down. This channel is mechanical and not of much interest but is included in order to have all wedges between GDP and consumption. International transfers are not large enough to provide significant risk sharing.

Our focus in this paper is on the role of saving, because saving is such a large proportion of GDP, and because saving displayed such large variation during the crisis years that we are able to obtain statistically significant estimates. Before the Great Recession, saving absorbed

[12]Kalemli-Ozcan, Sørensen, and Yosha (2005) find that risk sharing from foreign factor income turns significantly positive in the Euro area around the time of the introduction of the Euro.

[13]This result is a little unexpected because aggregate net factor income was positive for the PIIGS in 2010 according to Figure 2. However, Figure 2 does not control for time fixed effects (year-by-year "world averages"). Also, large countries will dominate the aggregates in Figure 2, but affect the regression less strongly.

49 percent of shocks and this increased slightly to 52 percent in 2008–2009 before pulling back to 33 percent in 2010. This leaves a substantial amount of variation un-smoothed: 53 percent before the Great Recession, falling to 40 percent during 2008–2009, and 86 percent in 2010. Before 2008, PIIGS smoothed about 30 percent of GDP shocks through saving while non-PIIGS smoothed a substantial 60 percent. During 2008–2009, smoothing through saving declined slightly to 57 percent among non-PIIGS while rising to 47 percent for the PIIGS. Nonetheless, only an insignificant 16 percent was un-smoothed for the non-PIIGS while 51 percent of shocks went un-smoothed for PIIGS 2008–2009. However, as the sovereign crises raised it ugly head, risk sharing collapsed among the PIIGS mainly due to the collapse of pro-cyclical saving; indeed for the PIIGS each percent decline in GDP in 2010 was accompanied by a more than one percent decline in consumption while the fraction un-smoothed for non-PIIGS was 45 percent.

Is the collapse in risk sharing due to changes in the behavior of government or private saving? Table 3 shows that government saving for non-PIIGS absorbed 46 percent of GDP shocks before the crisis while private saving absorbed 14 percent. For PIIGS, private saving smoothed 16 percent of shocks, similar to the results for non-PIIGS, while risk sharing from government saving was 15 percent, low compared to the non-PIIGS, indicating that the government surpluses of the fast growing PIIGS were not very high. In 2008–2009, as GDP fell, PIIGS governments dis-saved to the extent that government dis-saving absorbed 73 percent of the fall in GDP (after controlling for the aggregate un-smoothable component) while government dis-saving absorbed 38 percent of shocks among the non-PIIGS. Among the PIIGS, private saving increased as GDP fell, leading to a negative contribution to risk sharing, partly off-setting the governments dis-saving while for non-PIIGS the contribution was private saving was roughly unchanged at 19 percent (although statistically insignificant). In 2010, risk sharing from government saving declined to an insignificant 17 percent for non-PIIGS as government saving was positive but negligible, as shown in Figure 2, but positive private saving helped smooth consumption significantly. For PIIGS in 2010, private dis-saving provided substantial consumption smoothing at 57 percent; however, positive government saving resulted in significant dis-smoothing at minus 38 percent. This brings home the main point of our paper: government budgets can not provide substantial smoothing over long and deep recessions unless governments save in advance. This contrasts to risk sharing through cross-ownership of stocks—foreign investors will share the risk of falling stock values, but this does not in general lead to debt spirals where high debt leads to risk of sovereign default which leads to higher interest payments which leads to increasing debt and so on.

Table 2.4 explores, using the national account identity, $\text{S} = \text{CA} + \text{I} - \delta \text{K}$, where CA is the surplus on the current account and $\text{I} - \delta \text{K}$ is net investment, how the "uses" of saving—domestic physical investment or cross-border asset purchases—contributed to consumption smoothing. For non-PIIGS, self-insurance, in the form of pro-cyclical real investment at home, provided substantial risk sharing before the Great Recession at 46 percent, while procyclical current account surpluses provided less, but still statistically significant, smoothing at 14 percent. In the 2008–2009 Great Recession years, these channels contributed about equally with high significance, with 32 percent of the GDP decline offset by declining current accounts and 25 percent by investment. For 2010, for the non-PIIGS, smoothing via the current account was not significant, although the point estimate is numerically large but negative. Procyclical real investment absorbed 86 percent of GDP growth for the non-PIIGS in 2010. For the PIIGS, the current account surplus dis-smoothed consumption by being countercyclical before the Great Recession leading to 11 percent dis-smooting—while in 2008–2009 the current account balances for the PIIGS improved, at the same time as GDP contracted, leading to significant dis-smoothing at –22 percent. During 2008–2009, this dis-smoothing was outweighed by sharply declining real investment which helped smooth consumption substantially at 69 percent. For the PIIGS, real investment declined in 2010 absorbing 53 percent of the decline in GDP growth, but the current accounts improved significantly, providing substantial dis-smoothing at 34 percent. For completeness, we also show income smoothing through net exports.[14] Net exports absorb roughly the same as the current account, reflecting that these series are highly correlated, although the results for the current account generally are estimated with more precision during the crisis years.

In order to examine if the patterns observed for the PIIGS during the Great Recession are atypical, Table 2.5 displays the decomposition of risk sharing during two severe crises affecting developed count*ries; namely, the Scandinavian banking crisis 1991–1994 which severely affected Finland, Norway, and Sweden and the Japanese crisis of 1997–2001. Commenting only on the significant coefficients during the crises, we observe that the Scandinavian crisis was accompanied by severe dis-smoothing from net factor income, which may have been due to high interest rates paid on Scandinavian debt, as the governments tried to defend the currency values, although we are not able to verify this conjecture in this article. In Japan, the overall patterns of risk sharing did not change much during the crisis with the fraction un-smoothed declining from 61 to 57 percent while in "Scandinavia" (Denmark is part of Scandinavia but was not affected) the fraction of shocks un-smoothed increased from 28 to 47 percent, mainly due to the perverse net factor income flows, as smoothing through saving was unchanged.

Table 2.6 considers the roles of government and private saving in providing risk sharing during the crises in Scandinavia and Japan. The amount of smoothing from government saving hardly changed when the crisis hit, it was 76 percent in Scandinavia during non-crisis years, dropping to 70 percent during the crisis, while the point estimates for risk sharing through government saving in Japan, in spite of being statistically insignificant, stayed constant at 44 percent. In both Scandinavia and Japan, the contribution to smoothing from real investment increased in the crises. However, the main take-away from these results is that the pattern found for the PIIGS during the sovereign debt crises is unusual for developed

[14]The relevant national accounts identity is GDP − CONS = I + (NX) where I is now is gross investment and NX is net exports. Gross investment behaves quite similar to net investment and we do not display smoothing through gross invest separately.

European countries, although similar patterns hold in emerging economies as described by Kaminsky, Reinhart, and Végh (2005).

2.5 Conclusion

Risk sharing collapsed in Portugal, Ireland, Italy, Greece, and Spain in 2010. We show that this was the result of government austerity programs which were forced upon these countries because of their vulnerable external and internal asset positions. For other EU countries, risk sharing from government saving declined but did not turn negative.

Table 2.1: Descriptive Statistics: Government and External Debt.

	Net Government Debt			Net External Debt		
	2000–2007	2008–2009	2010	2000–2007	2008–2009	2010
Panel A: PIIGS.						
Greece	94	120	144	65	82	96
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Ireland	21	33	74	16	84	88
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Italy	89	92	99	14	24	23
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Portugal	52	73	88	62	102	107
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Spain	39	36	49	50	86	88
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Panel B: Non-PIIGS.						
Austria	43	45	52	20	12	8
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Belgium	86	76	79	–37	–46	–64
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Denmark	12	–5	–1	8	0	–13
	(2.87)	(5.23)	.	(5.78)	(5.65)	.
Finland	–47	–57	–65	44	4	–11
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
France	56	67	76	–5	11	7
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Germany	48	53	56	–13	–29	–34
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Netherlands	25	21	27	7	–10	–22
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
Sweden	–1	–15	–20	20	9	7
	(2.87)	(5.23)	.	(5.79)	(5.65)	.
United Kingdom	35	53	70	16	13	23
	(2.87)	(5.23)	.	(5.79)	(5.65)	.

Notes: Net government and external debt, as percentages of GDP, averaged over the periods 2000–2007, 2008–2009 and 2010. Standard deviations in parentheses. Net government and external debt are from the World Economic Outlook and the European Central Bank and defined as in Figure 3. Source: Authors' own calculations based on World Economic Outlook and European Central Bank data.

Table 2.2: Risk Sharing.

	Channels of Risk Sharing				Un-smoothed
	β_f	β_d	β_τ	β_s	β_u
Panel A: Group.					
GDP (1990–2007)	5	–7	0	49***	53***
	(0.87)	(–1.57)	(–0.00)	(5.47)	(7.62)
GDP (2008–2009)	4	–1	5	52***	40***
	(0.35)	(–0.43)	(1.17)	(3.77)	(2.91)
GDP (2010)	1	–21***	1	33***	86***
	(0.16)	(–4.45)	(0.68)	(3.04)	(6.26)
Panel B: Non-PIIGS against PIIGS.					
GDP (1990–2007) (non-PIIGS)	–5	–11***	–1	60***	57***
	(–1.53)	(–4.24)	(–0.46)	(6.19)	(8.10)
GDP (2008–2009) (non-PIIGS)	25	–5	7	57***	16
	(1.65)	(–1.16)	(1.52)	(3.02)	(1.02)
GDP (2010) (non-PIIGS)	12	–23**	6	60***	45***
	(0.86)	(–2.54)	(1.06)	(3.23)	(4.32)
GDP (1990–2007) (PIIGS)	12***	–5**	1	31***	61***
	(3.01)	(–2.29)	(0.55)	(4.66)	(12.69)
GDP (2008–2009) (PIIGS)	–3	1	4	47***	51***
	(–0.29)	(0.21)	(0.82)	(2.70)	(2.61)
GDP (2010) (PIIGS)	–13	–21***	1	19	114***
	(–1.59)	(–4.26)	(0.17)	(1.55)	(14.13)
Observations:			281		

Notes: Panel A: We estimate the relations $\Delta\textsc{gdp}_{it} - \Delta\textsc{gni}_{it} = \alpha_f^t + \sum_x \beta_f^x \Delta\textsc{gdp}_{it} \times \textsc{p}^x + \epsilon_{itf}$, $\Delta(\textsc{gni} - \textsc{ni})_{it} = \alpha_d^t + \sum_x \beta_d^x \Delta\textsc{gdp}_{it} \times \textsc{p}^x + \epsilon_{itd}$, $\Delta(\textsc{ni} - \textsc{nndi})_{it} = \alpha_\tau^t + \sum_x \beta_\tau^x \Delta\textsc{gdp}_{it} \times \textsc{p}^x + \epsilon_{it\tau}$, $\Delta \log(1 + \frac{\mathbf{S}_{it}}{\mathbf{CONS}_{it}}) = \alpha_s^t + \sum_x \beta_s^x \Delta\textsc{gdp}_{it} \times \textsc{p}^x + \epsilon_{its}$, and $\Delta\textsc{cons}_{it} = \alpha_u^t + \sum_x \beta_u^x \Delta\textsc{gdp}_{it} \times \textsc{p}^x + \epsilon_{itu}$, where x belongs to $\{90\text{–}07, 08\text{–}09, 10\}$, GDP, GNI, NI, and CONS are log GDP, gross national income, net national income, net national disposable income, and total consumption, respectively, $\mathbf{S}$ is net saving, $\mathbf{CONS}$ is total consumption, $\textsc{p}^x$ is a dummy variable for the period x, and α^t are time fixed effects. The panel shows the β^x coefficients. The estimated values of β_f, β_d, β_τ, and β_s are interpreted as the percentage of consumption smoothing obtained through international capital markets, physical capital depreciation, net transfers, and domestic saving, respectively. $1 - \beta_u^x$ is interpreted as the percentage of output shocks smoothed in period x.

Panel B: We estimate the relations $\Delta\textsc{gdp}_{it} - \Delta\textsc{gni}_{it} = \alpha_f^t + \sum_y \alpha_f^y \textsc{d}^y + \sum_y \sum_x \beta_f^{yx} \Delta\textsc{gdp}_{it} \times \textsc{d}^y \times \textsc{p}^x + \epsilon_{itf}$, $\Delta(\textsc{gni} - \textsc{ni})_{it} = \alpha_d^t + \sum_y \alpha_d^y \textsc{d}^y + \sum_y \sum_x \beta_d^{yx} \Delta\textsc{gdp}_{it} \times \textsc{d}^y \times \textsc{p}^x + \epsilon_{itd}$, $\Delta(\textsc{ni} - \textsc{nndi})_{it} = \alpha_\tau^t + \sum_y \alpha_\tau^y \textsc{d}^y + \sum_y \sum_x \beta_\tau^{yx} \Delta\textsc{gdp}_{it} \times \textsc{d}^y \times \textsc{p}^x + \epsilon_{it\tau}$, $\Delta \log(1 + \frac{\mathbf{S}_{it}}{\mathbf{CONS}_{it}}) = \alpha_s^t + \sum_y \alpha_s^y \textsc{d}^y + \sum_y \sum_x \beta_s^{yx} \Delta\textsc{gdp}_{it} \times \textsc{d}^y \times \textsc{p}^x + \epsilon_{its}$, and $\Delta\textsc{cons}_{it} = \alpha_u^t + \sum_y \alpha_u^y \textsc{d}^y + \sum_y \sum_x \beta_u^{yx} \Delta\textsc{gdp}_{it} \times \textsc{d}^y \times \textsc{p}^x + \epsilon_{itu}$, where y belongs to $\{\textsc{npiigs}, \textsc{piigs}\}$, $\textsc{d}^y$ is a dummy variable for the group y, and the other variables and coefficients are defined as in panel A. The panel shows the β^{yx} coefficients.

All coefficients are estimated by feasible GLS using annual data 1990–2010. The countries in the sample are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom, PIIGS are Portugal, Ireland, Italy, Greece, and Spain while NPIIGS are the other countries. t statistics in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 2.3: Saving and Risk Sharing.

	Saving	
	Government(β_{Gov})	Private(β_{Priv})
Panel A: Group.		
GDP (1990–2007)	16**	33***
	(2.09)	(4.19)
GDP (2008–2009)	62***	–10
	(5.87)	(–0.98)
GDP (2010)	–24*	57***
	(–1.82)	(4.34)
Panel B: Non-PIIGS against PIIGS.		
GDP (1990–2007) (non-PIIGS)	46***	14**
	(7.85)	(2.46)
GDP (2008–2009) (non-PIIGS)	38***	19
	(2.73)	(1.36)
GDP (2010) (non-PIIGS)	17	44*
	(0.65)	(1.69)
GDP (1990–2007) (PIIGS)	15***	16***
	(2.71)	(2.89)
GDP (2008–2009) (PIIGS)	73***	–25**
	(6.67)	(–2.33)
GDP (2010) (PIIGS)	–38**	57***
	(–1.98)	(2.97)
Observations:	281	

Notes: Panel A: We jointly estimate the relations $\Delta \frac{\mathbf{S}_{it}^{j}}{\mathbf{CONS}_{it}} = \alpha_j^t + \sum_x \beta_j^x \Delta \text{GDP}_{it} \times \text{P}^x + \epsilon_{itj}$, for $j = \{\text{Gov}, \text{Priv}\}$, with the constraints $\beta_{Gov}^x + \beta_{Priv}^x = \beta_S^x$, where $\mathbf{S}^{\text{Gov}}$ and $\mathbf{S}^{\text{Priv}}$ are government and private saving, respectively, $\mathbf{CONS}$ is total consumption, GDP, x, P^x, β_S^x, and α^t are defined as in panel A of Table 2.2. The panel shows the β^x coefficients. The coefficients β_{Gov}^x and β_{Priv}^x are interpreted as the amount of consumption smoothing reached through government and private saving, respectively, during period x.

Panel B: We jointly estimate the relations $\Delta \frac{\mathbf{S}_{it}^{j}}{\mathbf{CONS}_{it}} = \alpha_j^t + \sum_y \alpha_j^y \text{D}^y + \sum_y \sum_x \beta_j^{yx} \Delta \text{GDP}_{it} \times \text{D}^y \times \text{P}^x + \epsilon_{itj}$, for $j = \{\text{Gov}, \text{Priv}\}$, with the constraints $\beta_{Gov}^{yx} + \beta_{Priv}^{yx} = \beta_S^{yx}$, where y and D^y are defined as in panel B of Table 2.2, and the other variables and coefficients are defined as in panel A of this table. The panel displays the β^{yx} coefficients.

All coefficients are estimated by feasible GLS, using the same countries, country groups, and periods as in Table 2.2. t statistics in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 2.4: Capital Flows, Investment, Net Exports, and Risk Sharing.

	Net Investment (β_I)	Net Capital Outflows(β_{CA})	Net Exports (β_{NX})
Panel A: Group.			
GDP (1990–2007)	50***	–1	11*
	(7.05)	(–0.11)	(1.84)
GDP (2008–2009)	57***	–5	–1
	(5.94)	(–0.53)	(–0.05)
GDP (2010)	64***	–31***	–27**
	(5.44)	(–2.66)	(–2.29)
Panel B: Non-PIIGS against PIIGS.			
GDP (1990–2007) (non-PIIGS)	46***	14***	5
	(9.31)	(2.80)	(1.01)
GDP (2008–2009) (non-PIIGS)	25**	32***	51***
	(2.12)	(2.68)	(3.72)
GDP (2010) (non-PIIGS)	85***	–25	–11
	(3.89)	(–1.14)	(–0.60)
GDP (1990–2007) (PIIGS)	41***	–11**	7
	(8.94)	(–2.36)	(1.21)
GDP (2008–2009) (PIIGS)	69***	–22**	–21
	(7.45)	(–2.35)	(–1.22)
GDP (2010) (PIIGS)	53***	–34**	–44***
	(3.24)	(–2.08)	(–2.72)
Observations:		281	

Notes: Panel A: The first two columns of the panel show the β^x coefficients from jointly estimating $\Delta \frac{\mathbf{I}_{it}}{\mathbf{CONS}_{it}} = \alpha_I^t + \sum_x \beta_I^x \Delta \text{GDP}_{it} \times \text{P}^x + \epsilon_{itI}$ and $\Delta \frac{\mathbf{CA}_{it}}{\mathbf{CONS}_{it}} = \alpha_{CA}^t + \sum_x \beta_{CA}^x \Delta \text{GDP}_{it} \times \text{P}^x + \epsilon_{itCA}$, with the constraints $\beta_I^x + \beta_{CA}^x = \beta_s^x$, while the third column shows the β^x coefficients from estimating $\Delta \left(\text{GDP} - \log\left(\mathbf{GDP} - \mathbf{NX}\right)\right)_{it} = \alpha_{NX}^t + \sum_x \beta_{NX}^x \Delta \text{GDP}_{it} \times \text{P}^x + \epsilon_{itNX}$, where **I**, **CA**, **NX**, **GDP**, **CONS** are net investment, current account, net exports, GDP, and consumption, respectively, where GDP, x, P^x, β_s^x, and α^t are defined as in Table 2.2. β_I, β_{CA}, and β_{NX} are interpreted as consumption smoothing obtained through net investment, net capital outflows, and trade, respectively.
Panel B: The first two columns of the panel show the β^{yx} coefficients from jointly estimating $\Delta \frac{\mathbf{I}_{it}}{\mathbf{CONS}_{it}} = \alpha_I^t + \sum_y \alpha_I^y \text{D}^y + \sum_y \sum_x \beta_I^{yx} \Delta \text{GDP}_{it} \times \text{D}^y \times \text{P}^x + \epsilon_{itI}$ and $\Delta \frac{\mathbf{CA}_{it}}{\mathbf{CONS}_{it}} = \alpha_{CA}^t + \sum_y \alpha_{CA}^y \text{D}^y + \sum_y \sum_x \beta_{\text{CA}}^{yx} \Delta \text{GDP}_{it} \times \text{D}^y \times \text{P}^x + \epsilon_{it\text{CA}}$, with the constraints $\beta_I^{yx} + \beta_{CA}^{yx} = \beta_s^{yx}$, while the third column shows the β^{yx} coefficients from estimating $\Delta \left(\text{GDP} - \log\left(\mathbf{GDP} - \mathbf{NX}\right)\right)_{it} = \alpha_{NX}^t + \sum_y \alpha_{NX}^y \text{D}^y + \sum_y \sum_x \beta_{\text{NX}}^{yx} \Delta \text{GDP}_{it} \times \text{D}^y \times \text{P}^x + \epsilon_{it\text{NX}}$, where y and D^y are defined as in panel B of Table 2.2, and the other variables and coefficients are defined as in panel A of this table.
All coefficients are estimated by feasible GLS, using the same countries, country groups, and periods as in Table 2.2. t statistics in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Table 2.5: Crises and Risk Sharing.

	Channels of Risk Sharing				Un-smoothed
	β_f	β_d	β_τ	β_s	β_u
Panel A: Financial Crises and Non-Peripherical Developed Economies.					
GDP (Others) (Core)	6	–4	–5	47***	56***
	(0.83)	(–0.85)	(–0.96)	(3.56)	(5.78)
GDP (1991–1994) (Core)	4	–4	–5	31**	74***
	(0.83)	(–1.08)	(–1.01)	(2.25)	(6.55)
GDP (1997–2001) (Core)	8	–10**	–2	41***	63***
	(0.86)	(–2.36)	(–0.54)	(3.06)	(6.07)
Panel B: Financial Crises in Developed Countries.					
GDP (Others) (Scandinavia)	3	–14***	–3	86***	28***
	(0.79)	(–3.68)	(–0.92)	(8.90)	(3.24)
GDP (1991–1994) (Scandinavia)	–15***	–18***	–1	87***	47***
	(–3.68)	(–4.70)	(–0.65)	(5.06)	(3.27)
GDP (Others) (Japan)	–6	6	0	39*	61***
	(–0.76)	(0.82)	(0.04)	(1.96)	(4.20)
GDP (1997–2001) (Japan)	1	11	–7	38**	57**
	(0.12)	(0.75)	(–0.94)	(2.03)	(2.27)
Observations:			323		

Notes: The decomposition is constructed in a similar manner to that in panel B of Table 2.2 but now x and y belong to {91–94, 97–01, 08–09, 10, OTHERS} (OTHERS includes the years 90, 95–96, 02–07) and {CORE, JAPAN, PIIGS, SCANDINAVIA}, respectively. Panel A shows the coefficients corresponding to CORE, while the coefficients in panel B correspond to SCANDINAVIA and JAPAN.

All coefficients are estimated by feasible GLS using annual data for 1990–2010. The countries considered in the sample are the same as in Table 2.2 but including Japan and Norway, CORE includes Austria, Belgium, Denmark, France, Germany, the Netherlands, and the United Kingdom while SCANDINAVIA denotes Finland, Norway, and Sweden. t statistics in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

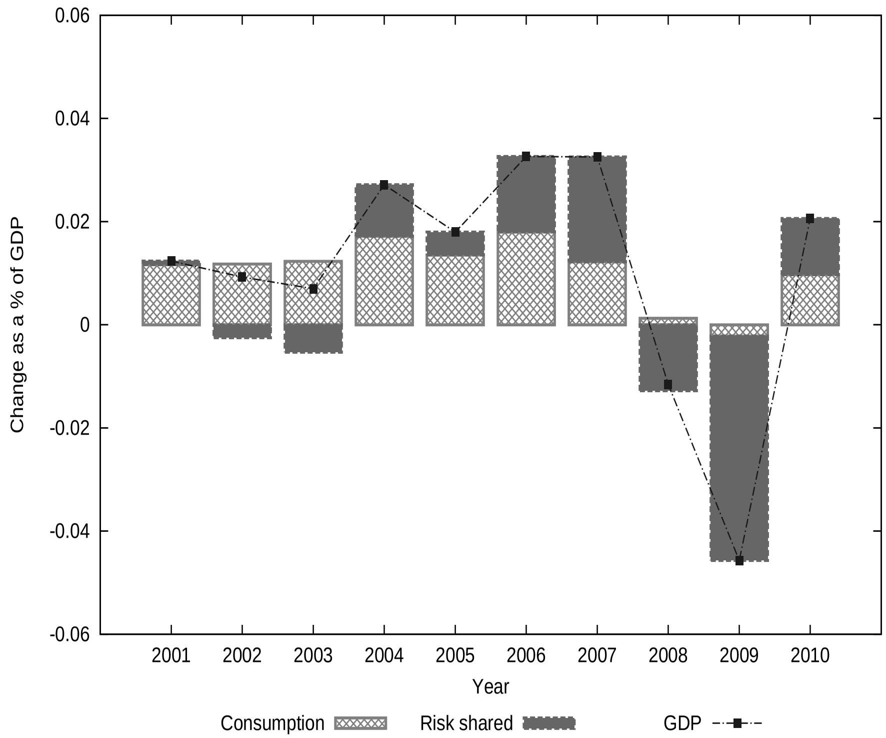
Table 2.6: Decomposing the Contribution of Saving.

	Saving		Saving	
	Government(β_{Gov})	Private(β_{Priv})	Net Capital outflows(β_{CA})	Net Investment (β_I)
Panel A: Financial Crises and Non-Peripherical Developed Economies.				
GDP (Others) (Core)	14	32***	13	33***
	(1.23)	(2.71)	(1.29)	(3.12)
GDP (1991–1994) (Core)	29*	2	–17	48***
	(1.91)	(0.12)	(–1.25)	(3.52)
GDP (1997–2001) (Core)	32**	9	34***	7
	(2.46)	(0.70)	(2.91)	(0.63)
Panel B: Financial Crises in Developed Countries.				
GDP (Others) (Scandinavia)	76***	10	40***	46***
	(9.48)	(1.21)	(5.61)	(6.37)
GDP (1991–1994) (Scandinavia)	70***	17	10	77***
	(6.70)	(1.62)	(1.07)	(8.24)
GDP (Others) (Japan)	44	–6	–35	74***
	(1.52)	(–0.19)	(–1.35)	(2.84)
GDP (1997–2001) (Japan)	44	–7	–55*	93***
	(1.19)	(–0.18)	(–1.66)	(2.80)
Observations:			323	

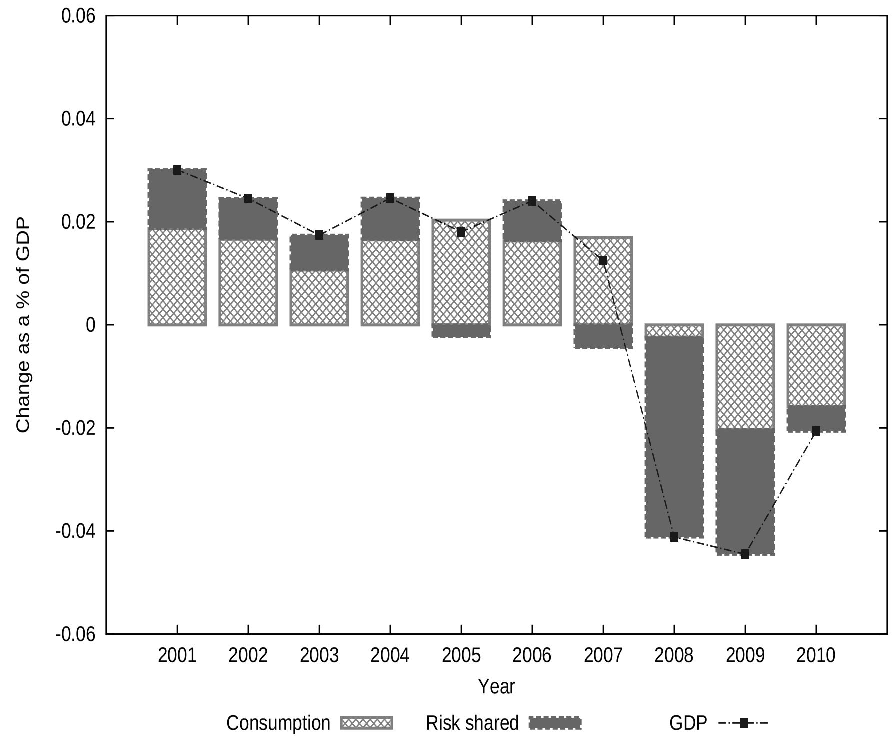
Notes: The decomposition is constructed in a similar manner to those in panel B of Tables 2.3 and 2.4, but now x and y belong to {91–94, 97–01, 08–09, 10, OTHERS} (OTHERS includes the years 90, 95–96, 02–07) and {CORE, JAPAN, PIIGS, SCANDINAVIA}, respectively. Panel A shows the coefficients corresponding to CORE, while the coefficients in panel B correspond to SCANDINAVIA and JAPAN.
The coefficients in the first two columns are estimated as in Table 2.3, while those in columns three and four are estimated as in Table 2.4. The countries, country groups, and periods are the same as in Table 2.5. t statistics in parentheses. *, **, and *** denote significance at 10, 5, and 1 percent, respectively.

Figure 2.1: Risk Sharing.

(a) Non-PIIGS.



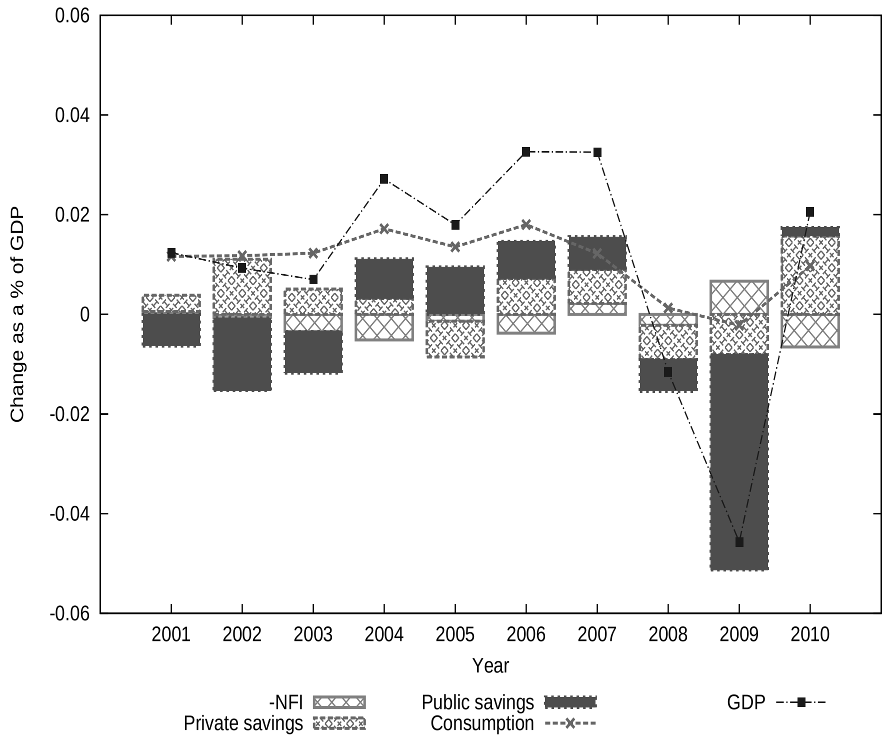
(b) PIIGS.



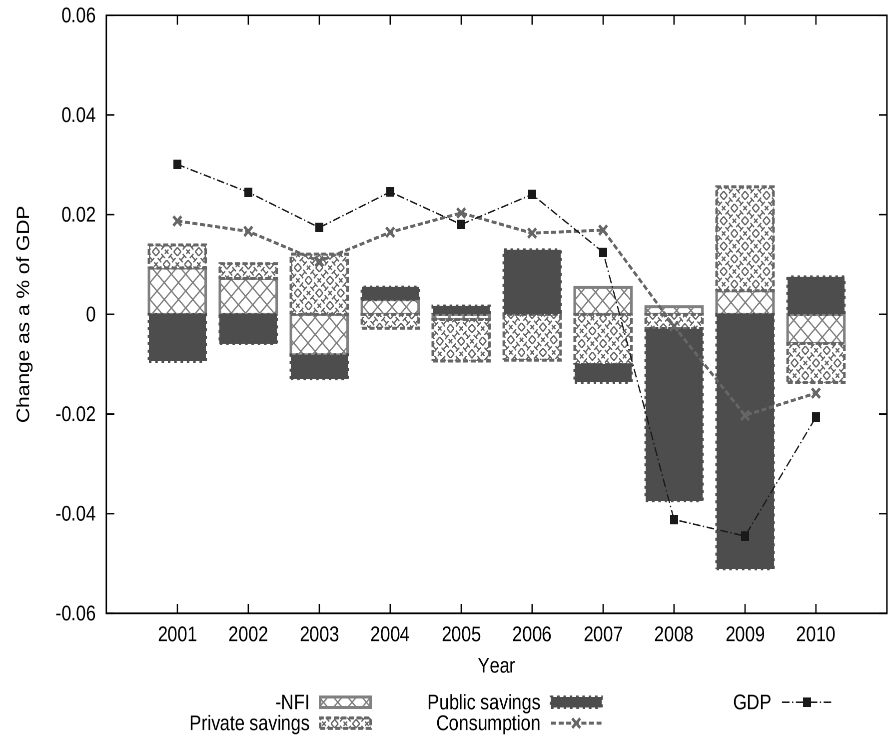
Notes: Figures 2.1a and 2.1b display annual growth of aggregate GDP and (crisscrossed) aggregate consumption as a share of GDP (the dollar change in consumption as a fraction of lagged GDP) for PIIGS and non-PIIGS, respectively. The change in consumption can be interpreted as the amount of GDP-risk not shared while the difference between GDP growth and consumption growth can be interpreted as the amount of risk shared in a given year. PIIGS denotes Portugal, Ireland, Italy, Greece, and Spain and non-PIIGS denotes Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom. Source: Authors' own calculations based on OECD data.

Figure 2.2: Decomposition of GDP Growth.

(a) Non-PIIGS.



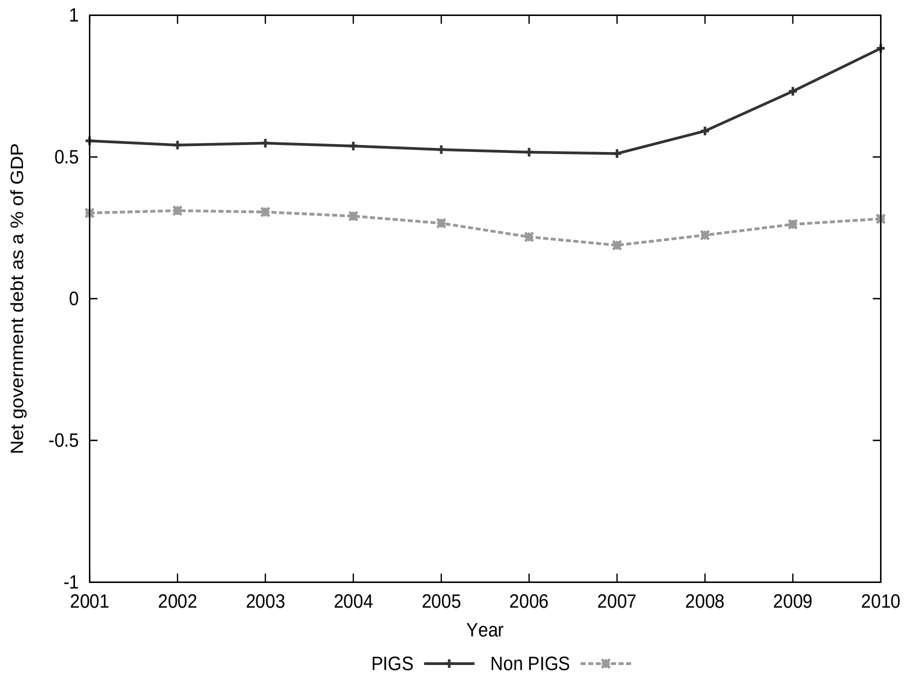
(b) PIIGS.



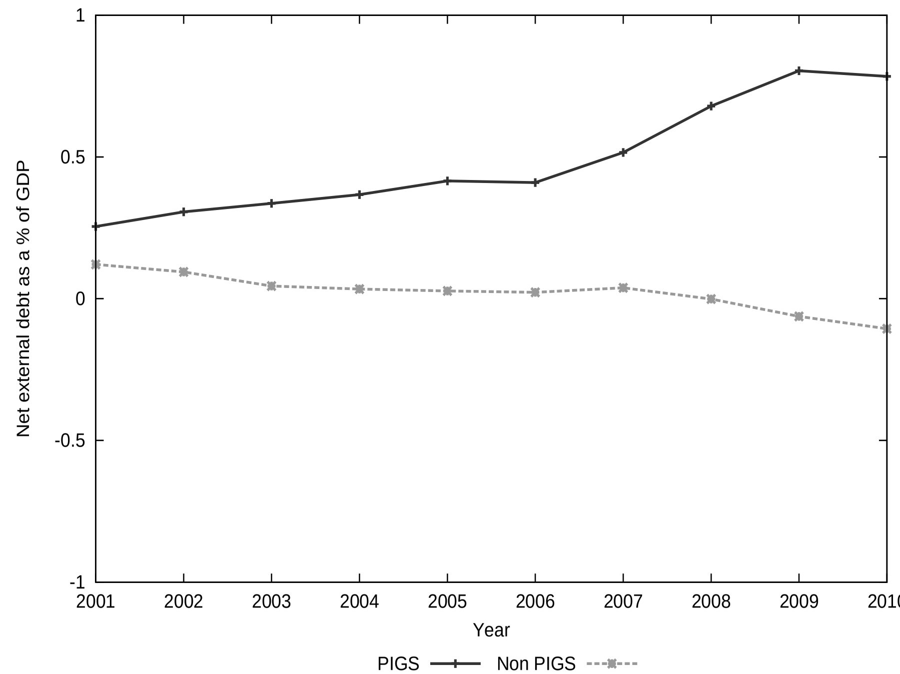
Notes: The bars in Figures 2.2a and 2.2b represent annual growth of aggregate net factor payments from the domestic country (net factor income with the sign reversed), aggregate government saving, and aggregate private saving—all as shares of GDP. The height of each bar can be interpreted as the amount of risk shared through a specific factor, and the vertical distance between GDP and consumption as the total amount of risk shared in a given period. PIIGS denotes Portugal, Ireland, Italy, Greece, and Spain and non-PIIGS denotes Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom. Source: Authors' own calculations based on OECD data.

Figure 2.3: Net Government and External Debt: Non-PIIGS vs PIIGS.

(a) Net Government Debt.

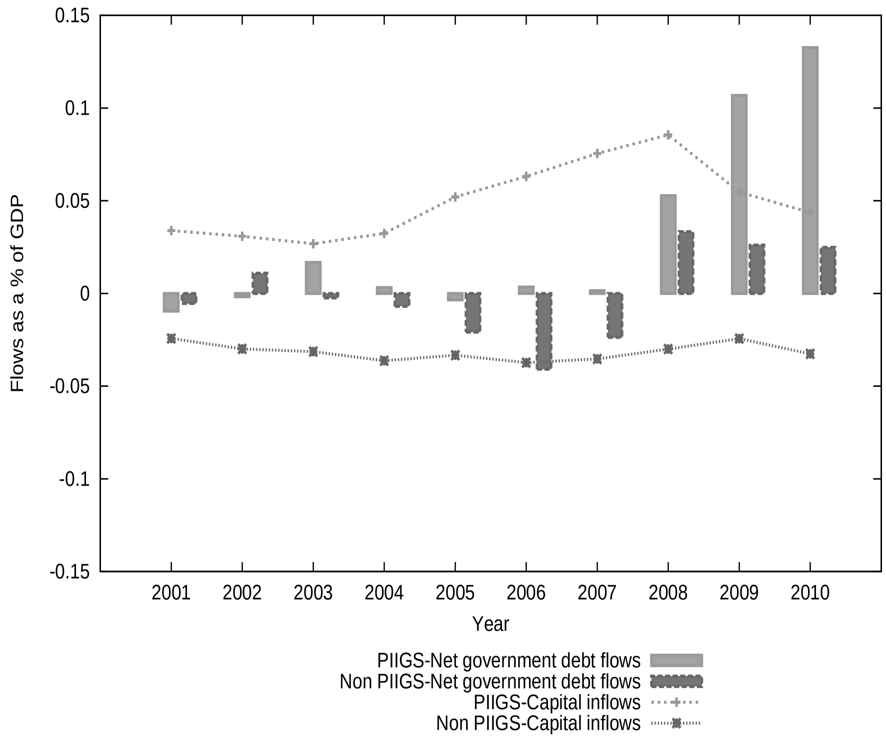


(b) Net External Debt.

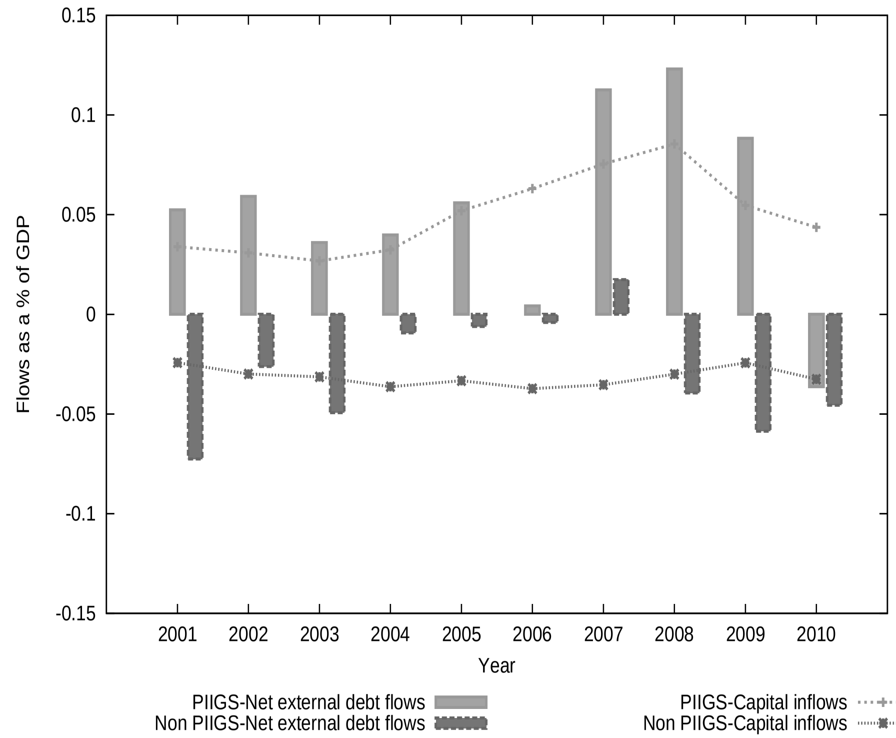


Notes: Net government and external debt are aggregate net government and external debt (each as a fraction of aggregate GDP) for each country group. Country data on net government and external debt are from the World Economic Outlook and the European Central Bank. Net government debt is defined as gross debt of the general government sector minus its financial assets in the form of debt instruments. External debt is the outstanding amount on the financial account of the balance of payments statistics at the end of the fourth quarter of each year. PIIGS denotes Portugal, Ireland, Italy, Greece, and Spain and non-PIIGS denotes Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom. Source: Authors' own calculations based on World Economic Outlook and European Central Bank data.

Figure 2.4: Net Government and External Debt Flows: Non-PIIGS vs PIIGS.



(a) Net Government Debt Flows.



(b) Net External Debt Flows.

Notes: For each country group, net government and external debt flows are measured as the change in aggregate net government and external debt. Capital inflows is the aggregate current account surplus with the sign reversed (each as a fraction of aggregate GDP). Country data on net government debt and current accounts are from the World Economic Outlook and net external debt is from the European Central Bank. Net government debt and external debt are defined as in Figure 3. PIIGS denotes Portugal, Ireland, Italy, Greece, and Spain and non-PIIGS denotes Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands, Sweden, and the United Kingdom. Source: Authors' own calculations based on World Economic Outlook and European Central Bank data.

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