STAREBEI Project between the EIB and Paris School of Economics

Financial integration, investment and risk sharing – a granular perspective

Jonas Heipertz

(PSE tutor: Florin Bilbiie, EIB tutor: Natacha Valla)

FINAL REPORT

The STAREBEI Project "Financial Integration, investment, and risk sharing – a granular perspective" has been conducted by Jonas Heipertz and has generated the following *outcomes*:

- A research paper "Domestic and International Sectoral Portfolios: Network Effects and and Balance-Sheet Effects" co-authored by Natacha Valla (ECB, PSE) and Romain Rancière (University of Southern California) on sectoral portfolios that has been presented at the "International Financial Integration in a Changing Policy Context – the End of an Era?" conference that took place at the European Commission in Brussels on March 1-2, 2018. It has been submitted for publication to the special conference issue of the Journal of International Money and Finance.

- Contributions to the EIB annual investment report of 2017/2018, in particular

    - a software tool to easily access and update data on investment and capital flows by institutional sectors of different European countries,

    - results from an empirical analysis of corporate financing choices obtained from the unique experiment conducted in the first wave of the EIB investment survey (Chapter 6, Box 1), which were also published as EIB Working Paper 2017/03.

The research carried-out traces the evolution of domestic and international sectoral portfolios using a unique and large security-level granular database on positions, valuation changes and flows of all different institutional sectors in the aftermath of the global financial crisis. These are crucial to understand the channels through which countries are internationally financially integrated and share risk in terms of both consumption and investments.

It generated stylized facts on the contributions of institutional sectors (in particular non-financial corporations, households, the public sector, as well as the financial sectors of the economy: banks, mutual funds, insurances) to the dynamics of countries' net external asset position and on bilateral linkages between sectors through security portfolios.

The model that was developed shows how institutional sectors of the economy are financially integrated and allows to understand how real as well as financial shocks to a sector (for example to non-financial corporations) travel through balance-sheets to other sectors of the

economy, as well as other countries. It can be derived from a balance-sheet equilibrium where sectoral asset demand and supply for securities are functions of endogenously determined returns on domestic securities.

Finally, the model is estimated using a unique and comprehensive database on French portfolio investments by institutional sectors and used to measure the degree and evolution of balance-sheet contagion between French institutional sectors. With a similar access to detailed whom-to-whom databases on holdings and issuance of securities, the methodology can be easily applied to measure contagion for other countries of the European Union.

Attachments:

Research paper: "Domestic and International Sectoral Portfolios: Network Effects and and Balance-Sheet Effects", Jonas Heipertz, Romain Rancière, Natacha Valla.

Domestic and External Sectoral Portfolios: Network Structure and Balance-Sheet Effects

Jonas Heipertz*, Romain Rancière†, Natacha Valla‡

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Abstract

This paper uses a unique comprehensive database on French security assets and liabilities to study the dynamics of domestic and external sectoral portfolios, their network structure, and their role in the propagation of shocks. We first show how the sharp deterioration of the net external portfolio position of France between 2008 and 2014 was driven by sectoral patterns such as the banking sector retrenchment and the increase in foreign liabilities of the public and corporate sectors, but was mitigated by the expansion of domestic and foreign asset portfolios of insurance companies. We also provide a network representation of the links between domestic sectors and the rest of the world, and document their evolution between 2008 and 2014. Second, we put forward and estimate a model of contagion through inter-sectoral security linkages. The estimation of the model through GMM shows that the financial sectors of the economy (banking, mutual funds, insurance) are strongly affected by balance-sheet contagion.

*Paris School of Economics
†University of Southern California, NBER and CEPR
‡European Investment Bank and Paris School of Economics

1 Introduction

Large shocks, such as the 2007-2008 financial crisis, can trigger sizable changes in countries' external portfolios, and in the dynamics of their net foreign assets position. Such aggregate changes result from security trade undertaken by various sectors (banking, mutual funds, insurance, corporate, household and public sector) as well as valuation changes experienced by the corresponding sectoral portfolios. Using a unique security-level database covering the universe of asset and liability stocks, valuation changes and flows of domestic and foreign portfolios of French sectors between 2008 and 2014, this paper documents how sectoral portfolio patterns shape the dynamics of a country's external portfolio investment position. An estimated model of balance-sheet contagion exposes the role played by network linkages, in the form of domestic and foreign security cross-holdings, in the transmission of real and financial shocks.

While there is a vast literature on cross-border bank holdings and flows, there is so far limited evidence on international asset and liability holdings for other sectors of the economy. Data limitations explain this gap. For example, the Coordinated Portfolio Investment Survey (IMF) only reports estimates of security holdings, at the sector-level, for some countries. The survey does not report any information on sector-level liabilities, nor any information on flows and valuations. In addition, the CPIS does not integrate international and domestic portfolios.

The ability to trace the institutional sector of the holding and emitting entity at the security-level, makes the data uniquely suitable for the analysis of balance-sheet contagion at the sectoral level. We refer to balance-sheet contagion in a broad sense as a phenomenon where a shock to one sector also affects balance-sheets of other sectors through bilateral exposures (see Kiyotaki and Moore, 2002). For example, the value of A's claim on B depends on the value of B's claims on C, who itself might have a claim on A. In focusing on balance-sheet contagion, the paper relates to a large literature on shock propagation through networks of firms and banks. For example, in the seminal paper by Eisenberg and Noe (2001), banks hold debt claims on each other and an outside asset. A sufficiently large shock to a bank's outside asset wipes out its equity and induces defaults on its debt pro-rata. Exposed banks are then affected.

The paper has three objectives. First, we document the evolution of security assets and liabilities of French sectors between 2008 and 2014, and

document a number of stylized facts on the evolution of domestic and foreign portfolio assets and liabilities. Second, we analyze the network structure of cross-holdings among domestic sectors and the foreign sector in the same period. Third, we propose and structurally estimate a model of transmission of sectoral shocks through the network implied by bilateral asset and liability positions. The model allows to identify the critical financial linkages that play a disproportionate role in the propagation of domestic and foreign sectoral shocks.

The main results are as follows. First, we provide a sectoral decomposition of the large deterioration of the net external portfolio position of France over the period which evolves from a positive net external position of 4.7 percent of GDP to a large negative net position of -35.7 percent of GDP. This deterioration of the net external portfolio position (-41 ppts) resulted mostly from that of the public sector (-24 ppts), the banking sector (-15 ppts), the corporate sector (-8 ppts), and was only partly compensated by an amelioration of the net position of the insurance sector ($+8$ ppts). The deterioration of the net external portfolio position came entirely from the external liability side of the aggregate balance-sheet, the external asset side remained constant (at about 100 percent of GDP), a reduction of the external assets of the banking sector (-9 ppts) being compensated by an increase in the external assets of the insurance sector and of mutual funds. The deterioration was three times larger vis-à-vis non-Eurozone countries (31 ppts) than vis-à-vis the Eurozone (10 ppts), and five times larger for public sector liabilities (20 vs 4 ppts). Within the Eurozone, the French sectors, and chiefly the banking sector, exhibited a large retrenchement from GIPS countries (-11.9 ppts).

The analysis cross-sectoral international portfolios reveals that the exposure of the French sectors to Eurozone sectors changed dramatically over the period: a large reduction of the exposure to the Eurozone banking sector (-4.3 ppts) and Eurozone corporate/household sector (-9.6 ppts) was mirrored by a large increase in the exposure to the Eurozone insurance / mutual funds sector ($+16$ ppts).

Second, we discuss the joint evolution of the domestic and international sectoral portfolios. The banking sector exhibited a severe retrenchment with an amelioration of 11 ppts of its net domestic position coinciding with a 15 ppts deterioration of its net external position. The insurance sector increased significantly its net position in both domestic ($+15$ ppts) and external assets. Consolidating the domestic and external sectoral net position reveals that the

insurance sector is the largest net security creditor (+90 percent of GDP), while the public sector (−77 percent of GDP) and the corporate sector (−63 percent of GDP) are the largest net security debtors.

Third, we provide a network representation of bilateral asset and liability position of sectors. Between 2008 and 2014, the banking sector substituted public sector securities with corporate securities and its liabilities became increasingly held by the rest of the world. The insurance sector ended up playing a much larger role in the financing of the economy through securities by increasing its holdings of securities emitted by all sectors,

Fourth, our estimation of the empirical model of balance-sheet contagion shows that balance-sheet contagion only affects the financial sectors of the economy, i.e. the banking sector, the insurance sector and mutual funds. That is the impact of portfolio returns on the price of real sector assets through balance-sheet mechanisms comes out as insignificant. This is consistent with the intuition that the price of securities emitted by the real sector is mostly driven by real shocks rather than financial contagion. We also show that consistent with the evolution of inter-sectoral linkages, the exposure of the banking and insurance sectors to public sector shocks has increased over the 2008 to 2014 period. All financial sectors are vulnerable to foreign sector shocks, consistent with their substantial external asset positions.

The descriptive section of the paper contributes to the literature of cross-sector balance-sheet exposures. Castrén and Kavonius (2009) use flow-of-funds data for the Eurozone and resort to entropy methods to estimate bilateral sectoral linkages due to data limitations. We do not have such limitations since our database allows us to exactly measure inter-sectoral links. Our main contribution is to integrate the analysis of domestic and international sectoral portfolios. Galstyan et al. (2016) also focus on international sectoral portfolios. Their analysis covers a cross-section of countries, but is constrained by the limitations of the CPIS data as discussed in Section 2.

The estimated model of balance-sheet contagion explores how changes in the value of the assets of a firm or sector propagate through the re-pricing of its liabilities which are held as assets by other firms. The estimated model makes three contribution to the existing literature. First, our ability to observe at quarterly frequency the entire bilateral asset and liability positions allows us to estimate a flexible reduced-form contagion model under very limited assumptions. In particular, we do not take any stance on the balance-sheet contagion mechanism that operates, but acknowledge that asset prices might be driven by all of them simultaneously. Second, compared

to Castrén and Kavonius (2009), we do not have to rely on estimated bilateral exposure matrices but can obtain inter-sectoral linkages directly from the data. Moreover we do not assume a one-for-one accounting rule of propagation as in Castrén and Kavonius (2009), but estimate the sector-specific link between the price of assets and liabilities from the data. Third, we provide estimates of sectors' vulnerability to shocks originating in any part of the financial system rather than in the banking sector only. Our estimated model thus provides a benchmark that can be used for counter-factual policy experiments and to test the importance of institutional regulatory constraints in the network propagation of real and financial shocks.

Other models test specific channels of network contagion. Shin (2008) constructs a model of balance-sheet contagion incorporating value-at-risk constraints. Banks face credit risk on their corporate loan portfolio and need to manage their assets and liabilities such that the value-at-risk constraint is satisfied. Another balance-sheet contagion mechanism proposed by Greenwood et al. (2014) works through the price impact of fire-sales. Banks target a fixed leverage ratio. After an adverse shock on the return of their portfolio, banks need to return to their leverage ratio by selling assets and repaying debt. Allen and Gale (2000) focus on the inter-bank market and analyze how a financial crisis in one region spreads to other regions and aim at analyzing how different network structures affect the resilience or proneness of the network to contagion (see also Acemoglu et al. 2012).

2 Data Description

We use data on French portfolio investments collected by the Banque de France at quarterly frequency since 2008 through the exhaustive[1] survey PROTIDE (PRoduction de statistiques de TItres en DEtention) among French resident custodians and financial institutions. The data are collected security-by-security and contain a wide range of information on the security itself, such as the type of the financial instrument, the sector of the holder and the

[1]It contains the totality of portfolio investments, assets as well as liabilities, as they appear in the French IIP/BOP statistics. In fact, the latter are constructed through aggregation of the security-level data available to us. Note that security accounts held by French residential households in non-residential custodial accounts are not recorded. This omission however applies to any statistic on residential financial transactions and might partly be addressed by the recent aggregation of national security-level portfolio investment data by the ECB into the Security Holdings Statistics (SHS).

issuer. Thus, at the most dis-aggregated level the data distinguishes a security (identified by its international security identification number, ISIN) in the portfolio of a holder of a specific type. The data has been complemented by the security emission survey of the Banque de France in order to obtain the complete coverage of French resident liabilities.[2]

These data are unique in the landscape of literature on capital flows for at least two reasons: First, they provide a complete whom-to-whom mapping of portfolio assets and liabilities between domestic sectors and between domestic sectors and the rest of the world from 2008.1 until today. The information on foreign asset holdings by domestic residents indicates the type of securities (τ), the sector of the French holder (k), and the country (n) and sector of the security issuer (j). The information on holdings of domestic asset by foreign residents include the type of securities (τ), and the sector of the French issuer (j). In addition it includes for the Eurozone the country (n) and sector of the security holder (k). Thus an asset or liability security-level position can be expressed as $a_{\tau,j,k,n}$ and $l_{\tau,j,k,n}$ in which the country subscript n is dropped for domestic securities.

To the best of our knowledge, this paper is the first to use such comprehensive portfolio cross-holdings of assets and liabilities to analyze domestic and international financial linkages. Bilateral financial linkages have so far been inferred from flow-of-funds data using entropy estimation methods, which requires an uniformity assumption which is questionable in research on financial stability. The ECB publicly provides whom-to-whom data for non-security financial instruments, deposits and loans, as part of the Euro-Area Accounts (EAA) since October 2010. It is however only since the first quarter of 2014 that the ECB aggregates national security holding databases, such as PROTIDE, and compiles whom-to-whom data for security holdings in one integrated database for the Eurozone, the Security Holdings System (SHS) database[3]. Second, the data have a high degree of dis-aggregation (security-by-security at holding sector level) and cover all sectors of the economy. Up to now, the literature on financial flows using security-level or loan-level data had been restricted to a sub-population of financial institutions. This complete dis-aggregated coverage allows, for instance, to study the sectoral distribution of exposure to specific valuation shocks, and the subsequent

[2]PROTIDE only records security holdings and does therefore not cover French resident security emissions held by non-resident financial institutions or custodians. The share of these liabilities amounts to approximately 20% of total portfolio liabilities.

[3]see ECB Economic Bulletin, 2015/2

portfolio re-balancing decisions.

Cross-border asset and liability portfolios represent about one third of French total asset and liability international investment positions, followed by other investments (i.e. bank loans), and foreign direct investments (see Figure 1, upper panel). Even more significant is the role of portfolio investments as a key driver of the *net foreign asset* position over the period (see Figure 1, lower panel). Between 2008 and 2014, one observes a large trend increase in the net negative position in portfolio securities and a large trend decrease in the net negative position in bank loans (included in other investments). The increase in net portfolio liabilities exceeds the decrease in net bank loan liabilities, the difference explaining the deterioration of the overall net international investment position.

The breakdown in the change of the net foreign asset position into flows and valuation shows that flows dominate the dynamics and clearly confirms the substitution of bank loans by portfolio securities as driver of the change in net positions. However, portfolio investment valuation still plays a sizable role for the aggregate foreign asset and liability positions (see Figure 2). It is consistent with the fact that other investments, i.e. bank loans, exhibit much smaller valuation effects than securities do. Aggregate valuation effects therefore reflect, for the most part, portfolio valuations effects [4]

3 Domestic and External Sectoral Portfolios

The objective of this section is first to describe the construction of domestic and international sectoral portfolios and then to show how the analysis of these portfolios helps understanding, for the period 2008-2014, (i) the deterioration of the net external portfolio position of France, (ii) the joint evolution of domestic and external sectoral portfolios, and (iii) the evolution of the financial network structure implied by bilateral asset and liability positions.

3.1 Constructing Sectoral Portfolios

Sectoral portfolios are obtained by aggregating security assets and liabilities of each sector. The underlying data are the security-level PROTIDE data

[4]Note also that for our purposes (of analyzing re-balancing and inter-sectoral linkages) foreign direct investment valuations seem less relevant, since investment motives are different from those underlying portfolio investments.

which report, at quarterly frequency, the issuer of a security, the holder of a security, and decompose assets and liabilities variations between flows and valuations.

We consider the following six sectors (indexed by j):

1. Banks and money market funds referred to as the *banking sector*
2. Other financial institutions, which are (mostly) mutual funds and thus referred to as *mutual funds*
3. Non-financial corporations referred to as the *corporate sector*
4. The *insurance sector*
5. Households and non-profit institutions referred to as the *household sector*
6. The *public sector*

For each sector, we report the assets (a) and liabilities (l) in equity (e) and debt (b). The portfolio of each sector is divided between the *domestic portfolio* (domestic assets and liabilities held by other domestic agents), and the *foreign portfolio* (indexed by $*$). Net asset positions are obtained as the difference between assets and liabilities.

By construction, the sum of domestic assets equals the sum of domestic liabilities:

$$\sum_{j=1}^{6}(b_{a,j}+e_{a,j})=\sum_{j=1}^{6}(b_{l,j}+e_{l,j})$$

which does not prevent each *individual sector* to have a positive or negative net domestic position. The sum of net foreign asset positions of each sector equals the country's net external portfolio (*nep*):

$$nep=\sum_{j=1}^{6}nep_j=\sum_{j=1}^{6}(b^*_{a,j}+e^*_{a,j})-\sum_{j=1}^{6}(b^*_{l,j}+e^*_{l,j})$$

Further, the evolution of any position between two periods can be decomposed into new flows and changes in the market value of existing positions. The change in the net foreign position of sector k can thus be written as:

$$nep_{j,t}-nep_{j,t-1}=f_{j,t}+\triangle Val(nep_{j,t-1})$$

where $f_{j,t}$ measures the *net new flows* during period t and $\triangle Val(nep_{j,t-1})$ measures the change in valuation of the portfolio hold at time $t-1$. The latter can be further decomposed into a *price effect* and an *exchange rate effect.*

3.2 Stylized Facts on French Domestic and External Sectoral Portfolios

3.2.1 External Portfolios

Table 1 decomposes the external assets and liabilities as ratio to GDP of each sector in 2008.1 and 2014.1. Table 1, panel A aggregates debt and equity positions which are dis-aggregated in panel B and panel C. Changes in assets and liabilities between 2008.1 and 2014.1 are measured by their percentage points (ppts) changes in their share of GDP. The analysis of sectoral portfolios allows to understand the role played by each sector in the large deterioration of the external security position of France from a net positive position in 2008.1 (+4.7 of GDP) to a large net negative position (−35.7% of GDP) in 2014.1:

Stylized Fact 1 ***[Net External Position]****: The sharp deterioration of the net external position between 2008.1 and 2014.1 (−41 ppts) is explained by the deterioration of the external position of: the public sector (−24 ppts), the banking sector (−15 ppts), and the corporate sector (−8 ppts). The insurance sector is the only sector whose net external position improved (+8 ppts).*

Between 2008.1 and 2014.1, the external asset position barely changed from 100.2 to 101.3 percent of GDP while the external liability position deteriorated sharply from 95.6 to 137 percent of GDP, thus explaining entirely the deterioration of the net external position. Underlying those aggregates are large re-shufflings in sectoral positions both on the asset and the liability side.

Stylized Fact 2 ***[External Assets and Liabilities]****: The stability in aggregate external asset portfolio between 2008.1 and 2014.1 has been associated with a sharp reduction in the external assets of the banking sector (−9 ppts) largely compensated by an increase in the external assets of the insurance sector (+6 ppts) and of mutual funds (+1.5 ppts). The deterioration*

of the net external position (Stylized Fact 1) is due to a deterioration in the liability positions.

Breaking down positions between debt and equity (Table 1, panel A and panel B) reveals that the net external position in 2008.1 was positive in debt (+12.8 percent of GDP) and negative in equity (−8.1 percent of GDP). By 2014.1, the net external position in equity barely changed (−6.6 percent of GDP), but the net position in debt became strongly negative (−29 percent of GDP). This implies that the sharp deterioration in the net external portfolio (−41 percent) can be explained by that of the debt liability position. The underlying sectoral patterns can be summarized as:

*Stylized Fact 3 [**Debt versus Equity Portfolio**s]: The deterioration in the net external position (-41ppts) is mostly explained by the increase of debt liabilities (−39 ppts) and is mostly driven by the increased debt liabilities of the public sector (+24 ppts), the banking sector (+5.5 ppts), and the corporate sector (+6.5 ppts). On the asset side, banks reduce sharply their external debt holdings (−10 ppts), while the insurance sector increased them significantly (+5 ppts).*

Table 2 summarizes the stylized facts described above by showing the contribution of each sector and each balance-sheet item to the change in the net external portfolio position between 2008.1 and 2014.1.

Table 3 contrasts the role of Eurozone and non-Eurozone countries in external portfolios. The net position of France vis-à-vis the Eurozone deteriorated from 23.4 to 13.6 percent of GDP. Vis-à-vis non-Eurozone countries, the net position of France deteriorated three times more, from −18.6 to −39.2 percent of GDP. The related sectoral patterns can be summarized as follows:

*Stylized Fact 4 **[Eurozone versus ROW]:** The deterioration of the net portfolio position vis-à-vis the non-Eurozone countries has been three times larger than vis-à-vis the Eurozone countries (−30.7 ppts vs. −9.7 ppts). The banking sector shifted from being a net portfolio creditor to becoming a net debtor vis-à-vis non-Eurozone countries. The deterioration in the public sector liability position has been about five time larger vis-à-vis the non-Eurozone countries than vis-à-vis Eurozone countries (−19.8 ppts vs.−4.4 ppts).*

Table 4 decomposes the Eurozone asset portfolios further into assets held on GIPS countries (Greece, Italy, Portugal, Spain) versus asset held on Non-

GIPS countries.[5]As expected the reduction in the exposure to GIPS countries has been massive between 2008.1. and 2014.1, from 23.6 to 11.29 percent of GDP, and especially so in the banking sector (from 10.5 to 4.7 percent of GDP). By contrast the international asset position towards non-GIPS countries has increased slightly from 39.2 to 43.1 percent of GDP, with the largest contribution coming from the insurance sector (+3.2 ppts).

Stylized Fact 5 ***[GIPS versus Non-GIPS]:*** *The asset exposure of French sectors to Eurozone countries exhibited a retrenchement from GIPS countries (*−11.9 *ppts), with a large contribution of the banking sector (*−5.9 *ppts), and a more modest expansion towards the non-GIPS countries (*+4.2 *ppts).*

Table 5, panel A decomposes the evolution of international sectoral portfolios between 2008.1 and 2014.1 between *flows and valuations*. Panel B and panel C provide the same decomposition for debt and equity portfolios. Overall, exchange rate fluctuations (FX) play a modest role compared to changes in asset prices (P) and portfolio flows (F). As previously discussed, most of the change in the country's external net portfolio position came from the debt liability side, and since the valuation losses on the liability side were, to a large extent, compensated by valuation gains on the asset side, net flows contributed seven times more to the change in the net portfolio position than net valuation effects (−36.2 ppts versus −5.1 ppts). The relative role of flows and valuations varies however substantially across sectors as summarized below.

Stylized Fact 6 [***Valuations versus Flows]:*** *Valuation effects account for about* 12 *percent of the change in the net external portfolio position between 2008.1 and 2014.1. The increase in the assets portfolio of the insurance sector is balanced between flows and valuation effects while the banking sector mostly experienced negative net asset flows. Valuation effects account for* 15 *to* 20 *percent of the deterioration of the liability position of the public sector, corporate sector, and the banking sector. Net valuation effects are about equally divided between equity and debt portfolios.*

[5]For such decomposition, the information is restricted on the asset side.

3.2.2 External Cross Sectoral Portfolios

Table 6 describes the asset and liability linkages between French sectors and the Eurozone sectors. The table shows how much a French sector (e.g. the banking sector) is exposed to a Eurozone sector (e.g. the corporate sector). The Eurozone sectors include four sector (banking, corporates and households, mutual funds and insurances, public).

Looking at the total assets combined of French sectors reveals a strinking fact: while the overall exposure stays nearly constant, the distribution of that exposure across the different Eurozone sectors changes dramatically between 2008.1 and 2014.1: the exposure to the Eurozone banking sector got reduced from 16.5 to 12.2 percent of GDP, and that to the Eurozone corporate and household sectors was divided by two from 20.3 to 10.7 percent of GDP; meanwhile the exposure to the mutual funds and insurance sector more than tripled from 6.7 percent of 22.7 percent of GDP. Turning to specific French sectors, the French banking sector reduced its exposure to the Eurozone banking sector substantially (from 7.7 to 4.7 percent of GDP), but it reduced exposure to the Eurozone corporate and household sector even more (from 7.9 to 1.3 percent of GDP). The insurance sector expanded its asset position in Eurozone mutual funds and insurances (from 0.9 to 7.5 percent of GDP).

On the liability side, French sectors combined increased their liabilities to Eurozone sectors from 39.1 to 51.47 percent of GDP, with almost all of this increase corresponding to an increase of French assets in the Eurozone banking sector portfolio.

Stylized Fact 6 ***[Eurozone Sectors]:*** *During the period 2008.1-2014.1, the exposure of French sectors to Eurozone sectors changed dramatically: a large reduction of the exposure to the Eurozone banking sector (*-4.3 *ppts) and Eurozone corporate/household sector (*-9.6 *ppts) was mirrored by a large increase in the exposure to the Eurozone mutual funds and insurance sector (*$+16$ *ppts). The increase in French liabilities towards the Eurozone (*$+12.3$ *ppts) has been almost entirely absorbed by the Eurozone banking sector.*

3.2.3 Domestic versus External Portfolios

Table 7 contrasts the evolution of the domestic and the foreign portfolio between 2008.1 and 2014.1. Panel A presents the domestic positions, panel B the external positions, and panel C the consolidated positions. While the aggregate domestic portfolio is balanced, by construction, there are "*internal*"

imbalances at the sector-level as well as external and consolidated imbalances. The comparison of the domestic, foreign and consolidated portfolios across sectors could be summarized as follows:

*Stylized Fact 8 [**Domestic and Foreign Portfolios]:** The banking sector improves its domestic net portfolio position (by* 11 *ppts) while its foreign net portfolio position deteriorates (by* 15 *ppts), as a result of a shift of its liabilities from foreign to domestic, and of its assets from foreign to domestic. The banking sector consolidated net position deteriorated modestly (*-3.8 *ppts). The public sector increased its external liabilities significantly more than its domestic liabilities (*-12.7 *ppts vs* -24 *ppts). The insurance sector increased its domestic assets (*$+13.2$ *ppts) significantly more than its foreign assets (*$+6.3$ *ppts).*

Consolidating the domestic and external sector net positions (panel C) reveals that in 2014.1 the insurance sector is the largest net security creditor ($+90\%$ of GDP) while the public sector (-77% of GDP) and the corporate sector (-63% of GDP) are the largest net debtors.

By looking at the share of foreign securities in total portfolios in 2008.1 and 2014.1 (Table 8), one can assess the relative role of p*ortfolio growth vs. portfolio re-balancing*, as discussed by Kraay and Ventura (2000). An implication of portfolio growth is that the share of foreign portfolio on domestic portfolio must remain roughly constant over time. Interestingly, the portfolio growth hypothesis works very well for the aggregate assets position - a constant share of about 37 percent of foreign assets over total assets - despite large heterogeneity across sector, with the retrenchment of the banking sector being compensated by the outwards expansion of other sectors, mostly the household sector. On the liability side, the aggregate portfolio liability position became increasing international, reflecting re-balancing towards foreign liabilities in all sectors. Theses findings can be summarized as follows:

*Stylized Fact 9 [**Portfolio Growth versus Re-balancing]:** The share of the aggregate foreign asset portfolio remained constant between 2008.1 and 2014.1 despite large heterogeneity across sectors, with the banking sector exhibiting retrenchment, and the household sector foreign expansion. On the asset side, the evolution of the portfolio of the insurance sector and that of mutual funds are consistent with the portfolio growth hypothesis. The share*

of foreign liabilities in total liabilities increased sharply over the period and all sectors re-balanced their liabilities towards international liabilities. Only the insurance sector exhibits a behavior consistent with portfolio growth on the liability side.

3.3 The Network Structure of Domestic and External Portfolios

The cross-sectoral asset and liability positions between domestic sectors, and between domestic sectors and the rest of the world form a weighted network whose weights are determined by the size of cross-sectoral exposures. Figure 3 graphs the network of domestic sectors. An arrow pointing from sector i to sector j indicates the amount of liabilities issued by sector j which are held in the asset portfolio of sector i. Cross-holdings are normalized by GDP and positions amounting to less than 1 percent of GDP are omitted to keep the graph easily readable. Each node represents a sector and the size of each node is proportional to the sum of total security assets of the sector.[6] The position of sectors in the graph is based on the number of links through which a sector is connected with other sectors, that is the number of cross-sector asset and liability positions that exceed one percent of GDP. The intensity of cross-sector links is captured by the thickness of the arrows.

Figure 3 compares the domestic network in 2008.1 and 2014.1. From Table 7, we know that the total of domestic security assets positions (which by construction is also the total of domestic security liabilities) barely changes (from 167 to 170 percent of GDP) but the network graph reveals that the *distribution of domestic cross-sectoral asset and liability position did change substantially.* A large fraction of the increase in the asset position of the insurance sector (from 44.9 to 58 percent of GDP) corresponds to a change in its holdings of public sector securities (+6.2 ppts). The banking sector slightly increased its domestic asset position (from 39 to 43 percent of GDP) as a result of a reduction in its holdings of corporate sector securities (from 5.6 to 3.5 percent of GDP), and an *increase* in its holdings of public sector securities (from 7.9 to 12.9 percent of GDP). The banking sector also reduced its liability positions (from 56 to 49 percent of GDP), which is reflected in the reduction of the holdings of bank securities in the portfolio of corporations,

[6] A node of the size of GDP is plotted on the top right hand corner of the Figure to provide a reference for the scale of the nodes.

households, and mutual funds. Finally, the government reduces its holding of securities issued by corporations (through privatization of government's assets) and households reduce their holdings of mutual funds. These findings can be summarized as follows:

Stylized Fact 10 [***Domestic Network]:*** *The banking and insurance sectors increase their holdings of government securities. The banking sector did so by reducing its holdings of corporate sector securities and the insurance sector by increasing its overall asset position. The reduction of banking sector liabilities has been associated with a reduction in the holdings of bank liabilities by corporations, mutual funds, and households.*

Figure 4 adds the rest of the world (ROW) as an additional node to the network, and thus the network graph maps both external and domestic sector portfolios. In 2008.1, the ROW accounted for 38 percent of French security assets, and 36 percent of French security liabilities. By 2014.1, the foreign share of assets was about the same, but that of foreign liabilities increased to 44 percent of GDP. The graph shows the reversal in the banking sector net external portfolio through a sharp reduction in external assets and a sharp increase in external liabilities. Securities emitted by the French corporate sector became also increasingly held by the ROW. Indeed, the liabilities of the corporate sector held in domestic portfolios remain constant at 47 percent of GDP, while corporate liabilities held in foreign portfolios increased from 30.8 to 38.8 of GDP. Figure 3 breaks down the ROW between Eurozone and non-Eurozone countries. The increase in foreign liabilities of the most externally indebted French sectors (banking sector, corporate sector, and public sector) has been disproportionately tilted towards non-Eurozone countries, which thus experienced an increase in their holdings of French assets by about 30 ppts vs. 12 ppts for Eurozone countries. These findings can be summarized as follows:

Stylized Fact 11 [***International Network]:*** *Between 2008.1 and 2014.1, France experienced an increase in its international financial integration driven by the increase in liability exposure of the banking sector, the corporate sector, and the public sector. Such international financial integration has been disproportionately tilted towards liability exposure to non-Eurozone countries. The insurance sector is the only sector that significantly increased its foreign assets .*

4 An Estimated Model of Sectoral Balance-Sheet Contagion

In this section we put forward and estimate a simple flexible model of balance-sheet contagion. The central idea is that the price of securities issued by a sector depends on the price of securities held on the asset side of the sector's balance-sheet. Structually this link can be derived from a model of asset and liability management in which asset demand and supply can be modelled as functions of prices, observables and unobservable characteristics as in Koijen and Yogo (2016). Contagion then results from the endogenous reaction of asset demand and supply to price changes. Being flexible, the model can be estimated under very limited assumptions and can encompass several alternative channels of balance-sheet contagion.

Our model assumes the existence of a sector-specific shock that affects the price of the securities issued. This shock is then transmitted through contagion mechanisms to its own sector (as securities issued by one sector are held as assets in the same sector) and to other sectors who are exposed to the securities subject to a shock. Through such propagation mechanism, shocks affecting one sector can propagate to all sectors of the economy. Further, since the composition of sectoral portfolios can substantially vary over time (as shown in section 3), so can the intensity of balance-sheet transmission across sectors. Our model accounts for such time-variation.

By introducing sector-specific shocks, we have in mind that the source of these shocks depends on the sector of the economy or that aggregate shocks affect different sectors differently. For example, the source of banking sector shocks could be changes in risk perception regarding the outstanding corporate loan portfolio, while for the public sector it could be related to sovereign solvency, and for the corporate sector to the demand for goods and services. The model is flexible enough to allow for correlation between those shocks.

4.1 The Setup

There is a set of domestic institutional sectors indexed by $i \in \{1, 2, \ldots, I\}$. The set of assets available for investment to sector i is noted by $\mathcal{P}_i^A$. It comprises securities issued by domestic sectors indexed by $j(i')$, $i' \in \{1, 2, \ldots, I\}$, and securities that are issued by foreign entities. The foreign portfolio of each

sector is different and is summarized by one bundled *sector-specific foreign asset* denoted by $f(i)$. It thus allows to capture the heterogeneity of returns on foreign asset portfolios across sectors highlighted by Galstyan and Velic (2018) for the case of Germany. Similarly, all other types of instruments that are not part of portfolio investments, such as loans, cash or real assets are bundled into a *sector-specific outside asset* noted $o(i)$. Each sector i can also raise funds through issuing either securities denoted by $j(i)$ or other financial instruments which are again bundled into the outside asset $o(i)$. The set of assets available to sector i for raising funds is denoted $\mathcal{P}_i^L$. In the following, we model equilibrium returns on the domestic securities issued by the different sectors, taking as given returns on foreign portfolio investments and outside assets.

We build on the approach followed by Koijen and Yogo (2018) and model a sector's optimal portfolio allocation as a logit model of asset characteristics. Compared to the mean-variance case, where the optimal allocation depends on the full variance-covariance matrix of returns, this might seem an over-simplification. However, when it is additionally assumed that (i) returns follow a factor structure, *and* that (ii) the factor loadings depend on asset characteristics, the optimal mean-variance allocation and the characteristics-based logit model can be shown to be approximately equivalent. In this case, asset characteristics are sufficient to capture expected returns and their variance-covariance.

With $s \in \{A, L\}$ noting assets or liabilities, the share of sector i's balance-sheet invested in (or raised through) asset k in period t is modeled as

$$\omega_{ikt}^s = \frac{\exp\left(b_{i0}^s + b_i^s \log P_{kt} + \log U_{ikt}^s\right)}{1 + \sum_{l \in \mathcal{P}_i^s} \exp\left(b_{i0}^s + b_i^s \log P_{lt} + \log U_{ilt}^s\right)}, \tag{1}$$

where b_{i0}^s and b_i^s are sector-specific intercept and coefficient on the log-price, $\log P_{kt}$, respectively, that determine the shape of sector i's demand and supply function. Asset characteristics other than the price that generate latent demand or supply for asset k are captured by the term $\log U_{ikt}^s$. Equation 1 and the budget constraint imply that the share of the outside asset is $\omega_{io(i)t}^s = 1/1 + \sum_{l \in \mathcal{P}_i^s} \exp\left(b_{i0}^s + b_i^s \log P_{lt} + u_{ilt}^s\right)$ and we derive the growth factors of balance-sheet shares from period $t-1$ to t as

$$\frac{\omega_{ikt}^s}{\omega_{ikt-1}^s} = \left(\frac{P_{kt}}{P_{kt-1}}\right)^{b_i^s} \cdot \frac{U_{kt}^s}{U_{kt-1}^s} \cdot \frac{\omega_{io(i)t}^s}{\omega_{io(i)t-1}^s}. \tag{2}$$

Taking logs of Equation 2 and using a first-order approximation, the growth rate of the share of asset k in sector i's balance-sheet,

$$z^s_{ikt} \approx b^s_i r_{kt} + \Delta u^s_{ikt} + z^s_{o(i)t}, \tag{3}$$

is approximately linear in the contemporaneous return on asset k, r_{kt}, the log-difference of latent demand (or supply), Δu^s_{ikt}, and the growth rate of the share of the outside asset, $z^s_{o(i)t}$. The coefficient on the log-price, b^s_i, is therefore simply the *sensitivity of balance-sheet share growth rates to contemporaneous returns.* Sectoral balance-sheet identities are used to determine the equilibrium vector of returns. Indeed, in equilibrium not only must markets clear, but also the value of assets must be the same as the value of liabilities for each sector:

$$A_{it} = L_{it}. \tag{4}$$

Now, using the linear expression for the growth rate of asset shares from Equation 3, sectoral balance-sheet identities can be decomposed as

$$\sum_{l \in \mathcal{P}^s_i} \omega^A_{ilt-1} \left[b^A_i r_{lt} + \Delta u^A_{ilt} \right] + z^A_{o(i)t} = \omega^L_{ij(i)t-1} \left[b^L_i r_{j(i)t} + \Delta u^L_{ij(i)t} \right] + z^L_{o(i)t}. \tag{5}$$

Returns on domestic securities must thus move to equalize asset- and liability side of the balance-sheet given the balance-sheet allocation in $t-1$, and exogenous changes in the allocation of the rest of the balance-sheet. Stacking balance-sheet identities (one for each domestic sector) in matrix notation, the I-column vector of equilibrium returns on domestic securities is shown to be

$$\mathbf{r}_t = \underbrace{\left(I - (\boldsymbol{\beta}) \widetilde{\Omega}_{t-1} \right)^{-1}}_{\equiv C(\boldsymbol{\beta})_{t-1}} \cdot \left(\underbrace{(\boldsymbol{\alpha}) \tilde{\boldsymbol{z}}_{ot}}_{(i)\, Outside\ Assets} + \underbrace{(\boldsymbol{\beta})(\widetilde{\boldsymbol{\omega}}_{ft-1}) \mathbf{r}_{ft}}_{(ii)\, Foreign\ Assets} + \underbrace{\boldsymbol{\epsilon}_t}_{(iii)\, Shocks} \right), \tag{6}$$

where *tilde* denotes normalization by the shares of a sector's liabilities raised through securities, $\omega^L_{ij(i)t-1}$. Equilibrium returns thus crucially depend on the ratio $\beta_i \equiv \frac{b^A_i}{b^L_i}$, that we call *balance-sheet contagion coefficient*, which is the relative sensitivity of sector i's asset demand over asset supply to contemporaneous returns. Importantly, given that β_i is a ratio, its value is unrestricted and, in particular, can be either smaller or larger than one. Further, we defined $\alpha_i \equiv 1/b^L_i$, the vector $\tilde{\boldsymbol{z}}_{ot} \equiv \tilde{z}^A_{o(i)t} - \tilde{z}^A_{o(i)t}$ as the asset-liability difference

in growth rates of the share of outside assets in sectors' balance-sheets, and $\boldsymbol{\epsilon}_t \equiv (\boldsymbol{\alpha})^{-1}\left[\left(\left(\tilde{\Omega}_{t-1} \quad (\widetilde{\boldsymbol{\omega}}_{ft-1})\right) \otimes \Delta U_t^A\right)\mathbf{1} - \Delta \mathbf{u}_t^L\right]$ the vector of shocks that contains sectors' latent demand and supply for domestic securities and foreign portfolio investments.

As shown in Equation 6, equilibrium returns are determined by the endogenous reaction of balance-sheet shares of domestic securities to exogenous changes in the allocation of the rest of the balance-sheet, i.e. exogenous changes in (i) the outside asset share, (ii) the return on foreign portfolio investments, and (iii) the net of latent demand and supply. The matrix $C(\boldsymbol{\beta})_t$, called *contagion matrix*, captures how exogenous changes in sectoral balance-sheets propagate to changes in equilibrium returns.

4.2 Estimation

We use the Two-Step Generalized Method of Moments (GMM) Estimator to estimate the parameters of the model. For identification, the number of moments[7] must be greater than the number of parameters[8] to estimate in equation (6). Given our restriction of zero correlation between sectoral shocks, our model is over-identified as long as the number of sectors J is larger than 3.

Moment Conditions

Equation (6) implies the following first order moments $m_1(\beta_0, \beta_1)$:

$$m_1(\beta_0, \beta_1) \equiv \mathbb{E}\left[\left(I - \beta_1\omega_t\right)\gamma_t - \beta_1\omega_t^x x_t\right] - \beta_0$$

and second order moments $M_2(\beta_0, \beta_1, \Sigma_\epsilon)$:

$$M_2(\beta_0, \beta_1, \Sigma_\epsilon) \equiv \mathbb{E}\left[\left(\left(I - \beta_1\omega_t\right)\gamma_t - \beta_1\omega_t^x x_t - \beta_0\right)\left(\left(I - \beta_1\omega_t\right)\gamma_t - \beta_1\omega_t^x x_t - \beta_0\right)'\right] - \Sigma_\epsilon$$

Since $M_2(\beta_0, \beta_1, \Sigma_\epsilon)$ is a symmetric $J \times J$ matrix this system of equation gives $J * (J+1)/2$ second-order moment conditions. The empirical moment conditions are summarized in the following column vector

[7] Since we assume shocks to be normally distributed, we only use first and second order moments. We have $N_m = J + J * (J+1)/2$ moments, corresponding to J first order moments and $J * (J+1)/2$ second order moments from the variance-covariance matrix of the sectoral shocks.

[8] Without further restrictions there are $N_p = J + J + J$ parameters (corresponding to the number of parameters in β_0 (J), the number of parameters in β_1 (J), and the number of parameters in the variance-covariance matrix of ϵ_t (J).

$$\bar{m}(\beta_0, \beta_1, \Sigma_\epsilon) = (\bar{m}_1(\beta_0, \beta_1) \;\; \bar{m}_2(\beta_0, \beta_1, \Sigma_\epsilon))'$$

Minimization

The first step GMM estimator is the minimizer of the sum of squared empirical moment conditions.

$$\left(\tilde{\beta}_0, \tilde{\beta}_1, \tilde{\Sigma}_\epsilon\right) = \arg\left\{\min_{\beta_0, \beta_1, \Sigma_\epsilon} \{\bar{m}(\beta_0, \beta_1, \Sigma_\epsilon) I \bar{m}(\beta_0, \beta_1, \Sigma_\epsilon)'\}\right\}$$

The second step GMM estimator uses the inverse of the estimate of the variance-covariance matrix of moment conditions obtained in the first step as a weighting matrix for the empirical moments. The estimate of the variance-covariance matrix of moments S_T is given by:

$$S_T = \frac{1}{T}\sum_{t=1}^{T} m_t(\tilde{\beta}_0, \tilde{\beta}_1, \tilde{\Sigma}_\epsilon) m_t(\tilde{\beta}_0, \tilde{\beta}_1, \tilde{\Sigma}_\epsilon)'$$

The second step GMM estimator is the minimizer of the sum of squared weighted empirical moment conditions.

$$\left(\hat{\beta}_0, \hat{\beta}_1, \hat{\Sigma}_\epsilon\right) = \arg\left\{\min_{\beta_0, \beta_1, \Sigma_\epsilon} \left\{\bar{m}(\beta_0, \beta_1, \Sigma_\epsilon) S_T^{-1} \bar{m}(\beta_0, \beta_1, \Sigma_\epsilon)'\right\}\right\}$$

Finally, the variance-covariance matrix of the Two-Step GMM Estimator can be obtained using the gradient of the empirical moment conditions and the updated estimate of the variance-covariance matrix of moments S_T.

4.3 Results

The estimates of the model's parameters are presented in Table 9. First, balance-sheet contagion coefficients are statistically significantly different from zero for the financial sectors, i.e. for the banking sector, the insurance sector, and for mutual funds, while they are statistically insignificant for the real sectors. This result is consistent with our prior that the return on securities emitted by real sectors rather depends on cash-flows generated in the real economy (for example profits or tax revenues) rather than on the realized return of their security portfolio. Second, all statistically significant balance-sheet contagion coefficients are positive. This result is also consistent with our prior that the return on securities emitted by the financial sector

increases with the return on its security portfolio. Third, we observe that the insurance sector is the sector who suffers more from contagion effects followed by banks and mutual funds. This result is consistent with insurances having the largest portfolio holdings of all sectors and following passive investment strategies.

We turn next to two possible applications of our estimated model.

Measuring Sectoral Financial Fragility.

To analyze the response of the return on securities emitted by a sector to sectoral shocks, we focus on the Leontief inverse $\left[I - \hat{\beta}_1 \omega_t\right]^{-1}$ (see **??**), the rows of which correspond to sectors impacted by a sectoral shock and the columns to the sector in which the shock originated. The coefficients of the Leontief inverse are sector-specific multipliers that measure the strength of the transmission of sectoral shocks through the network. These coefficients measure the instantaneous and final results of loops through the network. In the baseline model, shocks are i.i.d.[9] Since we assumed no time-variation in the balance-sheet contagion coefficients, the time-variation of the Leontief inverse is solely due to the re-balancing of sectoral portfolios that has been analyzed in section 3.3.

Figure 7 shows the time series of multipliers by impacted sector.[10] First, we observe that shocks to the banking sector and mutual funds on the return of its own securities are amplified through the inter-sectoral network with a stable factor of approximately 1.2, while the impact of shocks to the insurance sector on its own securities is roughly unity. The reason for this is the very low exposure of sectoral portfolios to the insurance sector and the fact that insurances are financed to a very small extent by security emissions. Second, in line with the re-balancing of sectoral portfolios to public securities, the vulnerability of insurance sector returns (2008.1: 0.62; 2014.1: 0.77) and banking sector returns (2008.1: 0.09; 2014.1: 0.12) to public sector shocks increased over the time period. Mutual funds securities remain relatively resilient to public sector shocks, given the small exposure of mutual funds to public sector securities (4.26%). Shocks to foreign securities have a large impact on sector returns. They constitute a large share of all sec-

[9] As a robustness check, we allowed for an AR(1) structure of the error terms. The coefficient of auto-correlation however was statistically insignificant.

[10] In the following, we have set statistically insignificant balance-sheet contagion coefficients to zero. Therefore returns on securities emitted by the corporate and the public sector are isolated from shocks to other sectors.

toral portfolios (banking sector: 46.4%, insurance sector: 38.7%, and mutual funds:50.4%). The banking sector is the most resilient to foreign security shocks with a factor of 0.48 in 2008.1 and further reduced to 0.38 in 2014.1 (in line with the retrenchment discussed in Section 3). The insurance sector is the most vulnerable with a factor of 2.5 in 2008.1 and 2.1 in 2014.1.

Corporate sector and mutual funds shocks transmit mostly to the insurance and the mutual funds sector, while the banking sector appears relatively resilient. Insurance sector shocks are confined to the insurance sector itself and do not transmit through the network. This again is due to the limited role of securities in the financing mix of the insurance sector as well as their small share in other sectors' portfolios. Figure 7 offers an alternative representation of the same results comparing how sectoral shocks affect the returns to financial sectors' securities in 2008.1 and 2014.1.

5 Conclusion

In this paper we traced the evolution of domestic and international sectoral portfolios using a unique security-level database on stocks, valuation changes and flows of all domestic and foreign portfolios of French sectors between 2008.1 and 2014.1. We generated stylized facts on their contributions to the dynamics of the France's net external security position and on bilateral linkages between sectors through security portfolios. The empirical model developed in section 4 on balance-sheet contagion proposes a flexible way to show how data on bilateral linkages can be used to structurally estimate the strength of various types of sectoral balance-sheet contagion and to measure sectoral vulnerability to shocks.

We plan to extend the results of this paper in the following directions: First, in our empirical model, balance-sheet contagion coefficients are assumed to be time-invariant. However, it is plausible that coefficients change in times of regulatory changes. Second, we aim to extend the empirical model on balance-sheet contagion to incorporate sectoral balance-sheet management constraints, such as leverage targeting or value-at-risk to assess their role in the network transmission of shocks.

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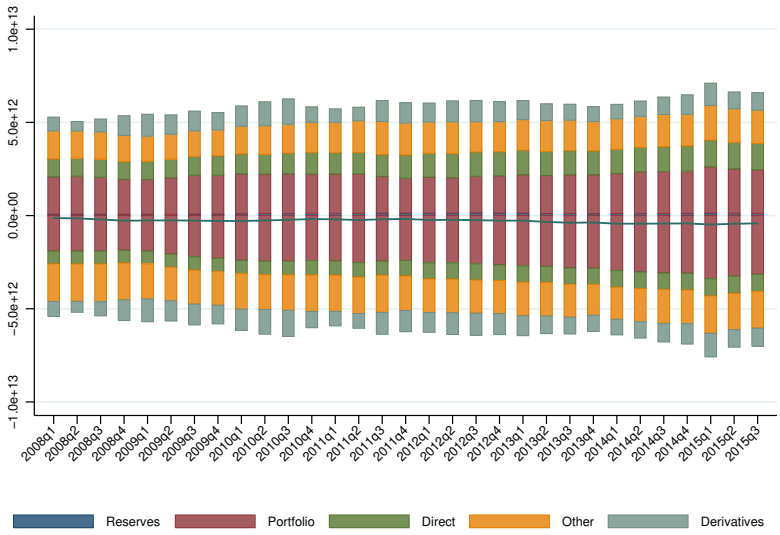
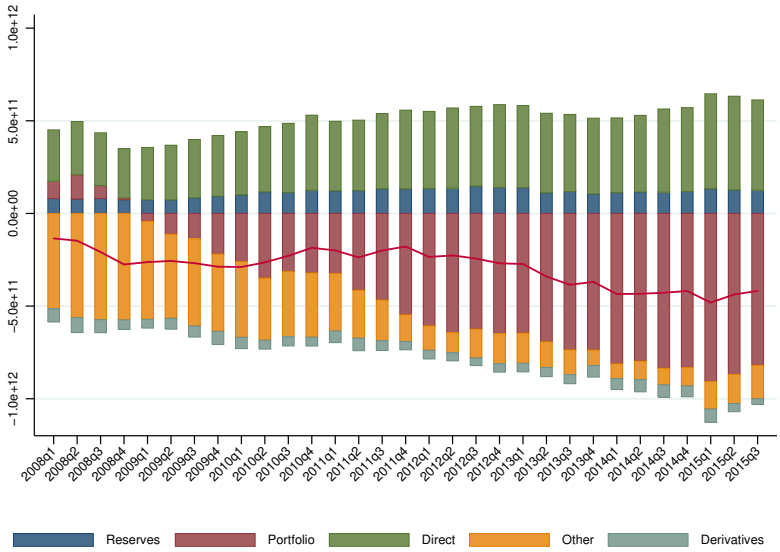
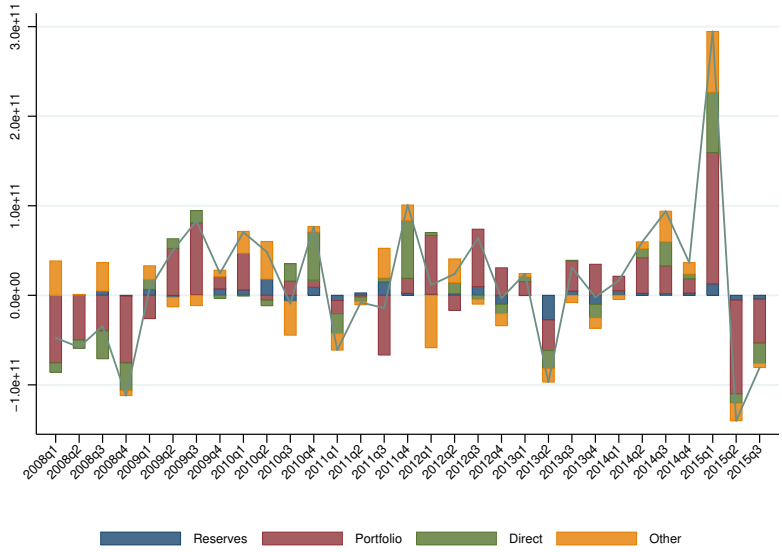


Assets and Liabilities

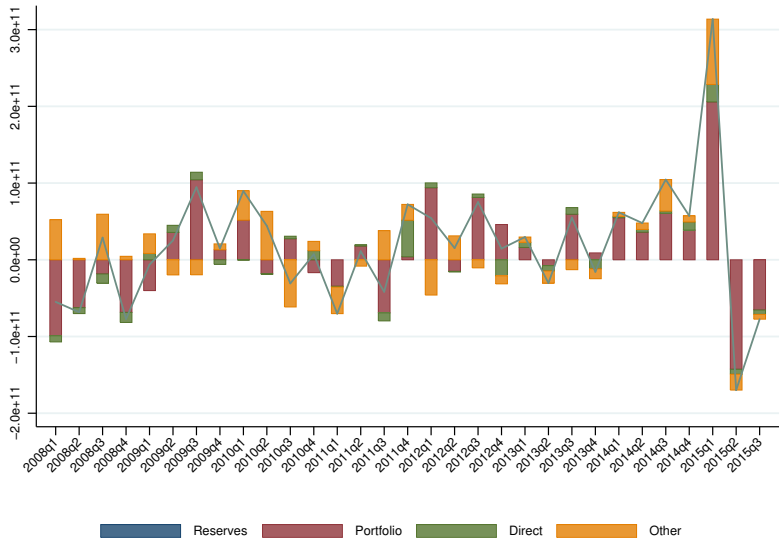


Net Position

Figure 1: **International Investment Position of France - 2008.1 to 2015.3**

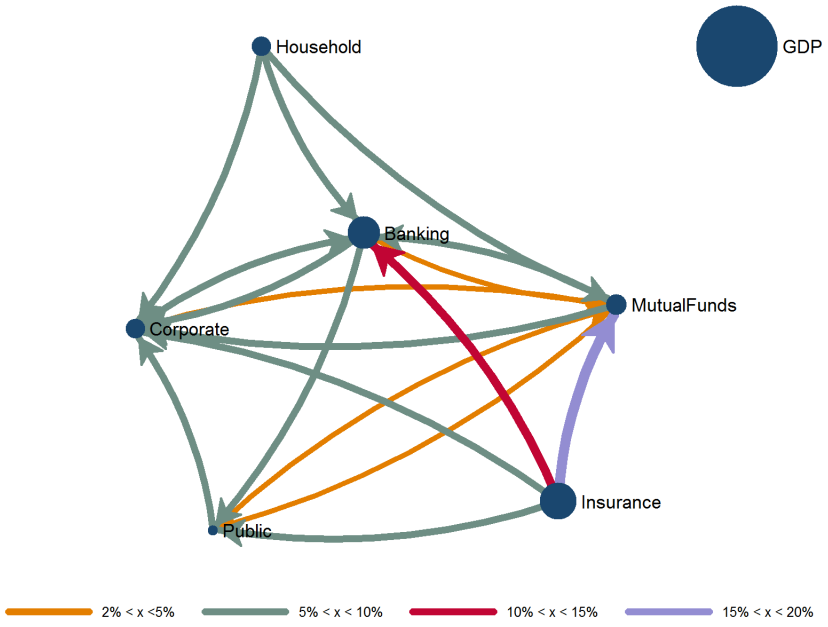


Foreign Asset Valuation (without Derivatives)

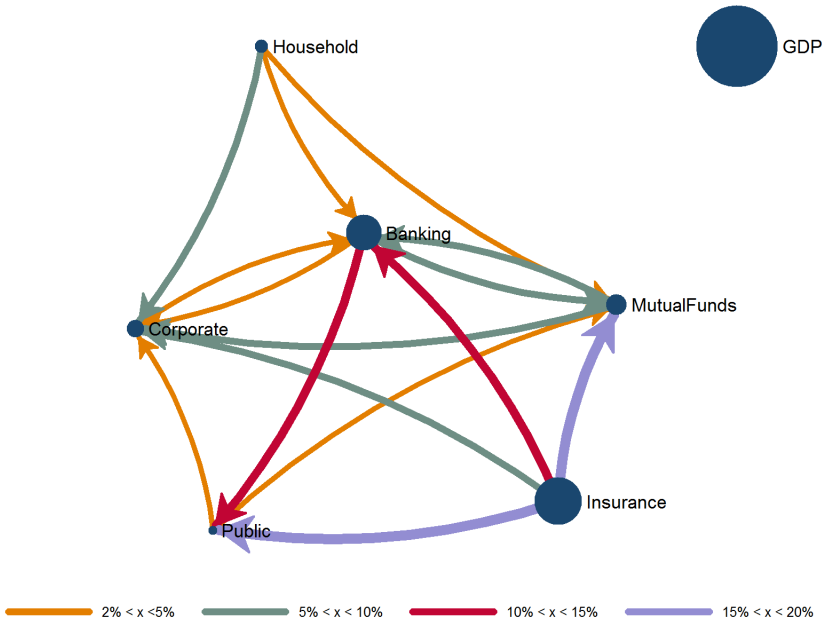


Foreign Liability Valuation (without Derivatives)

Figure 2: **Valuation of the International Investment Position of France - 2008.1 to 2015.3**

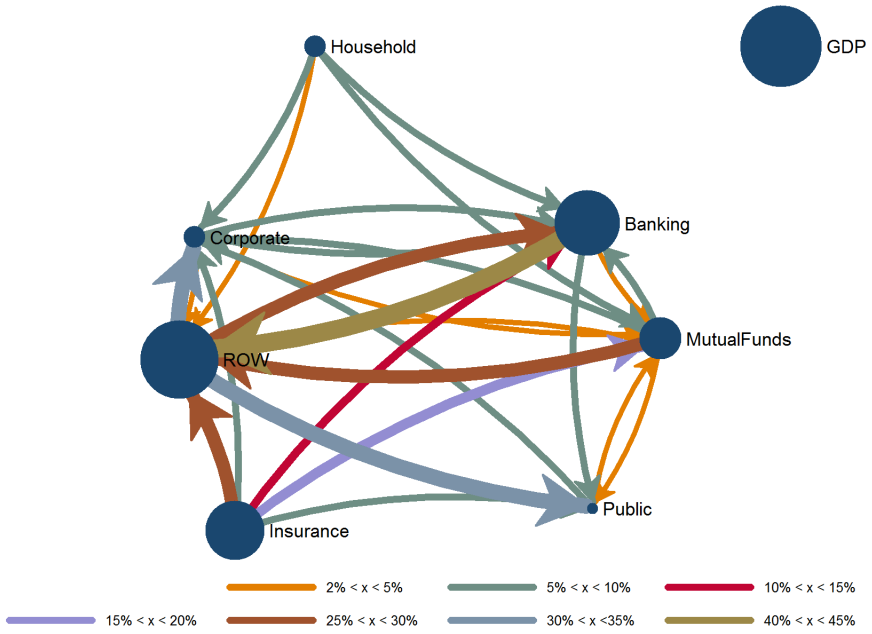


2008.1

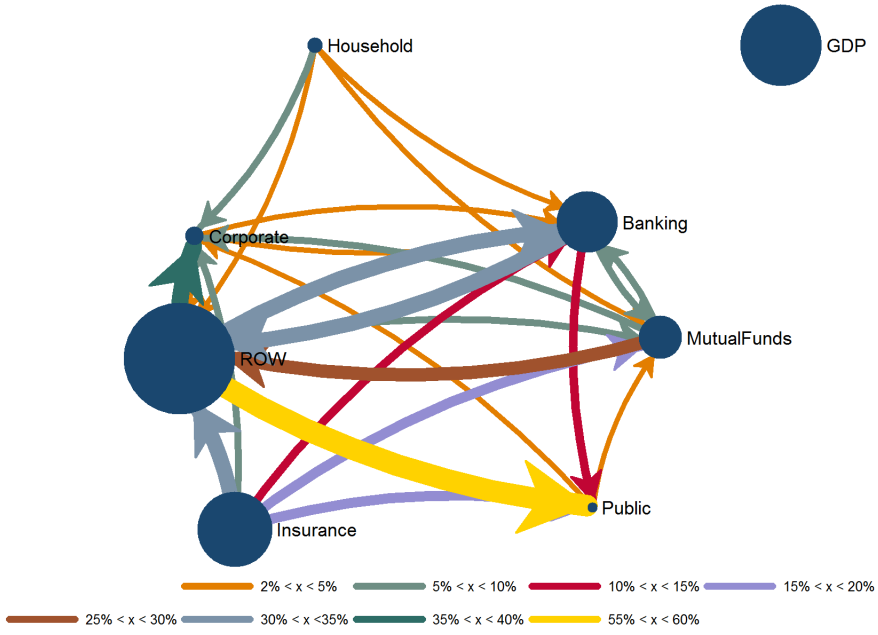


2014.1

Figure 3: **Network of Domestic Sectors**

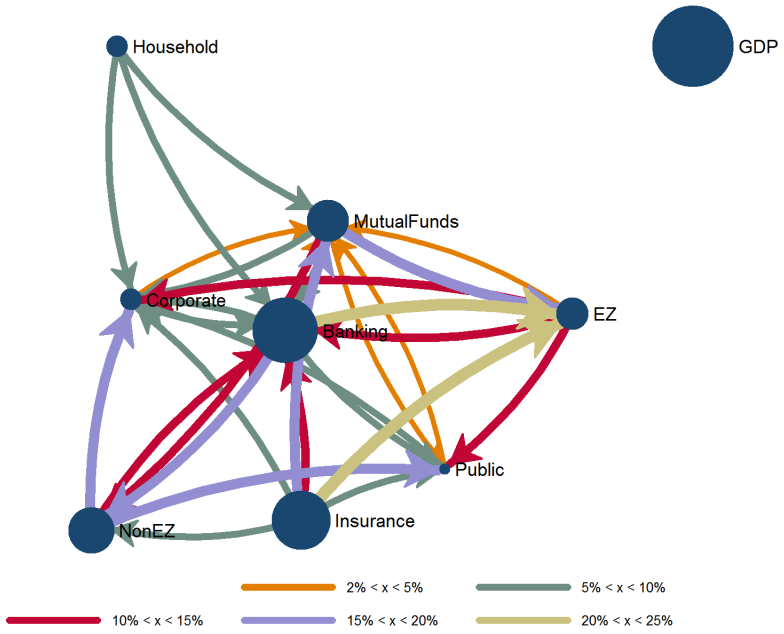


2008.1

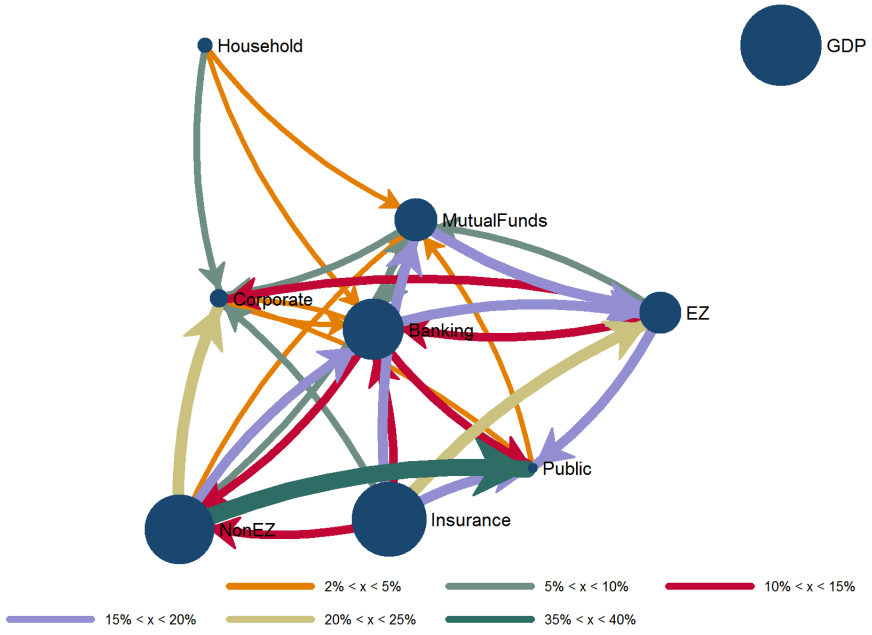


2014.1

Figure 4: **Network of Domestic Sectors and the Rest of the World**



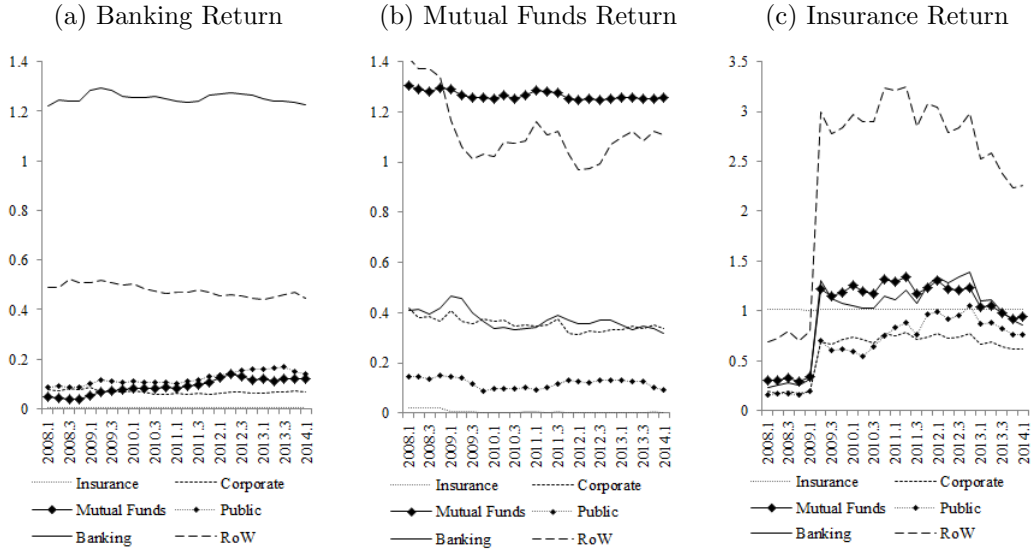
2008.1

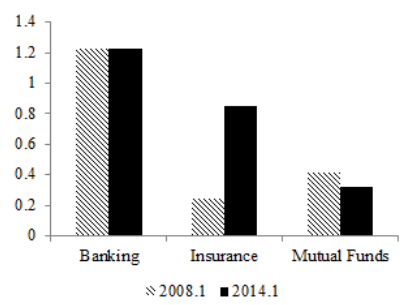


2014.1

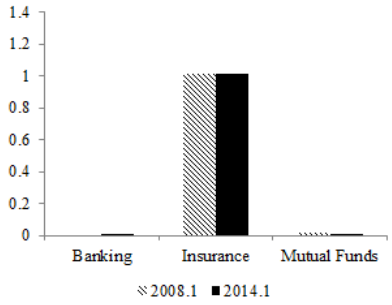
Figure 5: **Network of Domestic Sectors, Eurozone and Non-Eurozone**

Figure 6: ***Evolution of Balance-Sheet Contagion Effects from 2008Q1 to 2014Q1.***

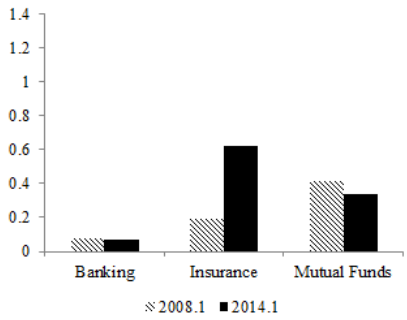




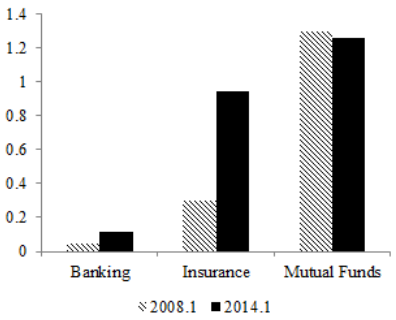
Banking Sector shock



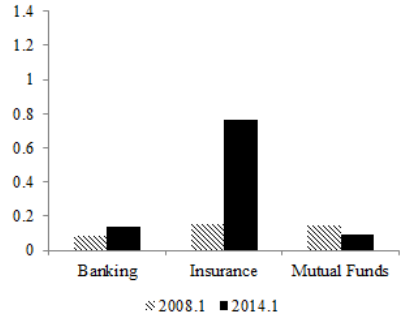
Insurance Sector shock



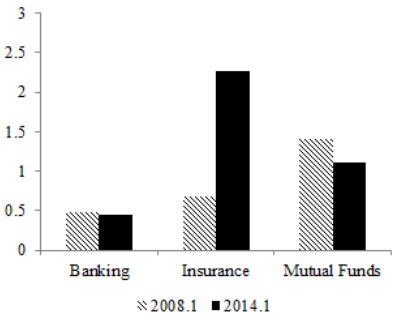
Corporate Sector shock



Mutual Funds shock



Public Sector Shock



ROW Shock

Figure 7: **Return-response to sector-specific shocks, 2008.1 vs. 2014.1**

	2008.1			2014.1		
Sector	**Asset**	**Liability**	**Net**	**Asset**	**Liability**	**Net**
Panel A: Total						
Banking	41.1	25.5	15.6	31.9	31.4	0.5
Mutual Funds	26.8	5.0	21.9	28.4	9.6	18.8
Insurance	26.8	1.9	24.9	33.1	0.57	32.5
Corporate	2.4	30.8	-28.4	2.6	38.9	-36.3
Household	2.6	0	2.6	3.0	0	3.0
Public	1.4	32.4	-31.0	1.5	56.6	-55.1
Total	100.3	95.6	4.7	101.3	137.0	-35.7
Panel B: Equity						
Banking	4.49	4.14	0.35	5.04	3.50	1.55
Mutual Funds	14.80	3.93	10.87	15.27	6.33	8.94
Insurance	2.41	1.35	1.06	3.81	0.17	3.64
Corporate	1.08	22.92	-21.84	1.34	24.54	-23.19
Household	1.34	0	1.34	1.37	0	1.37
Public	0.71	0	0.71	0.74	0	0.74
Total	24.22	32.34	-8.12	27.95	34.54	-6.59
Panel C: Debt						
Banking	36.65	21.36	15.29	26.83	27.86	-1.02
Mutual Funds	12.05	1.03	11.02	13.10	3.28	9.82
Insurance	24.42	0.56	23.86	29.30	0.40	28.91
Corporate	1.32	7.88	-6.56	1.22	14.33	-13.11
Household	1.27	0	1.27	1.62	0	1.62
Public	0.69	32.40	-31.71	0.75	56.57	-55.82
Total	76.04	63.23	12.81	73.37	102.43	-29.06

Table 1: **Breakdown of External Sectoral Portfolios into Equity and Debt (% of GDP)**

	Debt			Equity			Total
Sector	**Asset**	**Liability**	**Net**	**Asset**	**Liability**	**Net**	**Net**
Banking	−7.8	+6.5	−14.3	0.0	0.0	0.0	−14.3
Mutual Funds	+1.0	+2.2	−1.2	0.0	+2.4	−2.4	−3.6
Insurance	+4.9	0.0	+4.9	+1.4	−1.0	+2.4	+7.3
Corporate	0.0	+6.5	−6.5	0.0	+1.6	−1.6	−.8.1
Household	0.0	0.0	0.0	+2.4	0.0	+2.4	+2.4
Public	0.0	+26.0	−26.0	0.0	0.0	0.0	−26.0
Total	−1.8	+41.2	−43.0	3.8	+3.0	+0.8	−42.2

Table 2: **Change in Net External Sectoral Portfolios from 2008.1 to 2014.1 (% of GDP, <1% set to zero)**

	2008.1			2014.1		
Sector	**Asset**	**Liability**	**Net**	**Asset**	**Liability**	**Net**
Panel A: Eurozone						
Banking	22.90	11.56	11.34	18.49	13.64	4.85
Mutual Funds	15.54	3.23	12.31	18.94	6.30	12.64
Insurance	20.42	0.48	19.94	22.56	0.25	22.31
Corporate	1.69	11.23	-9.54	1.98	14.25	-12.27
Household	1.32	0	1.32	1.50	0	1.50
Public	0.88	12.64	-11.76	0.97	17.02	-16.05
Total	62.41	39.13	23.28	65.09	51.46	13.62
Panel B: Non-Eurozone						
Banking	18.24	13.94	4.30	13.39	17.71	-4.32
Mutual Funds	11.31	1.73	9.58	9.43	3.31	6.12
Insurance	6.41	1.43	4.98	10.55	0.32	10.24
Corporate	0.71	19.57	-18.86	0.59	24.62	-24.03
Household	1.28	0	1.28	1.49	0	1.49
Public	0.53	19.76	-19.24	0.52	39.55	-39.02
Total	37.85	56.44	-18.58	36.23	85.51	-49.28

Table 3: **Breakdown of External Sectoral Portfolios into Eurozone and Non-Eurozone (% of GDP)**

	GIPS			Non-GIPS		
Sector	**2008.1**	**2014.1**	**Δ**	**2008.1**	**2014.1**	**Δ**
Banking	10.54	4.67	-5.87	12.34	10.99	-1.35
Mutual Funds	3.88	2.2	-1.68	11.65	13.61	1.96
Insurance	8.36	4.56	-3.8	12.05	15.24	3.19
Corporate	0.38	0.44	0.06	1.31	1.37	0.06
Household	0.11	0.3	0.19	1.23	1.41	0.18
Public	0.26	0.07	-0.19	0.59	0.79	0.2
Total	23.53	12.24	-11.29	39.17	43.41	4.24

Note: GIPS comprise Greece, Italy, Portugal and Spain

Table 4: **Breakdown of Sectoral Eurozone Asset Portfolio into GIPS and Non-GIPS (% of GDP)**

	Asset			Liability			Net		
Sector	**FX**	**P**	**F**	**FX**	**P**	**F**	**FX**	**P**	**F**
Panel A: Total									
Banking	0.87	0.44	-9.00	0.58	1.62	4.82	0.29	-1.18	-13.82
Mutual Funds	0.61	-0.63	2.65	0.06	0.95	2.45	0.54	-1.58	0.20
Insurance	0.07	3.03	4.85	0.01	-0.38	0.38	0.06	3.41	4.47
Corporate	0.02	0.03	0.29	0.28	2.14	7.67	-0.26	-2.11	-7.37
Household	0.07	0.04	0.47	0	0	0	0.07	0.04	0.47
Public	0.06	0.06	0.07	0.16	3.89	21.96	-0.10	-3.84	-21.89
Total	1.64	3.10	1.06	1.09	8.22	37.27	0.55	-5.12	-36.21
Panel B: Equity									
Banking	0.06	-0.75	1.08	0.01	-0.49	0.17	0.06	-0.26	0.91
Mutual Funds	0.46	-1.25	2.01	0.01	0.67	0.90	0.45	-1.92	1.11
Insurance	0.05	0.00	1.60	0.00	-0.32	0.02	0.05	0.32	1.58
Corporate	0.01	-0.04	0.38	0.00	0.87	2.40	0.01	-0.92	-2.02
Household	0.07	0.00	0.08	0.00	0.00	0.00	0.07	0.00	0.08
Public	0.04	-0.04	0.08	0.00	0.00	0.00	0.04	-0.04	0.08
Total	0.67	-1.96	6.08	0.01	0.73	3.50	0.66	-2.70	2.58
Panel C: Debt									
Banking	0.81	1.18	-10.08	0.57	2.10	4.64	0.23	-0.92	-14.72
Mutual Funds	0.15	0.62	0.64	0.06	0.28	1.55	0.09	0.34	-0.91
Insurance	0.01	3.03	3.25	0.01	-0.06	0.36	0.01	3.09	2.89
Corporate	0.00	0.07	-0.09	0.28	1.27	5.26	-0.27	-1.19	-5.35
Household	0.00	0.05	0.39	0.00	0.00	0.00	0.00	0.05	0.39
Public sector	0.02	0.10	-0.01	0.16	3.89	21.96	-0.15	-3.79	-21.97
Total	0.96	5.06	-5.01	1.07	7.48	33.78	-0.11	-2.42	-38.79

Table 5: **Breakdown of the Change of External Sectoral Portfolios from 2008.1 to 2014.1 into Valuation (FX) Effects, Price (P) Effects and Flows (F) (% of GDP)**

Sector	Asset					Liability				
	Banking	**Corporate & Household**	**Mutual Funds & Insurance**	**Public**	**Total**	**Banking**	**Corporate & Household**	**Mutual Funds & Insurance**	**Public**	**Total**
Panel A: 2008.1										
Banking	7.73	7.88	0.75	6.52	22.88	11.03	0.37	0.17	0	11.57
Mutual Funds	2.6	6.02	4.07	2.84	15.53	2.6	0.22	0.4	0.01	3.23
Insurance	5.5	4.88	0.86	9.17	20.41	0.46	0.01	0.01	0	0.48
Corporate	0.26	0.71	0.47	0.25	1.69	9.63	1.13	0.46	0	11.22
Household	0.3	0.52	0.47	0.05	1.34	0	0	0	0	0
Public	0.18	0.32	0.06	0.29	0.85	12.43	0	0.2	0	12.63
Total	16.57	20.33	6.68	19.12	62.7	36.15	1.73	1.24	0.01	39.13
Panel B: 2014.1										
Banking	4.67	1.26	4.94	7.62	18.49	12.53	0.49	0.63	0	13.65
Mutual Funds	2.2	5.3	7.9	3.55	18.95	5.35	0.16	0.79	0	6.3
Insurance	4.56	3.29	7.51	7.2	22.56	0.23	0	0.01	0	0.24
Corporate	0.44	0.34	1.02	0.18	1.98	12.2	1.38	0.67	0	14.25
Household	0.3	0.4	0.78	0.03	1.51	0	0	0	0	0
Public	0.07	0.15	0.53	0.23	0.98	15.55	0.03	1.45	0	17.03
Total	12.24	10.74	22.68	18.81	64.47	45.86	2.06	3.55	0	51.47

Table 6: **Breakdown of Sectoral Eurozone Asset Portfolio into Eurozone Sectors (% of GDP)**

	2008.1			2014.1		
Sector	**Asset**	**Liability**	**Net**	**Asset**	**Liability**	**Net**
Panel A: Domestic						
Banking	38.8	56.1	-17.3	43.2	49.2	-5.9
Mutual Funds	24.3	39.4	-15.1	24.4	42.2	-17.8
Insurance	44.9	2.6	42.3	58.1	0.73	57.4
Corporate	23.5	47.6	-24.1	20.3	46.9	-26.6
Household	23.5	0.00	23.5	15.3	0.00	15.3
Public	11.8	21.4	-9.6	9.87	31.82	-21.95
Total	167.13	167.13	0.00	170.77	170.77	0.00
Panel B: Foreign						
Banking	41.1	25.5	15.6	31.9	31.4	0.5
Mutual Funds	26.8	5.0	21.8	28.4	9.6	18.8
Insurance	26.8	1.9	24.9	33.1	0.6	32.5
Corporate	2.4	30.8	-28.4	2.57	38.87	-36.30
Household	2.61	0	2.61	3.0	0	3.0
Public	1.4	32.4	-31.0	1.50	56.57	-55.07
Total	100.3	95.6	4.7	101.3	137.0	-35.7
Panel C: Consolidated						
Banking	79.96	81.61	-1.64	75.1	80.5	-5.4
Mutual Funds	51.1	44.4	6.7	52.8	51.8	1.0
Insurance	71.77	4.50	67.27	91.2	1.3	89.9
Corporate	25.87	78.39	-52.52	22.9	85.8	-62.9
Household	26.07	0.00	26.07	18.2	0.0	18.2
Public	13.2	53.8	-40.6	11.4	88.4	-77.0
Total	267.4	262.70	4.70	272.1	307.8	-35.7

Table 7: **Breakdown of Sectoral Portfolios in Domestic and Foreign (% of GDP)**

	Asset			Liability		
	2008.1	**2014.1**	Δ	**2008.1**	**2014.1**	Δ
Banking	51.45	42.45	-9.00	31.25	38.96	7.71
Mutual Funds	52.49	53.76	1.27	11.18	18.54	7.37
Insurance	37.39	36.30	-1.08	42.39	43.85	1.46
Corporate	9.27	11.21	1.95	39.29	45.33	6.04
Household	9.99	16.40	6.41	/	/	/
Public	10.63	13.17	2.54	60.21	64.00	3.79
Total	37.50	37.24	-0.26	36.38	44.51	8.13

Table 8: **Share of the External Sectoral Portfolio in the Total Sectoral Portfolio in 2008.1 and 2014.1 (% of GDP)**

	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\sigma}_\epsilon$
Banking	0.003**	3.195***	0.008***
	(.00)	(.96)	(.00)
Insurance	-0.003	4.879***	0.026*
	(.01)	(.94)	(.00)
Mutual Funds	-0.000	1.818***	0.007***
	(.00)	(.06)	(.00)
Corporate	-0.005	-0.261	0.068
	(.02)	(139.71)	(.07)
Public	0.006*	-0.371	0.012***
	(.00)	(.32)	(.00)

Significance: "***" at 1%; "**" at 5%; "*" at 10%

Table 9: **Two-Step GMM Estimates of Model Parameters**