WP/18/93

IMF Working Paper

Financial Crises, Macroeconomic Shocks, and the Government Balance Sheet: A Panel Analysis

by Matteo Ruzzante

INTERNATIONAL MONETARY FUND

 WP/18/93

IMF Working Paper

Statistics Department

Financial Crises, Macroeconomic Shocks, and the Government Balance Sheet: A Panel Analysis

Prepared by Matteo Ruzzante*

Authorized for distribution by Rainer Köhler

April 2018

Abstract

Government financial assets are increasingly recognized as playing an important role in assessing fiscal sustainability. However, very little research has been done on the dynamics of government financial assets compared to liabilities. In this paper, we investigate the impact of recent financial crises and macroeconomic shocks on government balance sheets, decomposing the separate effects on financial assets and liabilities. Using quarterly Government Finance Statistics (GFS) data, we analyze a panel of 27 countries over the period 1999Q1-2017Q1 through fixed effects and panel VAR techniques. Financial crises are shown to deteriorate the net financial worth of governments, but no significant impact is found on assets suggesting that they are not being used as fiscal buffers in bad times. On the contrary, countries that suffered both financial and banking crises experienced an "artificial" increase of their asset position through bank bailouts. Macroeconomic shock analyses reveal that government balance sheet items are countercyclical, but important asymmetries are found in their dynamics.

JEL Classification Numbers: E62, G01, H12, H63

Keywords: Government Financial Assets, Government Debt, Financial Crisis, Banking Crisis, Debt Sustainability Analysis.

Author's E-Mail Address: ruzzante.matteo@gmail.com

---

* I wish to thank Rifaat Basanti, Gary Jones, and Zaijin Zhan, for their continuous support and guidance provided during the research project. I am grateful to all the colleagues of the Government Finance Division in the IMF's Statistics Department, especially Alberto Jimenez de Lucio, Noriaki Kinoshita, Rainer Köhler, Clement Ncuti, Roderick O'Mahony, Iana Paliova, Philip Stokoe, and Tobias Wickens, for valuable comments, as well as seminar participants in the STA Brown Bag at IMF. Vassili Bazinas, Laurent Kemoe, Ethan Weisman, and Seyed Reza Yousefi gave insightful reviews of subsequent drafts of the paper. I would also like to thank Dario Giacomelli, Diane Kostroch, Elodie Marlet, Mike Seiferling, and Nelson Sobrinho, for very useful discussions and suggestions.

Contents

List of Tables

List of Figures

I Introduction

The global financial crisis (GFC) has posed serious concerns about the long-term sustainability of public finances in advanced countries, whose public debt reached an unprecedented peak in the last decade. The policy debate has tended to center on the current debt overhang, neglecting an additional card that governments could play in the event of crises, which is their stock of outstanding assets. By the same token, debt sustainability analysis (DSA) has been overwhelmingly focused on the liability position of the public sector, rather than on its assets. This bias towards debt liabilities has been generally related to data unavailability and to the argument that financial assets held by the government are not liquid enough to finance budget deficits or repay existing debts. In particular, data on gross debt have historically been seen as more reliable and comparable than those on net debt: different assets have been taken into account when constructing measures of net debt in different countries, reducing the scope for comparisons across countries.[1] Nevertheless, recent research has highlighted the important role that assets can play for fiscal sustainability, especially in emerging economies (EMEs). Based on this evidence, the International Monetary Fund (IMF) has recently started to incorporate highly liquid financial assets in DSA in order to capture the effective exposure of the public sector to fiscal risks.[2]

There exist many hypotheses why assets may be important for fiscal policy and crisis resolution. First, assets can serve as a fiscal buffer in bad times, in that the government can liquidate them in order to cope with periods of economic or financial crisis. This policy resource turns assets into a potential instrument to shift income across time and smooth business cycles. Assets can also be used to pay back debt or finance deficits when market access is lost, reducing government rollover risk. Finally, assets can work as a signaling device of fiscal commitment and solvency, given that investors can rely on their divestment as a means of debt repayment.[3] The existing literature has focused exclusively on the potential benefits of holding assets, whereas little research exists on the determinants and on the dynamics of assets. For instance, questions that are still unanswered are: What is the relationship between government financial assets and liabilities? How do assets react to episodes of financial distress or economic hardship? Are assets procyclical or not?

In this paper, we aim to fill the gap in the literature by empirically investigating the effect of financial crises on the balance sheet of the government, separating the impact on financial assets and liabilities. We also explore the mechanisms that underlie these effects, namely fiscal stabilization and bank bailout processes. Then, we test the response of government financial assets to

[1]Dippelsman, Dziobek, and Gutiérrez Mangas (2012) pointed out that “while key macroeconomic indicators such as Gross Domestic Product (GDP) or Consumer Price Index (CPI) are based on internationally accepted methodologies, indicators related to the debt of the public sector often do not follow international standards and can have several different definitions”. Thus, they show that “the absence of the standard nomenclature can lead to major misunderstandings in the fiscal policy debate”.

[2]See an overview of techniques in Chalk and Hemming (2000). Discussions on this issue are also presented in IMF (2011, 2013, 2016).

[3]To a certain extent, accumulating excessive financial assets can also be considered not to be desirable for the government, as it may eventually end up crowding out the private sector and, thus, hamper economic activity.

macroeconomic shocks in comparison with the one of government liabilities. In this way, we are able to unveil the existence of symmetries and asymmetries between the dynamics of government financial assets and liabilities.

We combine quarterly data from Government Finance Statistics (GFS) with a country-specific indicator of financial crisis and a set of macroeconomic variables, based on a parsimonious model of public debt dynamics. This study represents the first empirical work to employ the quarterly GFS dataset, which provides financial balance sheets of the general government, i.e., its financial assets and liabilities decomposed by instrument. Our sample covers 27 countries, which are mostly advanced economies (AEs), for the period 1999Q1-2017Q1. Besides their high frequency, the main benefit of these data is that they are comparable across countries as they rely on a common underlying framework, as set forth in the *Government Finance Statistics Manual* (IMF, 2014).

We use three different econometric approaches in order to address our research questions: static and dynamic fixed effects models, and a panel vector autoregressive (VAR). The fixed effects model allows us to study the government behavior during periods of financial crisis, i.e., its contemporaneous response to financial shocks originated in the stock market. On the other hand, the panel VAR allows us to explore the dynamic response of financial assets and liabilities to a wide range of macroeconomic shocks. In particular, we estimate impulse response functions (IRFs) to changes in GDP growth, inflation, short-term interest rate, and global volatility.

Financial crises are shown to deteriorate the net financial worth of governments, but no significant impact is found on financial assets suggesting that there may be little room for using them as fiscal buffers in bad times.[4] In other words, we find no empirical evidence in support of the hypothesis of financial assets being used as an instrument of fiscal policy in recent periods of financial distress: accumulating additional debt seems to be far more popular among governments than liquidating assets. On the contrary, countries that suffered both financial and banking crises experienced an "artificial" increase of their asset position through processes of bank bailout. In the second part of the paper, we find both liabilities and financial assets to be countercyclical, but the effect of a GDP shock is estimated to be twice as large on governments' liabilities than on their financial assets suggesting a stickier behavior of assets. On the other hand, increases in the short-term interest rate and in global volatility seem to inflate both government financial assets and liabilities.

We conclude that incorporating financial assets in DSA may not be as simple as it looks in that government assets seem to have different determinants and follow distinct dynamics compared to government debt. Our empirical results shed new light on the government balance sheet and paves the way for new research, needed to fully understand government behavior with regard to its portfolio management, and properly incorporate government financial assets in DSA.

[4]Government net financial worth, as defined in GFSM 2014, is financial assets less liabilities. This paper generally refers to (gross) debt and liabilities interchangeably.

The remainder of the paper is organized as follows. Section II provides a brief literature review on the importance of government assets and liabilities for fiscal policy and DSA. Section III describes the data and defines the variables of interest. Section IV outlines some stylized facts on the government balance sheet. Section V presents the estimation strategy. Section VI reports the main econometric results and the related sensitivity tests. Section VII concludes by suggesting some policy implications and by proposing further research avenues.

II Literature Review

The debate about gross and net debt dates back at least to the 1980s and originally arose from the need to incorporate assets as a relevant dimension of the government fiscal position. Boskin (1982) and Eisner and Pieper (1984) were the first to recognize the importance of distinguishing between these concepts for the analysis of government solvency. In particular, Penner (1982) pointed out that the US government had been acquiring future liabilities and assets at the same time, creating a puzzle for fiscal policy analysis.

The discussion about the definition of public debt led to the collection of data and gave rise to new research on this matter. The first empirical study to focus on net debt is by Corsetti and Roubini (1991), who tested government solvency of 18 OECD countries by looking at the inter-temporal budget constraint of the public sector, which is based on its net debt rather than on its gross debt. Then, Buiter, Corsetti, and Roubini (1993) criticized the definition of debt criterion in the Treaty of Maastricht as it is defined in terms of the nominal or face value of the gross financial debt of the general government rather than the economically more relevant net non-monetary liabilities of the consolidated general government and central bank sector. On the other hand, the authors suggested that any country can secure a cosmetic reduction in gross debt by selling financial assets to redeem outstanding liabilities. As a result, they portrayed the Maastricht requirements as much more stringent than those required to ensure public sector solvency, foreshadowing the risk of an excessive degree of fiscal retrenchment, which would have negative consequences on economic activity.

More recently, Milesi-Ferretti and Moriyama (2006) examined the degree to which reductions in government debt in EU countries have been accompanied by a decumulation of government financial assets in the runup to Maastricht. They witnessed a strong correlation between changes in government liabilities and assets, and larger declines in assets in countries starting from higher public debt levels. These 'nonstructural' fiscal operations, such as securitization of government assets or the transfer of expenditures off-budget, are suggested to have no real impact on government finances even if they seemingly improve budgetary figures. On the contrary, fiscal rules set forth in the Maastricht treaty may have partly encouraged European governments to use 'creative accounting', and not only fiscal adjustment, as predicted by the theoretical model of Milesi-Ferretti (2004).

Other research investigated the impact of net government debt on borrowing costs, yielding mixed evidence. In a panel regression over the period from 1988 to 2007, Gruber and Kamin (2012) found significant effects of both gross and net debt on long-term bond yields. They addressed the endogeneity of fiscal positions to the business cycle by utilizing forward projections by international organizations, such as the Organization for Economic Co-operation and Development (OECD). On the other hand, Ichiue and Shimizu (2015) showed evidence that net debt does not provide additional information beyond gross debt to explain long-term bond yields, which means that financial assets are not relevant for explaining 5-to-10-year forward rates. In particular, these authors used forward rates instead of long-term interest rates to control for endogeneity with the current state of the business cycle. Both studies employed data on debt from OECD, which follow international statistical standards, namely the *System of National Accounts* (SNA 2008), and are presumably consistent across country and time.[5]

The main weakness of the early literature on government balance sheet is that most studies had focused on net government debt, implicitly assuming that gross debt and financial assets have similar impact on borrowing costs and access. Recent empirical studies address this issue by allowing for a distinct impact of debt and financial assets on those outcomes. Hadzi-Vaskov and Ricci (2016) find that both gross debt and financial assets have a significant impact on long-term sovereign bond spreads in emerging markets. In particular, the effects roughly offset each other as they have coefficients of opposite sign but similar magnitude. Therefore, they suggest that net debt seems more appropriate than gross debt when evaluating the impact of indebtedness on spreads. On the other hand, Henao-Arbelaez and Sobrinho (2017) add a piece to the puzzle by finding that government financial assets significantly reduce not only sovereign spreads but also the probability of debt crises; the effect varies with asset characteristics, notably liquidity. However, these results hold in EMEs but not in AEs: it seems that investors pay more attention to policies, institutions, and macroeconomic fundamentals, rather than to the government asset position, in order to assess the fiscal sustainability of AEs. Assets also help discriminate countries across the distribution of sovereign spreads, thus signaling information about EMEs' creditworthiness, which is usually perceived as riskier than for AEs.

III Data Description

A The Government Balance Sheet

Borrowing a concept which is traditionally applied to the private sector, the government also has a balance sheet, which defines what it owns and what it owes to other agents of the domestic economy and to the rest of the world. In particular, the government balance sheet captures the

[5] Previous studies using net – instead of gross – debt as an explanatory variable of interest rates are O'Donovan, Orr, and Rae (1996), Conway and Orr (2002), Chinn and Frankel (2005).

outstanding stock positions of the general government as defined by its level of nonfinancial assets, financial assets, and liabilities. The main difference between nonfinancial and financial assets is that the former ones do not represent a contractual claim on other units. Namely, nonfinancial assets comprise fixed assets, inventories, valuables, and nonproduced assets, such as government land and infrastructure, and mostly provide benefits either through their use in the production of goods and services or in the form of property income.[6] The net worth is equal to the total values of assets minus the total value of liabilities. On the other hand, the net financial worth just results from the difference between financial assets and total liabilities.

In this paper, we analyze only the government net financial worth because of issues related to data availability, data consistency, and liquidity of balance sheet items. First, we do not have an adequate coverage of government nonfinancial assets that allows us to carry out a panel analysis: GFS data on the full balance sheet are available for few countries, such as Canada and United States, and for very short time periods. However, the definition of these data is still questionable, and the standards used may vary critically across countries. Finally, even if we were able to measure these assets properly, i.e., to capture their actual market value, the government may face important constraints to sell its nonfinancial assets off in period of crisis, and therefore such fire sales would provide less of a good evaluation of government solvency than financial assets do.[7]

We use quarterly GFS time series for a panel of 27 countries over the period 1999Q1-2017Q1. This panel is partially unbalanced, as it does not include observations on two countries for the first year of the sample.[8] It is composed by mostly AEs, and a few EMEs, which are listed in Table 1 in the Appendix. The benefits of using this dataset are manifold: GFS provides financial balance sheets, i.e., stock data, of the general government; data are comparable across countries as they use a common underlying framework, which was set forth in the GFSM 2014; balance sheet entries are reported at market values (at nominal values for loans) and, thus, capture variations both in the volume and in the value of such items. Also, note that all the countries in the study base their accounting of government finances on accrual – rather than cash – methods.[9]

Financial assets and liabilities covered here are further decomposed into: (1) monetary gold and special drawing rights (SDRs), (2) currency and deposits, (3) debt securities, (4) loans, (5)

[6]See Bova et al. (2013) for an overview on the size, composition, and management of state-owned nonfinancial assets.

[7]Partly because of these reasons, "full" public sector balance sheet analyses are very rare in the literature. A notable exception is offered by Brede and Henn (2018, forthcoming), who expand Finland's general government accounts by including government assets, public corporations, and pension liabilities, and, therefore, evaluate long-term sustainability of Finnish public finances through its intertemporal balance sheet. Given current data availability and comparability, this type of approach is nearly impossible to "scale up" to a panel framework.

[8]The results shown in the paper are robust to shrinking the sample to the years with a balanced panel, i.e., 2000Q1-2017Q1.

[9]An alternative source of government balance sheet data is the IMF's World Economic Outlook (WEO). Although these data provide longer time series for many countries, they have been compiled by country experts (desks) without following uniform reporting standards. As a consequence, they have been often subject to significant revisions. This issue could be solved by aligning WEO data submissions with the recommendations contained in the GFSM 2014.

equity and investment fund shares, (6) insurance, pension, and standardized guarantees (IPSG), (7) financial derivatives, (8) other accounts receivable. It should be noted that the GFSM 2014 definition of liabilities differs from the one used by European institutions, which is known as 'Maastricht debt' and defined in the *European System of Accounts* (ESA 2010). In fact, the latter definition comprises only currency and deposits, debt securities, and loans. In this paper, we look at the 'total liabilities' of the general government – and not only at its 'debt liabilities' – as we believe that the former ones provide a broader measure of government exposure to fiscal risks. We combine these categories in four types of assets, based on their level of liquidity. Namely, 'total financial assets' comprise all assets reported in the financial balance sheet of the general government. 'Assets held in debt instruments' exclude equity and shares and financial derivatives, and represent the asset counterpart of debt liabilities. 'Liquid financial assets' encompass currency and deposits, and debt securities, while 'highly liquid assets' only currency and deposits.[10]

The GFS definition of financial assets excludes international reserves held by the central bank, which include highly liquid foreign currency-denominated claims on non-residents, as well as monetary gold, SDRs, and IMF reserve positions. Similarly to government financial assets, international reserves represent a self-insurance device, which may facilitate the public sector to shift income across time, and may also be used to mitigate short-run fluctuations in the country's exchange rate through interventions in the foreign exchange markets. On the other hand, 'total liabilities' do not include any contingent liabilities, i.e., potential obligations of the public sector that may arise in the future depending on the outcome of particular discrete events, such as guarantees on public-private partnership contracts, state insurance schemes, and export trade guarantees.[11] Also, the available data do not encompass the breakdown of financial assets and liabilities by currency, maturity, and sector of counterparty (i.e., from-whom-to-whom information). We believe that having these data would highly enhance cross-country analysis, as mismatches are likely to play a major role in the propagation of financial shocks and for the fiscal sustainability of a certain country.[12]

B Financial Crises

Episodes of financial crises have been conventionally identified in the economic literature by using dummy variables. In this paper, we use data on stock prices in order to isolate crashes in

[10]Our definition of 'highly liquid' should be considered just as an approximation given that the 'deposit' category comprises term-deposits, which are not redeemable in less than 30 days.

[11]See Bova et al. (2016) for an historical overview on the fiscal costs of contingent liabilities. This study highlights the importance not only of explicit liabilities but also of implicit liabilities, which are related to an expected responsibility of the government, e.g., bank bailouts. It is understood that the latter category is difficult to incorporate in national financial accounts.

[12]See Allen et al. (2002) for a discussion on the risks created by balance sheet mismatches and the original proposal of a systematic analytical framework to examine these country vulnerabilities, the so-called "balance sheet approach" (BSA), which has recently gained momentum in Fund surveillance.

the stock market, and consider them as proxies of financial crises.[13] In particular, we employ the Morgan Stanley Capital International (MSCI) indices, which are market-capitalization-weighted indices designed to measure the stock performance of large and mid cap segments of the national market and are compiled on a daily basis for all the countries in our sample. Following the approach introduced by Patel and Sarkar (1998), we normalize each national MSCI index to an indicator, between 0 and 1, denoted by $CMAX_{idt}$. $CMAX_{idt}$ is the ratio of the daily MSCI index to the maximum level of the index in the quarter, so that

$$CMAX_{idt} = \frac{x_{idt}}{max\left[x_{idt} \in x_{i,d-j,t} | j = 0, 1, ..., T\right]}$$

where x_{idt} is the MSCI index of country i in day d and quarter t, and the moving window is determined by the number of days the stock market was open in the quarter, i.e., T. Hence, we use $CMAX_{idt}$ in order to identify periods of significant price declines by employing a threshold equal to two standard deviations below the mean value in the quarter, $\overline{CMAX_{it}}$,[14]

$$crisis_{idt} = \begin{cases} 1 & \text{if } CMAX_{idt} < \overline{CMAX_{it}} - 2\sigma_{idt} \\ 0 & \text{otherwise} \end{cases}$$

This methodology allows us to identify the 2008-2009 GFC and the European debt crisis episodes, but also the 2001-2002 dot-com bubble.

We also define a 'financial crisis intensity' variable equal to the number of days in a quarter in which there was a price decline below the two-standard-deviation threshold previously described. In other words, this variable counts the number of days when $crisis_{idt} = 1$, i.e., k, in a quarter, so that

$$CRISIS_{it} = \sum_{n=1}^{k} (crisis_{idt} = 1)$$

We use this measure of financial crisis "at the intensive margin" in our sensitivity analysis, as an alternative to the baseline model. This variable allows us to observe if the effect of financial crises varies with the degree of intensity of such events.

[13] Financial crises can be generated also by different types of fluctuations. However, in the recent years, major financial crises have been normally associated with significant drops in stock market prices.

[14] This measure is quite common in the finance literature. It was used, e.g., by Vila (2000), Illing and Liu (2006), Coudert and Gex (2008), Zouaoui, Nouyrigat, and Beer (2011). Similarly, Mishkin and White (2002) use the October 1929 and October 1997 crises as benchmarks of stock market crashes, and define a financial crisis as a 20 percent drop in the price of securities over different windows of time (e.g., one week, one month, one year). Our results are robust to the use of this method.

C Control Variables

The relationship between the government balance sheet and financial crises is likely to be spurious, i.e., to be caused by other factors. Therefore, in our regression analysis, we control for some possible confounders, derived by a simple public debt dynamics equation. In particular, government debt, d_t, is modeled as a function of the interest rate, i_t, the level of inflation, π_t, GDP growth, g_t, and primary balance (in percentage of GDP), pb_t, such that

$$d_t = \frac{(1+i_i)}{(1+\pi_t)(1+g_t)} d_{t-1} + pb_t$$

These variables are all retrieved from the WEO database: namely, GDP growth is computed as the annualized percentage change in real GDP, and inflation is the annualized percentage change in CPI. In the absence of data for certain countries, we use the data made available by the national authorities, and combine it with WEO.[15] Instead of using the primary balance, throughout the paper, we will employ the net operating balance of the general government (in percentage of GDP), which is the variable that directly affects changes in the volume of government liabilities and assets. The net operating balance, as defined in GFSM 2014, is equal to the difference between government revenue and expense or, equivalently, to the net acquisition of assets less the net incurrence of liabilities, i.e., government's financing.

Fluctuations in the government balance sheet do not only arise from changes in the volume of its components but may also stem from changes in their value. For example, following a financial crisis, the market value of government financial assets may plummet, giving the impression that the government lowered its asset position more than what it actually did. In order to account for valuation changes, we use the short-term (3-month) and long-term (10-year) interest rate on government bonds from OECD's Monthly Monetary and Financial Statistics (MEI). These variables should both capture the burden of interest rate payments that governments bear and provide a proxy for government asset prices, given the fact that yields are inversely related to the prices at which such bonds are traded on financial markets.[16]

A second type of valuation effect may be due to fluctuations in the country's exchange rate. The debt ratio dynamics considered above is based on an accounting identity and does not take into account the fact that most governments hold a non-negligible share of their liabilities and assets in foreign currency. In such cases, also exchange rate fluctuations may play a crucial role through valuation effects. Namely, these effects could either offset or exacerbate significant volume changes in government balance sheet components. As we want to isolate the policy reaction to financial crises, it is fundamental to control for exchange rate appreciation or devaluation. In

[15] We do that for Bulgaria, Czech Republic, and Poland as data for these countries were not directly available from the WEO database. On the other hand, we were not able to retrieve comparable quarterly data for Brazil, which is, therefore, dropped from the sample in all the estimations with macroeconomic controls.

[16] Dembiermont et al. (2015) show that aggregate valuation effect on general government debt appears to be driven essentially by interest rate movements on long-term debt securities, thus supporting our approach.

our estimation, we include changes in the nominal effective exchange rate, as an additional control variable, with the aim of capturing the valuation effects of foreign-currency-denominated balance sheet components.[17] Note that all countries in the sample, except Denmark, have a floating exchange rate regime.

Finally, we also include an indicator of global volatility, such as the VIX index, calculated and published by the Chicago Board Options Exchange (CBOE). The latter variable is obtained from the St. Louis' FRED database and used in its quarterly average.

IV Stylized Facts

A Descriptive Statistics

We start our analysis by looking at the evolution of government financial balance sheets over the last two decades. Table 2 contains descriptive statistics on the different entries of the government balance sheet, expressed in percentage of quarterly GDP. In particular we divide the sample in two sub-periods, i.e., before and after the GFC.

We observe that, on average, the net financial worth is negative, i.e., governments tend to hold more liabilities than financial assets. Countries that have had positive levels of net financial worth in at least one quarter of the sample are Bulgaria, Czech Republic, Denmark, Estonia, Finland, Ireland, Latvia, Lithuania, Norway, Romania, Slovak Republic, Slovenia, and Sweden. The remaining countries never witnessed a period in which government financial assets exceeded government liabilities. However, the mean of net financial worth is positive for the whole study sample only for Bulgaria, Czech Republic, Estonia, Finland, Norway, and Sweden.

In general, the net financial worth of governments has significantly deteriorated in the aftermath of the GFC. This effect has been driven by an increase of government liabilities, which are almost 50% higher in the period 2008-2017 than in 1999-2007. On the other hand, government financial assets have also increased in the last decade, but by less than gross debt. The rise in financial assets was common to all categories of assets, regardless of their level of liquidity. It is interesting to highlight that, if one looked only at the gross debt, the health of a nation's public finances would seem to be worse, than the one we witness when taking into account also financial assets, i.e., when looking at net debt.

The same picture emerges if we examine the growth rates of the same government balance sheet variables, as displayed in Table 3. On average, net financial worth has been increasing in

[17] Data on the nominal effective exchange rate, which is defined as a weighted average of indexed nominal bilateral rates of a country's principal trade partners, are from the IMF's International Finance Statistics (IFS). Missing data for some countries (Estonia, Lithuania, and Slovenia) were retrieved from the respective national central banks.

the pre-GFC, and decreasing in the period post-GFC. Again, liabilities and financial assets seem to follow parallel trends in that they both have average negative growth rates between 1999 and 2007, and positive growth rates between 2008 and 2017. However, liabilities seem to be more volatile than assets, as their fluctuations are, on average, of larger magnitude.

We also graph liabilities and financial assets for all the countries in our sample in Figure 1, and we analyze their patterns in periods of financial crises (shaded areas in the graphs). In most countries, in times of stock market distress, both government liabilities and government financial assets seem to have increased; this is particularly evident during the 2008/2009 GFC. Such pattern may be just an effect of the recession, i.e., of the decrease in nominal GDP. Nevertheless, we reject this explanation as similar patterns are observed if we graph the balance sheet variables in nominal terms, i.e., in national currency, instead of as a percentage of GDP. In the next section, we propose an econometric approach in order to empirically investigate the existence of such evidence, which is visible through the summary statistics we present above.

B Pairwise Correlations

In this subsection, we start investigating the relationship among different government balance sheet variables. First, fluctuations in net financial worth relate more to changes in the liability side rather than in the asset side of the balance sheet. This is arguably linked to the higher volatility of liabilities in comparison with assets. Figure 2 reports the scatter plot of government financial assets and government liabilities (in first difference) on the whole sample of the study. These two items of the balance sheet seem to co-move over time, i.e., if the government increases its level of liabilities in a quarter, on average, it also increases its financial assets in that quarter. Namely, the correlation is equal to 0.56. Such correlation is still positive and significant at the 1 percent level if we control for real GDP growth, which may be driving such relationship: the elasticity coefficient of a regression with changes in financial assets and liabilities – and GDP growth – is 0.49, with a standard error of 0.04.[18] This is in line with what we observe in the descriptive statistics and is arguably related to typical financial balance sheet operations: with the exception of large variations in the net operating balance of a government, incurrence of liability (e.g., debt issuance) often leads to an increase in cash or similar financial assets; then, these assets can be used to consume (in the short run) or to acquire nonfinancial assets.[19]

The sample contains some potential outliers. The observations in the right of Figure 2 – i.e., high increases in financial assets achieved without increases in liabilities – correspond to Norway, a country that has been accumulating huge amount of assets in the recent decades, mostly through the

[18]The simple regression equation estimated is $assets_{it} = \alpha_i + \sigma_t + \beta \times liabilities_{it} + \gamma \times GDP\,growth_{it} + \varepsilon_{it}$. Controlling for country and time fixed effects leaves the elasticity coefficient nearly unchanged.

[19]The correlation between financial assets and liabilities is similar in the sub-samples before and after 2008, and is fairly stable over time. Thus, we can conclude that this pattern is not an exceptional effect of the GFC or of other recent historical events.

allocation of oil revenues to its sovereign wealth fund. On the other hand, Hungary represents the country that experienced large increases in liabilities that were not accompanied by proportionally large increases in financial assets – upper part of the scatter plot.[20]

Other correlations are shown in Table 4 and Table 5. Financial assets and liabilities seem to be both countercyclical, i.e., they rise in periods of recession and decline in periods of economic growth. However, the correlation of real GDP growth with the first difference of liabilities (-0.34), is higher than the one with financial assets (-0.23). As a consequence, net financial worth is weakly procyclical with a correlation of 0.17 with real GDP growth. Also, liquid and highly liquid financial assets correlation with real GDP growth is smaller than the one of total assets. Price inflation is significantly associated with decreases in both gross debt and financial assets, which have a magnitude of 0.06 and 0.08, respectively, and, thus, leave net financial worth unaltered. The correlation between net financial worth and the short-term interest rate is also not significantly different from zero, while the correlation with the long-term interest rate is slightly negative (-0.08) because of the positive effect of the latter variable on liabilities (0.09). The correlation between balance sheet components and exchange rate fluctuations appears to be quite weak, too. As expected, the net operating balance is positively correlated with net financial worth. However, we can discern the existence of a substantial asymmetry between gross debt and financial assets: higher levels of net operating balance, i.e., higher surpluses or lower deficits, seem to be used by governments to decrease their level of total liabilities and increase their level of financial assets, but the former correlation (-0.30) is much larger than the latter one (0.06). Finally, global volatility is associated with decreases in the net financial worth of the government, as increases in liabilities are larger than increases in financial assets in periods with higher levels of the volatility index.

V Methodology

A Fixed Effects Model

We begin by estimating the following fixed effects model,

$$gov_{it} = \alpha_i + \beta \times crisis_{it} + X_{it}'\gamma + Z_t'\delta + \varepsilon_{it} \tag{1}$$

where gov_{it} is one item of the government balance sheet, namely total liabilities, financial assets, or the net financial worth of the government.[21] We also use a measure of 'leverage', defined as the ratio between liabilities and financial assets, which provides an alternative proxy of the exposure of the general government. α_i captures the country fixed effect, while $crisis_{it}$ is an indicator

[20] In the robustness analysis in Section VI, we exclude these two countries from the sample as their debt and asset accumulation may be driven by specific factors, which are not common to the remaining countries. The results we find are very similar to the ones of the baseline regressions.

[21] All variables are taken in percentage of GDP in order to make observations comparable across countries.

variable for financial crises, as defined in the data section. We control for a vector of macroeconomic controls at the country level, X'_{it}, which comprises real GDP growth, inflation, net operating balance (in percentage of GDP), short-term and long-term interest rates on government securities, and nominal effective exchange rate fluctuations, as well as for the VIX index, Z'_t, which aims to capture volatility in international markets.[22] ε_{it} is the error term.

According to a wide battery of panel unit root tests, namely Levin-Lin-Chu, Harris-Tzavalis, and Fisher-type tests, government balance sheet variables are found to be not stationary in level. The latter results are robust to cross-section dependence on the basis of Pesaran's panel unit root test. Therefore, we use these variables in first difference in all the specifications employed in the paper. A standard Hausman test leads us to reject a random effects assumption in favor of the fixed effects model. We control for seasonality by including country-specific quarter dummies, and we cluster standard errors at the country level in order to correct for correlation between observations of the same country in different quarters.[23]

One potential issue of this estimation technique is that it does not entirely control for reverse causality or omitted variables. In particular, the macroeconomic variables that theoretically determine the debt relation and, hence, are used in the fixed effects model, are jointly determined. The extensive panel data, in terms of cross-sectional observations (N) and time periods (T), allow us to address this issue by estimating a dynamic panel distributed lag model, which features lags of the independent variables.[24] Therefore, we assume the following autoregressive distributed lag (ARDL) specification,

$$gov_{it} = \alpha_i + \sum_{n=0}^{q} \beta_n \times crisis_{it-n} + \sum_{n=0}^{q} X'_{it-n}\gamma_n + Z'_t\delta + \varepsilon_{it} \tag{2}$$

where q indicates the number of lags included in the model, and the remaining notation is the same as in Equation (1). The model maintains the same features of the baseline fixed effects model, but distributed lags of the country-variant variables, i.e., of the 'crisis' dummy and of the public debt dynamics variables in X'_{it}, are added to the original equation. This, in turn, allows us to control for the existence of a dynamic response of balance sheet variables to macroeconomics fluctuations.

[22]The results do not vary importantly when 'net lending/borrowing' is used as control variable instead of 'net operating balance'. Note that the only difference is that the former variable does not include net acquisitions of nonfinancial assets. Thus, net lending/borrowing may neglect some government operations that have a relevant impact on the financial balance sheet, and therefore create an omitted variable bias in our estimation of the 'crisis' coefficient.

[23]Using only country-invariant quarter dummies does not importantly affect the significance of the results but decreases the fit of the model. Therefore, we will always use country-specific quarter dummies throughout the paper.

[24]This method constitutes a valid alternative to Arellano-Bond or Blundell-Bond estimators, which were designed to address contexts with "small T, large N" dynamic panels. If we were using annual data, the latter methods would provide the most suitable estimation techniques to address endogeneity issues. On the other hand, with a large time span, as in our case, dynamic panel bias becomes negligible, and a more straightforward fixed effects model, especially with a dynamic component, provide consistent estimates. Also, large T leads to the explosion of the number of instruments in difference and system GMM, discouraging us from using it. See Roodman (2009) for a more detailed discussion on dynamic panel estimation issues.

Given this, the ARDL model represents an appropriate econometric approach to better capture the causal relationship, identified by the 'crisis' coefficient, in a dynamic framework.

B Panel VAR

Since the seminal work by Holtz-Eakin, Newey, and Rosen (1988), panel VAR models have become a standard tool for analyzing multivariate time-series in a panel context. This model has the advantage to use both time-series patterns, by treating multiple variables in the system as endogenous, and the panel dimension of the data, i.e., their unobserved country heterogeneity. In other words, it combines country fixed effects with time-series techniques, and, thus, allows one to test the transmission of shocks by producing a set of common IRFs for each endogenous variable included in the system.

Based on the equation of public debt dynamics used throughout the paper, we estimate the following model,

$$Y_{it} = B_0 + \sum_{n=1}^{p} B_n Y_{it-n} + \alpha_i + e_{it} \tag{3}$$

where $Y_{it} = [g_{it}\ \pi_{it}\ gov_{it}\ i_{it}\ vix_{it}]'$ is a vector of the five endogenous variables for country i and quarter t, B_0 is a 5×1 vector of intercept terms, B_n is the matrix of autoregressive coefficients of order (5×5), and e_{it} is the 5×1 vector of random disturbances. Y_{it} is a vector of endogenous variables, which includes real GDP, price level, one of the government balance sheet variables, short-term interest rate, and the VIX index.[25] GDP and prices are in log difference, while government balance sheet variables are in first difference, as they all are not stationary in levels. Moreover, we want to purge the time series of assets and liabilities from one-off events that were likely to produce big changes in the government balance sheets. Hence, we also control for the dummy variable of financial crisis, as defined in Section III, with a view to capturing the structural relationship among the variables used in the system of equations. This, in turn, allows us to attribute movements in assets and liabilities to policies and other structural features of the economies of interest.[26] Analogously to the fixed effects model, we also include quarter dummies to correct for seasonality and cluster standard errors to accommodate within-country correlation.

The model fits a multivariate panel regression of each dependent variable on lags of itself and on lags of all other dependent variables using generalized method of moments (GMM). We use 1 lag according to common lag selection criteria.[27] The shocks are orthogonalized recursively

[25] Afonso, Baxa, and Slavík (2017) employ the same specification in a threshold VAR model, which aims to estimate the effect of fiscal policy on economic activity under different financial market conditions.

[26] A panel VAR model lacking the 'crisis' dummy, as additional control, generates nearly equivalent IRFs, both in terms of shape and significance, suggesting that episodes of financial crisis did not importantly affect the structural relationship between balance sheet variables and macroeconomic shocks in our data sample.

[27] The lag length of the endogenous variables, $p = 1$, is selected according to the Bayesian information criterion, which penalizes higher number of parameters in the model to a greater extent than alternative information criteria,

according to a standard Cholesky decomposition, which implies that the variables ordered at the top are considered exogenous in the period of interest, i.e., a quarter, while those at the bottom are considered endogenous. In particular, the endogenous variables are stacked as following: output growth, inflation, the government balance sheet variable, short-term interest rate, and global financial volatility. This specific ordering, which is common in the literature, reflects the propagation of the shock in the economy. VIX is placed at the bottom of the matrix as it is assumed to react contemporaneously to all variables in the system, as macroeconomic and policy shocks are supposed to transmit to financial markets within the quarter in which they occur.[28] gov_{it} is ordered after output and inflation following Blanchard and Perotti (2002), who suggest that all reactions of fiscal policy within each quarter (e.g., changes in government debt) are purely automatic because of implementation lags of fiscal policy measures.[29] The interest rate shows up after the fiscal variable since the short-term interest rate can react contemporaneously to fiscal policy, but not vice versa.

This empirical framework allows one to compute IRFs and therefore to trace the direct and indirect effect of the variables of interest. In other words, it provides a powerful tool to assess the dynamic behavior of one endogenous variable in the system to innovations in another variable in the system, while taking into account the feedback effects from one time period to the other. At the same time, the fixed effects variable, denoted by α_i, captures the country-specific characteristics that are time invariant.

By estimating this model, we aim at shifting the focus of the study from episodes of financial crisis, which are likely to be exceptional events, to the analysis of structural symmetries and asymmetries that exist in the fluctuation of balance sheet variables over time. The latter estimates may be considered to have higher external validity to different countries and future time periods than the ones from Equation (1). Also, we rely on panel VAR and GMM techniques in order to partly solve issues of endogeneity related to the fixed effects model estimation.

VI Estimation Results

The estimation results are organized as follows. Section A presents the baseline regressions from the fixed effects model. Section B further explores the mechanisms behind government balance sheet reactions to crises. Section C shows robustness of the panel regression results. Finally, Section D presents the IRFs computed with the panel VAR model.

such as Akaike and Hannan-Quinn.

[28] It can be claimed that US monetary policy leads the VIX index, and this may undermine the identification strategy based on the Cholesky ordering used in the paper. Therefore, we estimate the panel VAR model excluding the US from the sample, but we do not find this to be a relevant issue of our empirical specification.

[29] Arguably, this happens because the political decision-making reacts with a certain delay to GDP shocks. Note that using quarterly data is essential to our identification strategy of the shock. In fact, within one year, we cannot assume that fiscal policy does not endogenously react to GDP fluctuations.

A Baseline Regressions

This section discusses the estimates obtained with the fixed effects model, as reported in Table 6. Financial crises are found to deteriorate the net financial worth of governments: this effect is statistically significant at the 1 percent level in the regression without controls, and at the 10 percent level after including country-level and global control variables. The negative effect is mainly driven by an increase of government liabilities in periods of financial distress, with a higher significance level in the regression with controls, i.e., 5 percent level. On the other hand, no statistically significant impact is found on the level of total financial assets. Surprisingly, the results hold independently of the liquidity of financial assets: governments do not seem to decrease even their highly liquid stocks of financial assets in the event of stock market crises. In particular, the results shown in Table 7 exclude the existence of relevant heterogeneity between the response of different types of government assets to financial crises.

The latter set of results suggests that, in periods of financial distress, there may be little room for using government financial assets as fiscal buffers. We give two different interpretations to this finding: on the demand side, the government may face constraints to place its financial assets, even the more liquid ones, on the bond market as investors do not have sufficient incentives to purchase such assets given their increased level of perceived risk; on the supply side, as well, governments may be restrained to sell their assets because the prices of these may be too low in the aftermath of the crisis, and awaiting the crisis resolution may guarantee higher returns from the liquidation of the same financial assets. This relationship is likely to depend also on the composition and the quality of the government portfolio, which is difficult to assess through the aggregate data we use throughout the paper.[30]

Moreover, we examine the coefficients estimated on the control variables, although we do not claim these effects to be causal ones. In particular, government liabilities and financial assets are confirmed to be both countercyclical – with a larger sensitivity of liability, in comparison with financial assets, to variations in GDP growth. Both effects are significant at the 1 percent level. On the other hand, a higher net operating balance, i.e., a higher surplus or a lower deficit, is used by the government to decrease its level of gross debt, rather than increase financial assets. The effect on government liabilities is significant at the 1 percent level and is reflected on the positive effect on the net financial worth and on the negative effect on leverage, which are both significant at the 1 percent level. This evidence is further discussed in the next subsection. On the other hand, the coefficient of both measures of interest rates and exchange rate fluctuations are not statistically significant in any of the regressions, suggesting a minor role for "pure" valuation effects in the evolution of the government balance sheet variables.

Finally, it is worth noticing the different size in the adjusted R-squared that underlies the regres-

[30]For instance, during the GFC, European governments may have had very low incentives to sell Greek debt, in order to avoid a further deterioration of Greece's financial distress and a surge in the risk of contagion to other countries.

sions we estimate. The parsimonious model of public debt dynamics we employ seems to explain around 52% of the variation of government liabilities, but it explains only the 18% of changes in government financial assets. This suggests that financial assets may have different determinants than liabilities, rejecting the accuracy of the economic model we employ to predict the behavior of government assets.

Note that the estimation results with time fixed effects are not reported, as our explanatory variable of interest 'financial crisis' does not show much variation across countries, and, thus, is nearly collinear with the time dummies. Given that most episodes of stock market price declines in the last two decades were common to all the countries in our sample, the remaining country-specific variation is not sufficient to find any significant relationship with the government balance sheet variables.[31] In particular, the 2001-2002 dot-com bubble and the 2008-2009 GFC, which together account for roughly two thirds of the crisis episodes in our sample, caused stock market crashes in all the countries in our sample, leaving few "idiosyncratic" financial crises. Thus, including quarter fixed effects, would not allow one to identify the impact of those crises that assumed a global dimension. One potential implication is that our regressions are simply measuring the impact of "systemic" crises, such as the GFC, had on the government balance sheet, and such finding is not valid with other types of financial crisis. Given the data availability, we are not able to either reject or confirm such hypothesis.[32] On the other hand, the inclusion of quarter fixed effects does not change direction, size, and significance of the other coefficients in the regressions.

We also estimate the effect of financial crises at the intensive margin. In order to do so, we restrict the sample to the periods when $crisis_{it} > 0$ (i.e., 408 quarters out of 1793 total observations) and by using the number of days in which the CMAX index was below the threshold indicated in the data section, denoted by $CRISIS_{it}$, as alternative explanatory variable of interest. This allows one to test whether the impact of financial crises on the government balance sheet is significantly greater when such crises have a larger magnitude. Despite the considerable reduction of the sample, the estimates, shown in Table 8, confirm this hypothesis and give more robustness to our results: liabilities tend to increase with the intensity of the financial crisis – the coefficient is significant at the 1 percent level without controls and at the 5 percent level with controls. On the other hand, no statistically significant impact is found on financial assets when using control variables in the regression.

Dynamic Fixed Effects.

Dynamic estimates, with different lag specifications, are shown in Table 9. Baseline results

[31] This recent phenomenon, in turn, relates to the increasing interconnection of global capital markets, which facilitates the spread of financial disturbances from one country to the other and exacerbates the contagion risk across the world economy.

[32] Additional estimations with a GFC dummy, which considers only stock market price declines that followed the crisis in the subprime mortgage market in the United States and the collapse of Lehman Brothers, and with different sample specifications, suggest that the GFC determined important fluctuations in the government balance sheet of most countries in our data, but is not sufficient to explain the panel regression results by itself.

hold both in terms of sign and statistical significance. On the other hand, the impact of financial crises on balance sheet variables is found to have a larger magnitude, after controlling for an ARDL structure of the country-specific independent variables.[33] In particular, episodes of financial crisis are confirmed to increase the level of liabilities and deteriorates the net financial worth of governments. Both coefficients are statistically significant at the 5 percent level, regardless of the number of lags included in the model. No significant effect is detected on financial assets, in line with the previous findings presented in the paper.

As the inclusion of lagged independent variables does not significantly affect our original results, we will return to use the baseline fixed effects equation in order to analyze the transmission channels behind crisis-driven balance sheet fluctuations in the following subsection.

B Transmission Channels

We turn our analysis to the mechanisms that may lie behind the results we find in the previous subsection. The first is that, in periods of financial crisis, governments could start implementing fiscal stabilization policies and, therefore, increase the level of financial assets to rebuild confidence in their fiscal sustainability. We define a dummy variable, $surplus_{it}$, equal to 1 if the net operating balance is positive, and equal to 0 otherwise.[34] Then, we include this variable in the equation, and interact it with the explanatory variable of financial crisis,

$$gov_{it} = \alpha_i + \beta_1 \times crisis_{it} + \beta_2 \times surplus_{it} + \beta_3 \times crisis_{it} \cdot surplus_{it} + X'_{it}\gamma + Z'_t\delta + \varepsilon_{it} \qquad (4)$$

The results reported in Table 10 lead us to strongly reject the hypothesis of ‘fiscal austerity’ in crisis periods as the coefficients on the interaction term are not statistical significant for any of the government balance sheet variables. Austerity measures are usually not put in place amidst financial crises, when the government needs to run countercyclical fiscal policies to soften the impact of the adverse shock, but only after the peak of financial distress fades. In other words, the rebuilding of fiscal buffers, which could be done by increasing the stock of government financial assets, is likely to not be contemporaneous to financial crises, but to have a delayed onset. Also, these additional estimates suggest that, when governments run positive fiscal balances, they prefer to decrease their levels of liabilities rather than accumulating financial assets, i.e., they prefer to lower their leverage ratio. This is in line with the fact that, generally, the average interest rates paid on government debt are higher than the return on financial assets, giving an incentive for the government to repay the debt before purchasing new assets.[35]

---

[33] Analogous results are found when estimating the dynamic panel distributed lag model with quasi-maximum likelihood linear techniques, based on Hsiao, Pesaran, and Tahmiscioglu (2002), which maximize the likelihood function obtained by taking the first-difference of the variables in the model.

[34] We did the same exercise with net lending/borrowing. The results are in line with the ones shown in the paper.

[35] Such evidence partly confirms the theory that governments do not systematically use asset-financed-by-debt strategy, i.e., they do not incur additional debts in order to buy financial assets.

The second mechanism that we explore, in the attempt to explain the behavior of financial assets during episodes of financial crises, relates to bank bailouts. Following Laeven and Valencia (2012), we identify periods when a country experienced a banking crisis, and define a dummy variable, $bank_{it}$.[36] Analogously with what we did in Equation (4), we use $bank_{it}$ as an interaction variable with $crisis_{it}$,

$$gov_{it} = \alpha_i + \beta_1 \times crisis_{it} + \beta_2 \times bank_{it} + \beta_3 \times crisis_{it} \cdot bank_{it} + X'_{it}\gamma + Z'_t\delta + \varepsilon_{it} \tag{5}$$

In our sample, we identify episodes of banking crisis starting in the last quarter of 2007 for United Kingdom and United States, and in the last quarter of 2008 for a large group of European countries, such as Austria, Belgium, Denmark, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Portugal, Slovenia, Spain, and Sweden. As the original database does not include the ending date of these crises, we test our hypothesis assuming different lengths of banking crisis, and the results hold for all specifications.[37] Namely, in Table 11 and Table 12, we show estimation with the less and more conservative definition of the explanatory variable, $bank_{it}$, respectively.

The results suggest that countries that experience banking crises coupled with financial crises increase their level of government liabilities and financial assets. This result is significant at the 1 percent level with country fixed effects and at the 5 percent level when adding the country-level and global control variables. Differently from the baseline regressions without interaction term, the results with the 'banking crisis' variable hold also after including time fixed effects as only half of the countries in the sample experienced a banking crisis, and, thus, the time fixed effect does not clear the effect of banking crises.

The driver of this positive relationship is likely to be the process of bank bailouts that many governments undertook during the GFC in order to prevent the collapse of their domestic financial sector. In fact, bank bailouts usually entail an injection of equity and the takeover of loans, which inflate the asset position of the general government.[38] Such improvement of the net financial worth seems to be artificial and its effect on fiscal sustainability is highly debatable. If, on one hand, these assets do not create any short-term fiscal buffer as they are not directly redeemable, on the other hand, if countries are able to keep these assets until the financial crisis has been resolved, central governments may eventually be able to sell them at a higher price than when they took them over. Again, we suggest that changes in the quantity and quality of assets need to be evaluated carefully in order to project fiscal sustainability of a country in the short and in the long term.

[36] The correspondence between banking crises and bank bailouts is not perfect, but we believe that the former one provides a good proxy for the latter one, especially during the GFC.

[37] We consider banking crises to cover a period between 2 to 6 years (i.e., till the last quarter of 2010 to 2016). Results are very similar.

[38] As pointed out in the data section, loans are the only item that is not evaluated at market value in the GFS framework. Given that, the reported value of government loans may be overstating the actual value in the aftermath of bank bailouts, especially in the presence of non-performing loan assets. In short, governments usually take over the loans of the rescued private banks and write off such assets from their own balance sheet in the following years.

As was briefly discussed in Section III, financial crises are most of the time associated with sharp exchange rate movements. In such cases, the coefficient of 'crisis' may be explained by the effect of exchange rate depreciation on the market value of government balance sheet items, which, in turn, might either offset or exacerbate underlying volume changes. Prima facie, this does not seem to be the case in our sample as the correlation between financial crises and exchange rate depreciation periods is considerably weak (0.01). However, we empirically test this hypothesis by defining a dummy variable, $depreciation_{it}$, which is equal to 1 if there was a decrease in the nominal effective exchange rate larger than the average decrease of the country's exchange rate over the sample period, and equal to 0 otherwise. Therefore, following the same approach as for fiscal stabilization and banking crises, we interact this variable with the binary variable of financial crisis, so that

$$gov_{it} = \alpha_i + \beta_1 \times crisis_{it} + \beta_2 \times depreciation_{it} + \beta_3 \times crisis_{it} \cdot depreciation_{it} + X'_{it}\gamma + Z'_t\delta + \varepsilon_{it} \quad (6)$$

The results are shown in Table 13. We do not find evidence that exchange rate depreciation is driving the value of liabilities and financial assets either up or down during episodes of financial crisis, as all the interaction-term coefficients do not pass commonly-accepted thresholds of statistical significance. On the other hand, the coefficients for net financial worth and leverage remain the same as in the baseline regressions. These results must be contextualized with the sample of the study, which is mostly composed by AEs, especially Eurozone countries. In emerging and developing economies, where exchange rate fluctuations still play a major role, valuation effects are likely to have a larger impact on the volatility of government balance sheet positions and, therefore, on their fiscal sustainability.

C Robustness

Flow Variables. Our study looks exclusively at stock variables (i.e., government financial assets and liabilities) rather than flow variables (i.e., net purchase of financial assets or net incurrence of liabilities) as indicators of government fiscal position. In fact, economic theory suggests that stock variables influence long-term interest rates – and, thus, fiscal sustainability – as emphasized in Engen and Hubbard (2005), more than flow variables. Yet, flow variables also provide useful information on stock variables when they are persistent. Therefore, we test the effect of financial crises on net incurrence of liabilities and net purchase of financial assets. These variables measure the transactions that are performed by the government but do not take into account changes in the value of the existing balance sheet items. This, in turn, allows one to disentangle the effect of government budgetary policies from other economic flows, such as changes in asset and liability prices. The estimated coefficient on liabilities, presented in Table 14, is statistically significant at the 5 percent level in the simple panel regression and loses significance when adding controls.[39]

[39] The latter coefficient is significant at the 10 percent level when using, as regressor, the crisis variable at the intensive margin, i.e., $CRISIS_{it}$.

Such results make room for the possibility that part of the crisis effect on government debt may be due to other economic flows, and might not be a mere consequence of fiscal policy choices. However, the baseline regressions in Section A do not find evidence of significant valuation effects driving balance sheet variables through changes in government bond yields or exchange rate movements. On the other hand, no impact of episodes of financial crisis is found on the net acquisition of financial assets, in line with the results given by the estimates on the stock position.

Debt Haircuts. The change in net financial worth we observe in the event of financial crises may partly be the effect of debt haircuts. Nevertheless, this is not a possibility with the data we use, as no country in our sample experienced debt write-offs, according to the latest information as noted by Cruces and Trebesch (2013).

Outliers. As we anticipated in Section IV, we are concerned that some outliers may be introducing noise in our estimations and, hence, biasing the accurateness of our results. In particular, Norway and Hungary seem to show different patterns, than the rest of the countries in the sample, with regard to the correlation between financial assets and liabilities. Therefore, we exclude these two countries and re-estimate the baseline regressions, as in Equation (1). The results, shown in Table 15, are very similar to the ones with the whole sample. In fact, without outliers, the level of statistical significance is higher for some of the estimates.

Seemingly Unrelated Regressions. The results of the fixed effects model do not seem to be an artifice of the econometric approach we follow in the baseline regressions. We also estimate the same model through a system of seemingly unrelated regressions (SUR). This method is particularly adapt to small N, large T, and it enables us to jointly estimate the effect on both liabilities and financial assets in the same system of equations, allowing the error terms of the two regressions to be correlated. Again, Table 16 confirms the baseline results that were shown in Section A.

D Dynamics

We further explore the existence of structural asymmetries in the response of government liabilities and financial assets to macroeconomic shocks by estimating a panel VAR, as specified in Equation (3).[40] The model – with 1 lag – satisfies the eigenvalue stability condition, i.e., the modulus of each eigenvalue is strictly less than 1. IRFs to different shocks are reported in Figure 3-7: namely, shocks are of one standard deviation, and IRFs are estimated up to a forecast horizon of 16 quarters, i.e., 4 years.

First, Figure 3 depicts the response of government balance sheet variables, i.e., liabilities, financial assets, net financial worth, and leverage, to a shock in real GDP growth. Both liabilities

[40]For the panel VAR estimation, we used both Stata packages `pvar` from Abrigo and Love (2015) and `pvar2` by Ryan Decker.

and financial assets significantly decrease after a growth shock; the effects fade out after one year with a cumulative negative response. However, the impact on liabilities is twice as large than on assets: liabilities decrease by almost 4 percent when the shock hits the economy, while assets decrease only by 2 percent. In other words, financial assets seem to be less countercyclical and more "sticky" than liabilities. As a consequence, government net financial worth is weakly procyclical, in that it increases by 1.5 percent in reaction to a one standard deviation raise in output growth. On the other hand, Figure 4 shows the impact that changes in the government balance sheet have on GDP growth. A positive shock in government liabilities lowers the rate of output growth, while a positive shock in government financial assets seem to have a positive, though short-termed, impact on the economic growth of a country.[41] The significant effect of a positive shock in the net financial worth on GDP growth is, thus, determined by both sides of the government balance sheet. The main policy implication of the latter results is that governments can use debt reduction or asset accumulation as alternative tools to boost the economy to achieve higher output growth.

Government liabilities and financial assets do not significantly respond to inflation shocks, considering the 5 percent confidence interval displayed in Figure 5. On the other hand, a one standard deviation raise in the short-term interest rate, as reported in Figure 6, has a positive effect – between 0.1% and 0.2% per quarter – on both balance sheet variables, which emerges with a lag of 4 quarter and lasts over time. In line with the literature, higher interest rates seem to increase the cost of servicing debt and, in the absence of fiscal adjustment, increment the burden of debt. This impact turns significant only after one year from the initial shock, arguably because interest payments arise with a certain delay with respect to the date when corresponding treasury bills were issued; therefore, the effect of such payments on government financing needs tends to accumulate over time. Moreover, a shock in global volatility, i.e., in the VIX index, increases the level of government liabilities and assets by a similar amount – respectively, by 1% and 0.5% – leaving net financial worth ultimately unchanged – see Figure 7. This represents a partially counterintuitive result, which seems to be in line with our previous findings on the observed correlation between changes in government financial assets and liabilities.[42]

VII Conclusion

The complete financial government balance sheet has recently drawn the attention of policymakers and economists, especially in the context of macroeconomic surveillance, as it seems to provide a better instrument than gross debt to assess the fiscal sustainability of a country. In particular, many economists advocate that financial assets should be included in the DSA framework in that assets provide a buffer for the government needs to finance countercyclical fiscal policies and

[41] Granger causality tests on the panel VAR equations confirm such findings.

[42] We do not report IRFs to government balance sheet shocks, with the exception of the ones of GDP growth in Figure 4, as they do not provide additional evidence to enhance our analysis. The full set of IRFs is available upon request from the author.

cope with unexpected economic shocks. Nonetheless, very little is known about the dynamics of government financial assets, i.e., there is no empirical evidence that governments actually use – or are able to use – their assets to cope with bad economic circumstances. In this paper, we contribute to the literature by taking a balance sheet approach, in order to analyze the government reaction to recent episodes of financial crises, and by unveiling the existence of major asymmetries between the dynamics of financial assets and liabilities. In order to do so, we are the first to employ a novel database on the government financial balance sheet, i.e., the quarterly GFS, in a static and dynamic panel setting.

We document the large impact of financial crises on the net financial worth of governments. Government liabilities increase in the aftermath of major stock market shocks – this effect is significant both at the extensive and at the intensive margin – but no significant impact is found on financial assets: accumulating additional debt seems to be a far more prevalent reaction among governments than liquidating assets. On the other hand, fiscal stabilization policies are associated with decreases in the leverage ratio, suggesting that governments prefer to use improvements in their fiscal stance to decrease the level of liabilities rather than accumulating financial assets. We also test the transmission mechanism of asset increases in periods of financial crisis, which is related to government bank bailouts: when the financial crisis is coupled with a banking crisis, governments are found to inflate both their liability and asset positions by taking over the balance sheets of the private financial institutions that were rescued. Government liabilities and financial assets seem to both be countercyclical, i.e., to respond negatively to GDP shocks. However, the effect on governments' liabilities is twice as large than on their financial assets, suggesting a stickier behavior of assets. In line with previous literature, we also observe significant benefits from improving the net financial worth of a country, which implies that, in the long-term, the government could use balance sheet stabilization policies to spur economic growth. On the other hand, interest rate and global volatility shocks tend to raise the levels of both government liabilities and financial assets.

The empirical results are robust to the specification of the sample, alternative definitions of financial crisis, and econometric approaches. Nevertheless, given data availability, the study focuses mostly on AEs and on the last two decades. Therefore, our findings should be taken with a great deal of caution. In particular, we believe that the government balance sheets of EMEs might follow very different patterns as their public finances have diverse tolerance to high levels of debt (see Reinhart, Rogoff, and Savastano, 2003) and as they seem to benefit more than AEs from holding financial assets (see our literature review in Section II). Moreover, the estimates of our paper may be simply capturing the impact of recent episodes of global financial distress, such as the GFC, which were an exceptional event in the recent history, and must be distinguished from recurring episodes of asset bubble or economic recession. Our estimates may also suffer of endogeneity issues, due to omitted variable and simultaneity bias in the identification of the crisis coefficient. We partly address this issue by controlling for country fixed effects and for a wide set of macroeconomic variables, including the ones related to valuation effects, as well as by allowing a distributed lag specification of the fixed effects model. On the other hand, the application of panel VAR and GMM techniques represents a further tool to facilitate the identification of exogenous shocks and the estimation of their causal impact on government finances.

Regardless of these caveats, the results of the paper point to the existence of important symmetries and asymmetries in the dynamics of the government balance sheet components. In light of this, incorporating financial assets in DSA may not be an effortless exercise. Forecasting different balance sheet variables cannot be done with the same behavioral assumptions. In particular, government assets behave differently from liabilities under assumptions of risk management and, according to our empirical evidence, during periods of financial distress. Neglecting these asymmetries may yield to misleading projections, which, in turn, could suggest erroneous policy formulations and recommendations. This does not imply that both financial assets and other economic flows are not relevant for DSA: DSA needs to incorporate both assets and other economics flows in its framework, but such process should be informed by a careful distinction between unalike balance sheet variables. On the other hand, both theoretical and empirical research is needed in order to better understand the mechanisms of government debt and asset accumulation.

This paper focuses on the quantity of government assets and liabilities, but also the quality of balance sheet items may play a fundamental role in DSA exercises. For instance, quantitative easing (QE) and other forms of central bank interventions can lead to the impression that the sustainability of a country has improved, ignoring the considerable shifts of risk from the public to the private sector. In this regard, a sectoral BSA can be used to track the inter-temporal transmission of macro-financial shocks across the different sectors of an economy. In turn, such method allows one to explore the multidimensional nature of financial crises.[43] A parallel trend of research focusing on cross-country financial linkages also promises to enhance the analysis of bilateral exposures and financial vulnerabilities.[44]

Future work might follow two alternative, yet complementary, avenues. First, we need to better model the dynamics of financial assets compared to debt. Although the political economy literature on public debt is quite vast, the behavior of government financial assets is still underemphasized in the fiscal policy debate. Second, more empirical research is suggested in order to comprehend the underlying sources of asset accumulation. Appealing exogenous variations may be provided by news shocks, e.g., arising from natural resource discoveries, or by population shifts, such as migration flows. In particular, questions that remain open are: Why do governments hold financial assets instead of selling them in order to liquidate part of the outstanding debt they have?

[43] E.g., Ruzzante (2017) analyzes the transmission of an external financial shock, from private banks to the public sector, in the case of the 2008 Icelandic crisis, highlighting the role played by the large exposure to nonresidents and by currency mismatches.

[44] E.g., Antoun de Almeida (2015) combines sectoral accounts data to study financial networks between G-4 economies and finds that, after the GFC, bilateral exposures in debt securities have increased, while exposures in loans and equities have declined. Also, on the basis of shock simulations in the paper, the vulnerability of the financial sector to the government is revealed to have risen in the wake of the GFC.

Do capital structure and portfolio allocation matter for governments? What are the distributional implications of assets and liabilities' combined movements? Finally, even if our analysis does not detect an important role for exchange rate fluctuations, these may have a decisive impact in different contexts, such as in emerging and developing countries, especially in the existence of large shares of foreign-currency-denominated assets or liabilities in the government balance sheet.

References

Abrigo, M. R. and Love, I. (2015). Estimation of Panel Vector Autoregression in Stata: A Package of Programs. University of Hawaii Working Paper.

Afonso, A., Baxa, J., and Slavík, M. (2017). Fiscal Developments and Financial Stress: A Threshold VAR Analysis. *Empirical Economics*, pages 1–29.

Allen, M., Setser, B., Keller, C., Rosenberg, C. B., and Roubini, N. (2002). A Balance Sheet Approach to Financial Crisis. IMF Working Paper No. 13/95.

Antoun de Almeida, L. (2015). A Network Analysis of Sectoral Accounts: Identifying Sectoral Interlinkages in G-4 Economies. IMF Working Paper No. 15/111.

Blanchard, O. and Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics*, 117(4):1329–1368.

Boskin, M. J. (1982). Federal Government Deficits: Some Myths and Realities. *American Economic Review*, 72(2):296–303.

Bova, E., Dippelsman, R. J., Rideout, K., and Schaechter, A. (2013). Another Look at Governments' Balance Sheets: The Role of Nonfinancial Assets. IMF Working Paper No. 13/95.

Bova, E., Ruiz-Arranz, M., Toscani, F., and Ture, H. E. (2016). The Fiscal Costs of Contingent Liabilities. IMF Working Paper No. 16/14.

Brede, M. and Henn, C. (2018). Finland's Public Sector Balance Sheet: A Novel Approach to Analysis of Public Finance. IMF Working Paper. Forthcoming.

Buiter, W., Corsetti, G., and Roubini, N. (1993). Excessive Deficits: Sense and Nonsense in the Treaty of Maastricht. *Economic Policy*, 8(16):57–100.

Chalk, N. and Hemming, R. (2000). Assessing Fiscal Sustainability In Theory and Practice. IMF Working Paper No. 00/81.

Chinn, M. and Frankel, J. (2005). The Euro Area and World Interest Rates. Mimeo.

Conway, P. and Orr, A. (2002). The GIRM: A Global Interest Rate Model. Westpac Institutional Bank.

Corsetti, G. and Roubini, N. (1991). Fiscal Deficits, Public Debt, and Government Solvency: Evidence from OECD Countries. *Journal of the Japanese and International Economies*, 5(4):354–380.

Coudert, V. and Gex, M. (2008). Does Risk Aversion Drive Financial Crises? Testing the Predictive Power of Empirical Indicators. *Journal of Empirical Finance*, 15(2):167–184.

Cruces, J. J. and Trebesch, C. (2013). Sovereign Defaults: The Price of Haircuts. *American Economic Journal: Macroeconomics*, (3):85–117.

Dembiermont, C., Scatigna, M., Szemere, R., and Tissot, B. (2015). A New Database on General Government Debt. *BIS Quarterly Review*. September.

Dippelsman, R., Dziobek, C. H., and Gutiérrez Mangas, C. (2012). What Lies Beneath: The Statistical Definition of Public Sector Debt. IMF Staff Discussion Notes No. 12/09.

Eisner, R. and Pieper, P. J. (1984). A New View of the Federal Debt and Budget Deficits. *American Economic Review*, 74(1):11–29.

Engen, E. M. and Hubbard, R. G. (2005). Federal Government Debt and Interest Rates. *NBER Macroeconomics Annual 2004*, 19:83–160. MIT Press.

European Commission. *European System of Accounts – ESA 2010*. Luxembourg.

European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, and World Bank (2009). *System of National Accounts*. New York.

Gruber, J. W. and Kamin, S. B. (2012). Fiscal Positions and Government Bond Yields in OECD Countries. *Journal of Money, Credit and Banking*, 44(8):1563–1587.

Hadzi-Vaskov, M. and Ricci, L. A. (2016). Does Gross or Net Debt Matter More for Emerging Market Spreads? IMF Working Paper No. 16/246.

Henao-Arbelaez, C. and Sobrinho, N. (2017). Government Financial Assets and Debt Sustainability. IMF Working Paper No. 17/173.

Holtz-Eakin, D., Newey, W., and Rosen, H. S. (1988). Estimating Vector Autoregressions with Panel Data. *Econometrica: Journal of the Econometric Society*, pages 1371–1395.

Hsiao, C., Pesaran, M. H., and Tahmiscioglu, A. K. (2002). Maximum Likelihood Estimation of Fixed Effects Dynamic Panel Data Models Covering Short Time Periods. *Journal of Econometrics*, 109(1):107–150.

Ichiue, H. and Shimizu, Y. (2015). Determinants of Long-Term Yields: A Panel Data Analysis of Major Countries. *Japan and the World Economy*, 34-35:44–55.

Illing, M. and Liu, Y. (2006). Measuring Financial Stress in a Developed Country: An Application to Canada. *Journal of Financial Stability*, 2(3):243–265.

International Monetary Fund (2011). *Modernizing the Framework for Fiscal Policy and Public Debt Sustainability Analysis*. Washington, D.C.

International Monetary Fund (2013). *Staff Guidance Note for Public Debt Sustainability Analysis in Market-Access Countries*. Washington, D.C.

International Monetary Fund (2014). *Government Financial Statistics Manual 2014*. Washington, D.C.

International Monetary Fund (2016). *Analyzing and Managing Fiscal Risks – Best Practices*. Washington, D.C.

Laeven, L. and Valencia, F. (2012). Systemic Banking Crises Database: An Update. IMF Working Paper No. 12/163.

Milesi-Ferretti, G. M. (2004). Good, Bad or Ugly? On the Effects of Fiscal Rules with Creative Accounting. *Journal of Public Economics*, 88(1-2):377–394.

Milesi-Ferretti, G. M. and Moriyama, K. (2006). Fiscal Adjustment in EU Countries: A Balance Sheet Approach. *Journal of Banking & Finance*, 30(12):3281–3298.

Mishkin, F. S. and White, E. N. (2002). U.S. Stock Market Crashes and Their Aftermath: Implications for Monetary Policy. NBER Working Paper 8992.

O'Donovan, B., Orr, A., and Rae, D. (1996). A World Interest Rate Model. National Bank of New Zealand Financial Research Paper No. 7.

Patel, S. A. and Sarkar, A. (1998). Crises in Developed and Emerging Stock Markets. *Financial Analysts Journal*, 54:50–61.

Penner, R. G. (1982). How Much Is Owed by the Federal Government? *Carnegie-Rochester Conference Series on Public Policy*, 16(1):233–256.

Reinhart, C. M., Rogoff, K. S., and Savastano, M. A. (2003). Debt Intolerance. NBER Working Paper 9908.

Roodman, D. (2009). How to Do xtabond2: An Introduction to Difference and System GMM in Stata. *Stata Journal*, 9(1):86–136.

Ruzzante, M. (2017). A Balance Sheet Approach to Fiscal Risk: The Lesson from the Icelandic Banking Crisis. International Monetary Fund. Mimeo.

Vila, A. (2000). Asset Price Crises and Banking Crises: Some Empirical Evidence. *BIS Conference Papers*, (8):232–252.

Zouaoui, M., Nouyrigat, G., and Beer, F. (2011). How Does Investor Sentiment Affect Stock Market Crises? Evidence from Panel Data. *Financial Review*, 46(4):723–747.

Appendix

Tables

Table 1: List of countries in the sample

Austria	Latvia
Belgium	Lithuania
Brazil*	Luxembourg
Bulgaria	Netherlands
Canada	Norway
Czech Republic	Poland
Denmark	Portugal
Estonia	Romania
Finland	Slovak Republic
France	Spain
Germany	Sweden
Hungary	United Kingdom
Ireland	United States*
Italy	

* Government balance sheet (quarterly) data for these countries start in 2001Q1.

Table 2: Descriptive statistics – Balance sheet variables in level

	1999-2007	2008-2017	Total
Net financial worth	-0.607	-1.017	-0.823
	(1.657)	(2.304)	(2.034)
Liabilities	2.182	2.906	2.564
	(1.095)	(1.361)	(1.294)
Financial assets	1.575	1.889	1.741
	(1.024)	(1.621)	(1.381)
Financial assets held in debt instruments	1.572	1.878	1.733
	(1.023)	(1.618)	(1.378)
Liquid assets*	0.397	0.528	0.466
	(0.349)	(0.510)	(0.446)
Highly liquid assets**	0.257	0.323	0.292
	(0.203)	(0.169)	(0.189)
Observations	1025	1145	2170

Mean coefficients; standard deviations in parentheses. All the values are in percentage of quarterly GDP.

* 'Liquid financial assets' comprise currency and deposits, and debt securities.

** 'Highly liquid assets' are currency and deposits.

Table 3: Descriptive statistics – Balance sheet variables in first difference

	1999-2007	2008-2017	Total
Net financial worth	0.0116	-0.0213	-0.00599
	(0.0941)	(0.124)	(0.113)
Liabilities	-0.0118	0.0361	0.0139
	(0.0903)	(0.149)	(0.128)
Financial assets	-0.000149	0.0149	0.00788
	(0.0929)	(0.123)	(0.110)
Financial assets held in debt instruments	-0.000228	0.0146	0.00768
	(0.0923)	(0.122)	(0.110)
Liquid assets*	0.00303	0.00404	0.00357
	(0.0574)	(0.0817)	(0.0714)
Highly liquid assets**	0.000393	0.00292	0.00175
	(0.0487)	(0.0721)	(0.0623)
Observations	1025	1145	2140

Mean coefficients; standard deviations in parentheses. All the values are in percentage of quarterly GDP.

* ‘Liquid financial assets’ comprise currency and deposits, and debt securities.

** ‘Highly liquid assets’ are currency and deposits.

Table 4: Correlation matrix – Balance sheet variables in level

	Net financial worth	Liabilities	Financial assets	Real GDP growth	Inflation	Net operating balance	Short-term interest rate	Long-term interest rate	Exchange rate appre-ciation	VIX
Net financial worth	1									
Liabilities	-0.742***	1								
Financial assets	0.778***	-0.156***	1							
Real GDP growth	0.0623***	-0.137***	-0.0364*	1						
Inflation	0.100***	-0.212***	-0.0513**	0.0326	1					
Net operating balance	0.481***	-0.298***	0.427***	0.119***	-0.0207	1				
Short-term interest rate	0.151***	-0.349***	-0.0937***	-0.0282	0.379***	0.0244	1			
Long-term interest rate	-0.0242	-0.185***	-0.188***	-0.0752***	0.262***	-0.175***	0.748***	1		
Exchange rate appreciation	0.0152	-0.0725***	-0.0446**	0.00535	-0.312***	0.0123	0.151***	0.0674***	1	
VIX	0.0413*	-0.106***	-0.0381*	-0.301***	0.0108	-0.108***	0.302***	0.327***	-0.0637***	1

*Significant at 10%. **Significant at 5%. ***Significant at 1%.

Table 5: Correlation matrix – Balance sheet variables in first difference

	Net financial worth	Liabilities	Financial assets	Real GDP growth	Inflation	Net operating balance	Short-term interest rate	Long-term interest rate	Exchange rate appre-ciation	VIX
Net financial worth	1									
Liabilities	-0.584***	1								
Financial assets	0.345***	0.560***	1							
Real GDP growth	0.169***	-0.344***	-0.226***	1						
Inflation	-0.00828	-0.0636***	-0.0820***	0.0326	1					
Net operating balance	0.398***	-0.298***	0.0586***	0.119***	-0.0207	1				
Short-term interest rate	0.0256	-0.0314	-0.00901	-0.0282	0.379***	0.0244	1			
Long-term interest rate	-0.0804***	0.0925***	0.0260	-0.0752***	0.262***	-0.175***	0.748***	1		
Exchange rate appreciation	-0.0360*	-0.0118	-0.0507**	0.00535	-0.312***	0.0123	0.151***	0.0674***	1	
VIX	-0.178***	0.221***	0.0739***	-0.301***	0.0108	-0.108***	0.302***	0.327***	-0.0637***	1

*Significant at 10%. **Significant at 5%. ***Significant at 1%.

Table 6: Fixed effects regressions

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.038***	0.012**	0.008	-0.000	-0.030***	-0.012*	0.017**	0.016*
	(0.007)	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)	(0.008)
Real GDP growth		-0.694***		-0.397***		0.298*		-0.072*
		(0.140)		(0.058)		(0.164)		(0.039)
Inflation		-0.418**		-0.447**		-0.029		0.286**
		(0.201)		(0.196)		(0.162)		(0.137)
Net operating balance		-0.750***		-0.129		0.622***		-0.565***
		(0.078)		(0.128)		(0.133)		(0.095)
Short-term interest rate		-0.003		0.000		0.003		-0.000
		(0.003)		(0.003)		(0.002)		(0.002)
Long-term interest rate		0.003		0.003		0.000		-0.005**
		(0.003)		(0.003)		(0.003)		(0.002)
Exchange rate appreciation		0.032		-0.157		-0.189		0.053
		(0.053)		(0.142)		(0.125)		(0.060)
VIX		0.002***		-0.000		-0.002***		0.000
		(0.000)		(0.001)		(0.001)		(0.001)
Observations	1793	1494	1793	1494	1793	1494	1793	1494
Countries	27	23	27	23	27	23	27	23
R^2 adjusted	0.364	0.518	0.144	0.175	0.222	0.296	0.249	0.312

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 7: Fixed effects regressions – Different categories of financial assets

	Assets held in debt instruments		Liquid assets		Highly liquid assets	
	(1)	(2)	(3)	(4)	(5)	(6)
Financial crisis	0.007	-0.002	0.007	-0.003	0.004	0.000
	(0.007)	(0.006)	(0.005)	(0.005)	(0.003)	(0.005)
Real GDP growth		-0.402***		-0.099*		-0.114***
		(0.059)		(0.053)		(0.024)
Inflation		-0.433**		-0.219***		-0.160***
		(0.193)		(0.060)		(0.056)
Net operating balance		-0.115		0.173***		0.152***
		(0.130)		(0.044)		(0.052)
Short-term interest rate		-0.000		0.002		0.001
		(0.003)		(0.001)		(0.001)
Long-term interest rate		0.003		0.000		0.001
		(0.003)		(0.002)		(0.001)
Exchange rate appreciation		-0.158		-0.048		-0.008
		(0.142)		(0.076)		(0.025)
VIX		-0.000		0.001**		0.000
		(0.001)		(0.000)		(0.000)
Observations	1793	1494	1838	1513	1793	1494
Countries	27	23	27	23	27	23
R^2 adjusted	0.141	0.173	0.134	0.157	0.218	0.242

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables are different categories of government financial assets, defined in terms of liquidity. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 8: Fixed effects regressions with 'crisis intensity' variable

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.004***	0.002**	0.002***	0.001	-0.002**	-0.001	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Real GDP growth		-0.689***		-0.387***		0.302		0.034
		(0.130)		(0.072)		(0.182)		(0.096)
Inflation		-0.409		-0.362		0.047		0.321
		(0.384)		(0.373)		(0.225)		(0.252)
Net operating balance		-0.933*		-0.651		0.283		-0.276
		(0.477)		(0.449)		(0.522)		(0.253)
Short-term interest rate		-0.003		-0.002		0.002		0.006
		(0.008)		(0.008)		(0.007)		(0.009)
Long-term interest rate		0.001		0.004		0.003		-0.001
		(0.009)		(0.004)		(0.010)		(0.006)
Exchange rate appreciation		-0.068		-0.359		-0.291		-0.052
		(0.158)		(0.355)		(0.274)		(0.170)
VIX		0.001		-0.001		-0.003		0.001**
		(0.001)		(0.001)		(0.002)		(0.001)
Observations	408	345	408	345	408	345	408	345
Countries	27	23	27	23	27	23	27	23
R^2 adjusted	0.367	0.553	0.188	0.214	0.273	0.307	0.242	0.306

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is an indicator variable equal to the number of days in which the stock market prices of the country, as measured by the national MSCI index, were two standard deviations below the quarterly mean. The sample is restriced to periods for which 'financial crisis' is greater than 0. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 9: Dynamic fixed effects regressions

	Liabilities			Financial assets			Net financial worth			Leverage		
Number of lags:	$q=1$	$q=2$	$q=4$	$q=1$	$q=2$	$q=4$	$q=1$	$q=2$	$q=4$	$q=1$	$q=2$	$q=4$
Financial crisis	0.021**	0.020**	0.016**	0.004	0.004	-0.004	-0.018**	-0.015**	-0.019**	0.008	0.007	0.010
	(0.009)	(0.009)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.009)
Real GDP growth	-0.691***	-0.671***	-0.614***	-0.391***	-0.367***	-0.347***	0.300*	0.305*	0.268	-0.064	-0.061	-0.025
	(0.142)	(0.152)	(0.169)	(0.052)	(0.040)	(0.034)	(0.168)	(0.162)	(0.176)	(0.042)	(0.039)	(0.050)
Inflation	-0.101	-0.104	-0.288	-0.260*	-0.286*	-0.499**	-0.159	-0.182	-0.210	0.290**	0.294**	0.253***
	(0.219)	(0.236)	(0.214)	(0.153)	(0.171)	(0.208)	(0.186)	(0.198)	(0.222)	(0.115)	(0.116)	(0.097)
Net operating balance	-0.882***	-0.908***	-0.711***	-0.095	-0.176	-0.197	0.787***	0.732***	0.514**	-0.593***	-0.469***	-0.527***
	(0.054)	(0.071)	(0.089)	(0.118)	(0.138)	(0.191)	(0.122)	(0.148)	(0.232)	(0.101)	(0.122)	(0.117)
Short-term interest rate	-0.006	-0.009	-0.006	0.002	0.003	0.008	0.008	0.012**	0.014*	-0.009***	-0.011**	-0.014***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.004)	(0.006)	(0.007)	(0.006)	(0.008)	(0.003)	(0.005)	(0.004)
Long-term interest rate	0.004	0.005	0.003	0.003	0.004*	0.002	-0.001	-0.001	-0.001	-0.005**	-0.006***	-0.005*
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Exchange rate appreciation	0.037	0.022	-0.026	-0.154	-0.149	-0.141	-0.190*	-0.171*	-0.115	0.057	0.055	0.023
	(0.054)	(0.060)	(0.056)	(0.130)	(0.118)	(0.125)	(0.115)	(0.102)	(0.103)	(0.056)	(0.054)	(0.056)
VIX	0.002***	0.002***	0.002***	-0.000	-0.000	-0.000	-0.002***	-0.003***	-0.003**	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	1484	1462	1419	1484	1462	1419	1484	1462	1419	1484	1462	1419
Countries	23	23	23	23	23	23	23	23	23	23	23	23

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. Short-run coefficients are estimated through a dynamic fixed effects model, which features q lags of the country-variant regressors, and are constrained to be equal across the panel. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 10: Fixed effects regressions with ‘fiscal stabilization’ interaction

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.049***	0.014*	0.018**	0.005	-0.031***	-0.009	0.016	0.017
	(0.008)	(0.007)	(0.008)	(0.009)	(0.008)	(0.007)	(0.010)	(0.011)
Fiscal balance > 0	-0.056***	-0.037***	-0.004	0.003	0.051***	0.041***	-0.042***	-0.038***
	(0.007)	(0.007)	(0.005)	(0.006)	(0.008)	(0.006)	(0.009)	(0.011)
Financial crisis $\times$ (fiscal balance > 0)	-0.031***	-0.009	-0.027**	-0.017	0.005	-0.008	-0.000	-0.000
	(0.011)	(0.012)	(0.011)	(0.013)	(0.011)	(0.010)	(0.012)	(0.013)
Real GDP growth		-0.723***		-0.402***		0.321*		-0.101**
		(0.143)		(0.071)		(0.179)		(0.041)
Inflation		-0.454**		-0.433**		0.020		0.231
		(0.179)		(0.188)		(0.155)		(0.159)
Short-term interest rate		-0.008**		-0.001		0.007***		-0.003
		(0.003)		(0.003)		(0.002)		(0.002)
Long-term interest rate		0.008**		0.004		-0.004		-0.002
		(0.004)		(0.003)		(0.003)		(0.003)
Exchange rate appreciation		0.028		-0.165		-0.193		0.071
		(0.054)		(0.142)		(0.117)		(0.057)
VIX		0.002***		-0.000		-0.002***		0.000
		(0.000)		(0.001)		(0.001)		(0.001)
Observations	1793	1534	1793	1534	1793	1534	1793	1534
Countries	27	23	27	23	27	23	27	23
R^2 adjusted	0.396	0.492	0.146	0.170	0.249	0.275	0.265	0.292

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. ‘Financial crisis’ is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. ‘Fiscal balance’ is equal to the net operating balance of the general government. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 11: Fixed effects regressions with 'banking crisis' interaction – Short crisis length

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.019***	0.007	-0.002	-0.005	-0.022***	-0.012*	0.019***	0.020**
	(0.006)	(0.006)	(0.005)	(0.006)	(0.004)	(0.006)	(0.006)	(0.009)
Banking crisis	0.052***	-0.011	0.009	-0.010	-0.043**	0.001	0.029**	0.002
	(0.018)	(0.011)	(0.007)	(0.012)	(0.016)	(0.009)	(0.013)	(0.012)
Financial crisis × banking crisis	0.077***	0.042*	0.055***	0.041*	-0.022	-0.001	-0.034	-0.032
	(0.023)	(0.021)	(0.019)	(0.020)	(0.017)	(0.013)	(0.020)	(0.020)
Real GDP growth		-0.682***		-0.385***		0.297*		-0.082*
		(0.147)		(0.058)		(0.166)		(0.043)
Inflation		-0.399*		-0.428**		-0.029		0.269*
		(0.205)		(0.200)		(0.163)		(0.141)
Net operating balance		-0.746***		-0.123		0.623***		-0.580***
		(0.087)		(0.134)		(0.145)		(0.100)
Short-term interest rate		-0.003		-0.000		0.003		-0.000
		(0.003)		(0.003)		(0.002)		(0.001)
Long-term interest rate		0.003		0.004		0.000		-0.006**
		(0.003)		(0.003)		(0.003)		(0.002)
Exchange rate appreciation		0.030		-0.158		-0.188		0.050
		(0.054)		(0.145)		(0.128)		(0.056)
VIX		0.002***		-0.000		-0.002***		0.001
		(0.000)		(0.001)		(0.001)		(0.001)
Observations	1793	1494	1793	1494	1793	1494	1793	1494
Countries	27	23	27	23	27	23	27	23
R^2 adjusted	0.400	0.520	0.154	0.177	0.237	0.295	0.251	0.313

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. 'Banking crisis' is a dummy variable, based on Laeven and Valencia (2012) and on authors' update, where banking crises are considered to end in the last quarter of 2010. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 12: Fixed effects regressions with 'banking crisis' interaction – Long crisis length

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.018***	-0.001	-0.005	-0.011	-0.023***	-0.009	0.025***	0.026**
	(0.006)	(0.006)	(0.005)	(0.007)	(0.005)	(0.008)	(0.007)	(0.011)
Banking crisis	0.043***	0.007	0.001	-0.014	-0.042***	-0.022	0.033***	0.012
	(0.010)	(0.012)	(0.004)	(0.013)	(0.010)	(0.017)	(0.011)	(0.011)
Financial crisis × banking crisis	0.070***	0.042**	0.044***	0.034**	-0.027**	-0.008	-0.027	-0.032*
	(0.017)	(0.017)	(0.013)	(0.013)	(0.011)	(0.009)	(0.018)	(0.016)
Real GDP growth		-0.684***		-0.404***		0.280		-0.067*
		(0.156)		(0.066)		(0.183)		(0.038)
Inflation		-0.383*		-0.424**		-0.042		0.265*
		(0.205)		(0.201)		(0.171)		(0.133)
Net operating balance		-0.691***		-0.131		0.560***		-0.566***
		(0.088)		(0.143)		(0.161)		(0.097)
Short-term interest rate		-0.001		-0.001		0.000		0.001
		(0.003)		(0.003)		(0.003)		(0.002)
Long-term interest rate		0.003		0.003		0.000		-0.006**
		(0.003)		(0.003)		(0.003)		(0.002)
Exchange rate appreciation		0.037		-0.154		-0.191		0.049
		(0.059)		(0.141)		(0.124)		(0.057)
VIX		0.002***		-0.000		-0.002***		0.001
		(0.000)		(0.001)		(0.001)		(0.001)
Observations	1793	1494	1793	1494	1793	1494	1793	1494
Countries	27	23	27	23	27	23	27	23
R^2 adjusted	0.407	0.523	0.150	0.178	0.252	0.300	0.258	0.314

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. 'Banking crisis' is a dummy variable, based on Laeven and Valencia (2012) and on authors' update, where banking crises are considered to end in the last quarter of 2016. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 13: Fixed effects regressions with 'large exchange rate depreciation' interaction

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.026**	0.005	-0.003	-0.006	-0.029***	-0.011*	0.024***	0.021**
	(0.011)	(0.009)	(0.010)	(0.008)	(0.006)	(0.006)	(0.007)	(0.010)
Large depreciation	0.019***	0.010	0.011	0.010	-0.008	-0.000	0.001	0.002
	(0.005)	(0.006)	(0.011)	(0.013)	(0.011)	(0.013)	(0.010)	(0.011)
Financial crisis × large depreciation	0.031	0.025	0.032	0.027	0.001	0.002	-0.028	-0.026
	(0.027)	(0.024)	(0.023)	(0.025)	(0.017)	(0.014)	(0.020)	(0.019)
Real GDP growth		-0.710***		-0.405***		0.304*		-0.062
		(0.139)		(0.065)		(0.165)		(0.037)
Inflation		-0.408*		-0.401**		0.007		0.255*
		(0.201)		(0.174)		(0.150)		(0.131)
Net operating balance		-0.749***		-0.138		0.611***		-0.563***
		(0.079)		(0.133)		(0.138)		(0.095)
Short-term interest rate		-0.003		-0.000		0.002		-0.000
		(0.003)		(0.003)		(0.002)		(0.002)
Long-term interest rate		0.003		0.003		0.000		-0.005**
		(0.003)		(0.003)		(0.003)		(0.002)
VIX		0.002***		-0.000		-0.002**		0.001
		(0.000)		(0.001)		(0.001)		(0.001)
Observations	1749	1493	1749	1493	1749	1493	1749	1493
Countries	27	23	27	23	27	23	27	23
R^2 adjusted	0.374	0.521	0.146	0.176	0.221	0.290	0.251	0.313

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. 'Large depreciation' is a dummy variable, equal to one if there was a decrease in the nominal effective exchange rate larger than the average decrease of a country over the sample period. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 14: Fixed effects regressions – Government flows

	Net incurrence of liabilities		Net acquisition of financial assets	
	(1)	(2)	(3)	(4)
Financial crisis	0.011**	-0.000	0.007	0.001
	(0.005)	(0.005)	(0.005)	(0.005)
Real GDP growth		-0.082***		-0.085***
		(0.027)		(0.018)
Inflation		-0.095		-0.132*
		(0.072)		(0.067)
Net operating balance		-0.693***		0.267***
		(0.056)		(0.056)
Short-term interest rate		-0.001		-0.001
		(0.002)		(0.002)
Long-term interest rate		0.003		0.003
		(0.002)		(0.002)
Exchange rate appreciation		0.020		0.005
		(0.025)		(0.026)
VIX		0.001**		0.001*
		(0.000)		(0.000)
Observations	1814	1507	1814	1507
Countries	27	23	27	23
R^2 adjusted	0.164	0.342	0.172	0.222

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables are government flows that are results of transaction in liabilities and financial assets. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

Table 15: Fixed effects regressions without outlier countries

	Liabilities		Financial assets		Net financial worth		Leverage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial crisis	0.040***	0.014**	0.009	-0.002	-0.031***	-0.016**	0.020***	0.017*
	(0.007)	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)	(0.006)	(0.009)
Real GDP growth		-0.719***		-0.355***		0.365**		-0.058
		(0.135)		(0.029)		(0.133)		(0.036)
Inflation		-0.340*		-0.279*		0.061		0.177***
		(0.190)		(0.143)		(0.128)		(0.062)
Net operating balance		-0.748***		-0.043		0.704***		-0.596***
		(0.079)		(0.105)		(0.069)		(0.098)
Short-term interest rate		-0.004		-0.000		0.004*		-0.001
		(0.003)		(0.003)		(0.002)		(0.002)
Long-term interest rate		0.003		0.004		0.001		-0.006**
		(0.004)		(0.003)		(0.002)		(0.002)
Exchange rate appreciation		0.037		-0.040		-0.077*		0.082
		(0.054)		(0.037)		(0.040)		(0.065)
VIX		0.002***		0.000		-0.002***		0.001
		(0.000)		(0.001)		(0.000)		(0.001)
Observations	1649	1370	1649	1370	1649	1370	1649	1370
Countries	25	21	25	21	25	21	25	21
R^2 adjusted	0.110	0.399	0.128	0.183	0.130	0.300	0.258	0.336

Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. Norway and Hungary are excluded from the sample. ‘Financial crisis’ is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. All regressions use country fixed effects and control for seasonality. Standard errors are clustered at the country level in every specification and reported in parentheses.

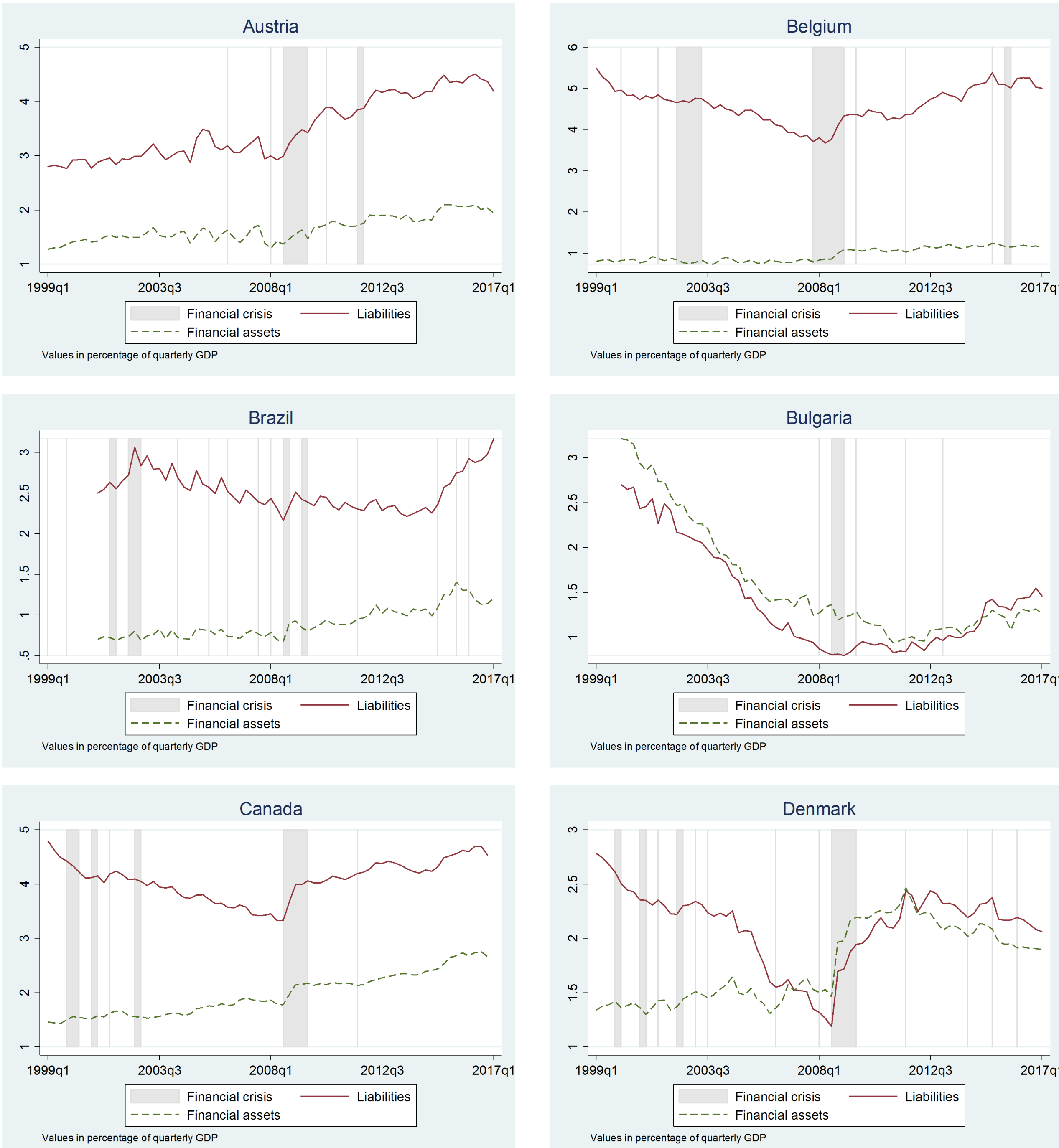
Table 16: Seemingly unrelated regressions on government liabilities and financial assets

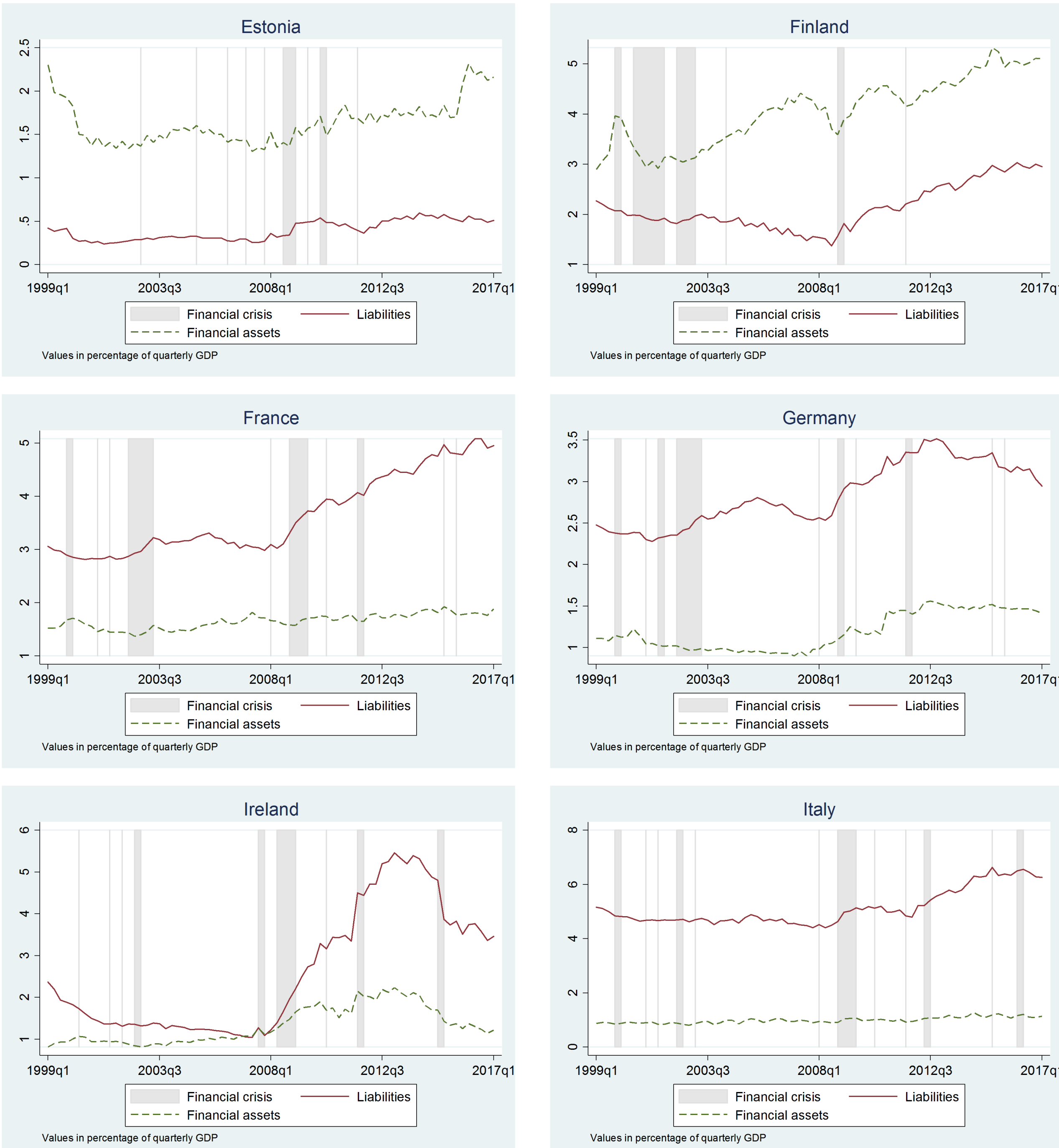
	Liabilities		Financial assets	
	(1)	(2)	(3)	(4)
Financial crisis	0.038***	0.012*	0.008	-0.000
	(0.006)	(0.007)	(0.006)	(0.007)
Real GDP growth		-0.694***		-0.397***
		(0.050)		(0.054)
Inflation		-0.418***		-0.447***
		(0.104)		(0.113)
Net operating balance		-0.750***		-0.129
		(0.072)		(0.078)
Short-term interest rate		-0.003*		0.000
		(0.002)		(0.002)
Long-term interest rate		0.003		0.003
		(0.002)		(0.002)
Exchange rate appreciation		0.032		-0.157***
		(0.053)		(0.057)
VIX		0.002***		-0.000
		(0.000)		(0.000)
Observations	1793		1793	1494
Countries	27	23	27	23
R^2 adjusted	0.402	0.553	0.231	0.266

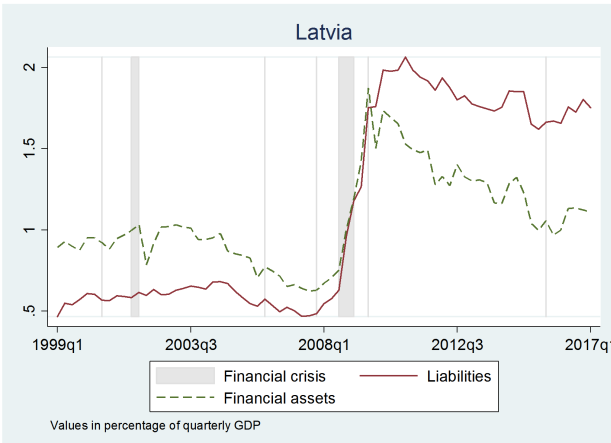
Note: *Significant at 10%. **Significant at 5%. ***Significant at 1%. Dependent variables come from the government financial balance sheet. 'Financial crisis' is a dummy variable equal to one when the stock market of the country, as measured by the national MSCI index, experienced a decline in prices of more than two standard deviations below the quarterly mean, in at least one day of the quarter. All regressions use country fixed effects and control for seasonality. Standard errors allow for correlation between the two equations and are reported in parentheses.

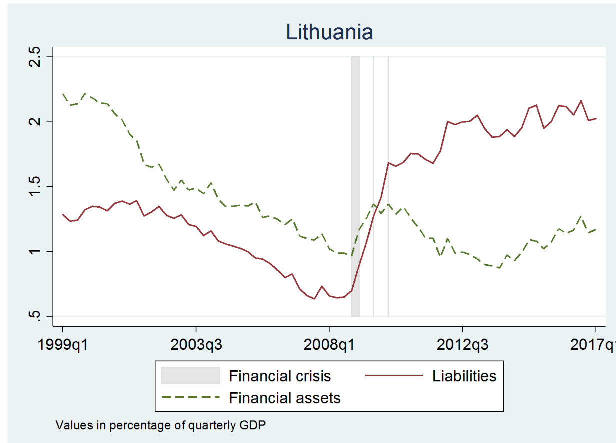
Figures

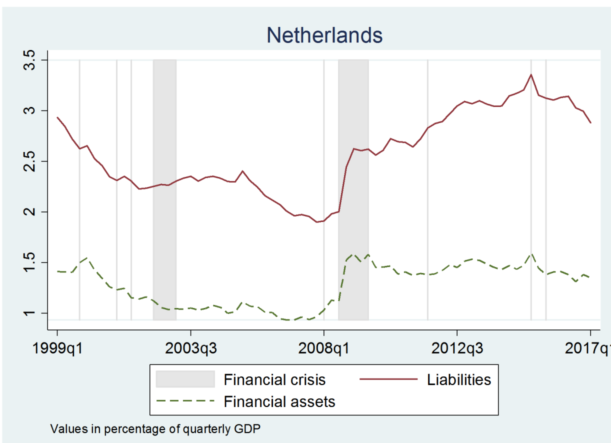
Figure 1: Financial crises and the government balance sheet, by country

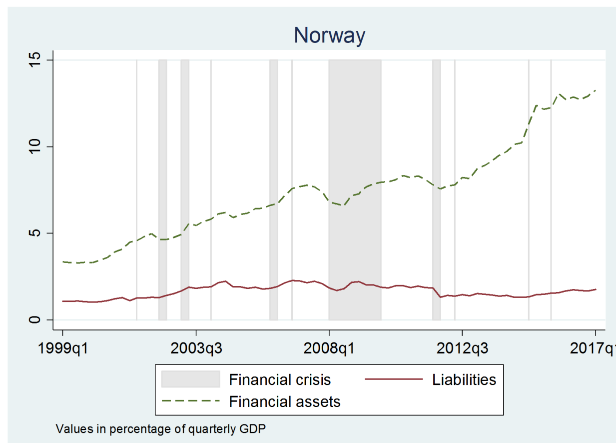


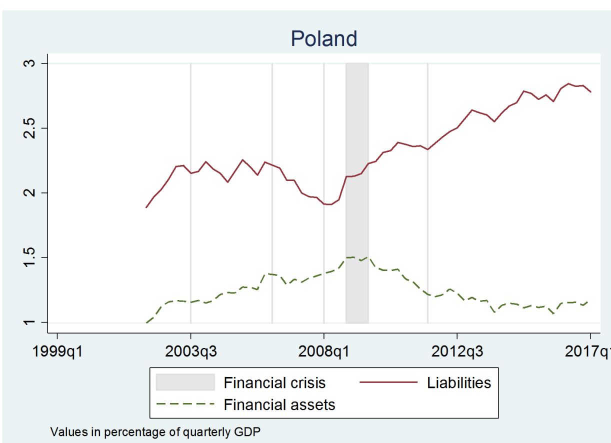

Estonia
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP
Finland
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP
France
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP
Germany
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP
Ireland
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP
Italy
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP
1999q1
2003q3
2008q1
2012q3
2017q1

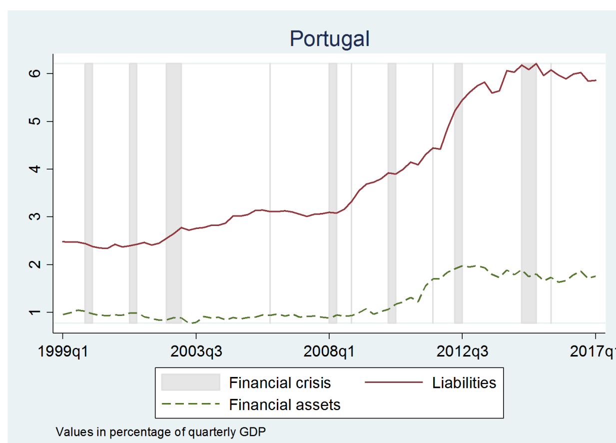

Latvia
.5
1
1.5
2
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

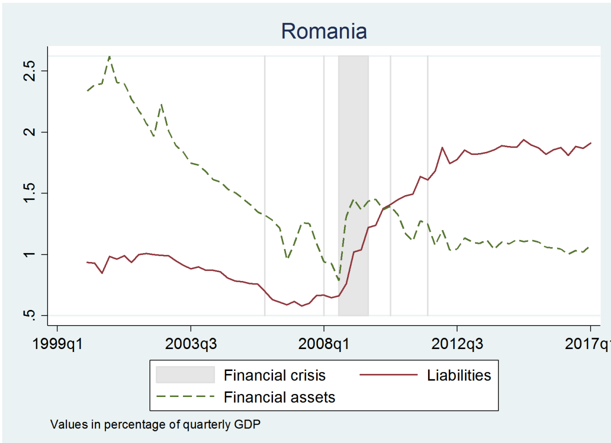

Lithuania
.5
1
1.5
2
2.5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

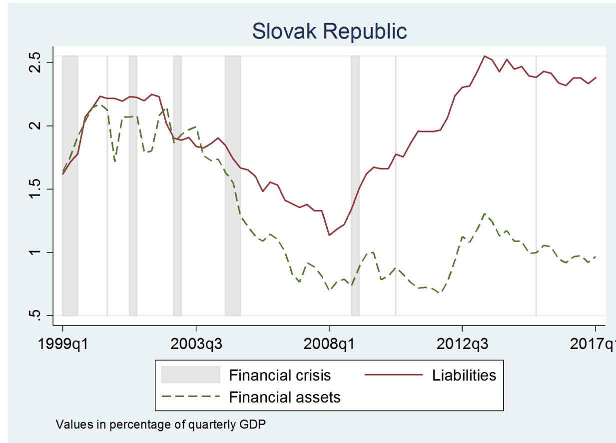

Netherlands
1
1.5
2
2.5
3
3.5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

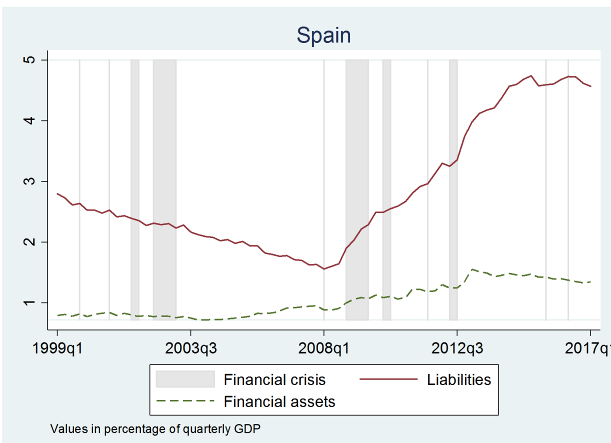

Norway
0
5
10
15
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

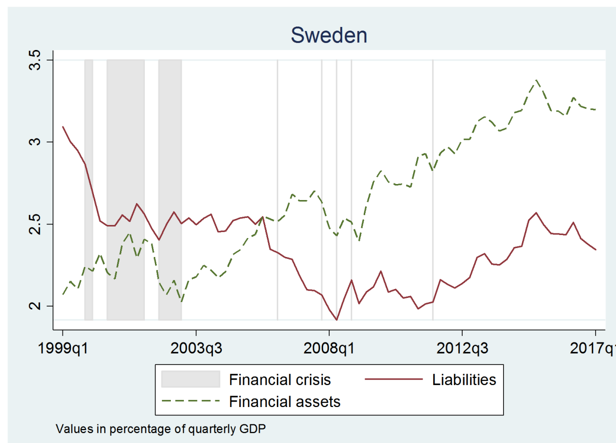

Poland
1
1.5
2
2.5
3
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

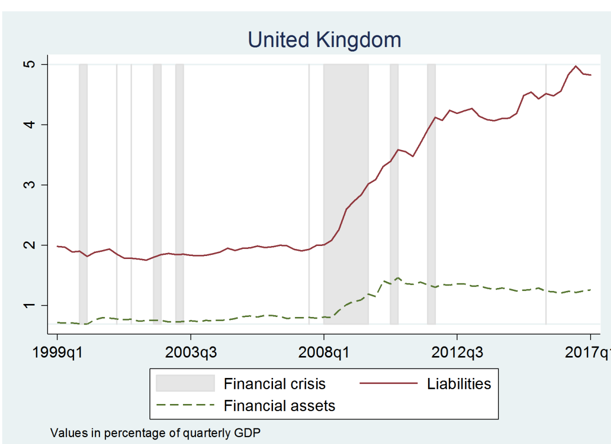

Portugal
1
2
3
4
5
6
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP


Romania
.5
1
1.5
2
2.5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP


Slovak Republic
.5
1
1.5
2
2.5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP


Spain
1
2
3
4
5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP


Sweden
2
2.5
3
3.5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP


United Kingdom
1
2
3
4
5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

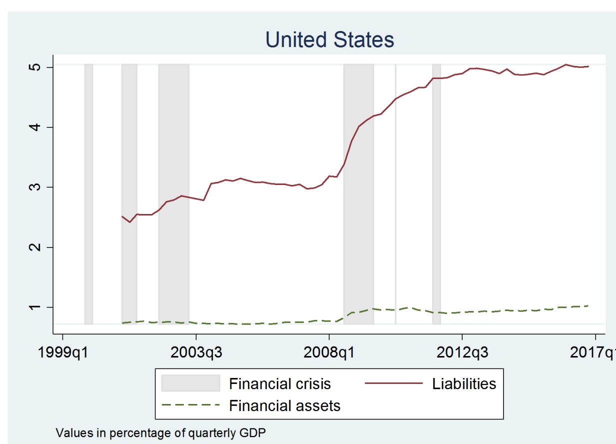

United States
1
2
3
4
5
1999q1
2003q3
2008q1
2012q3
2017q1
Financial crisis
Liabilities
Financial assets
Values in percentage of quarterly GDP

Figure 2: Scatter plot of government balance sheet variables

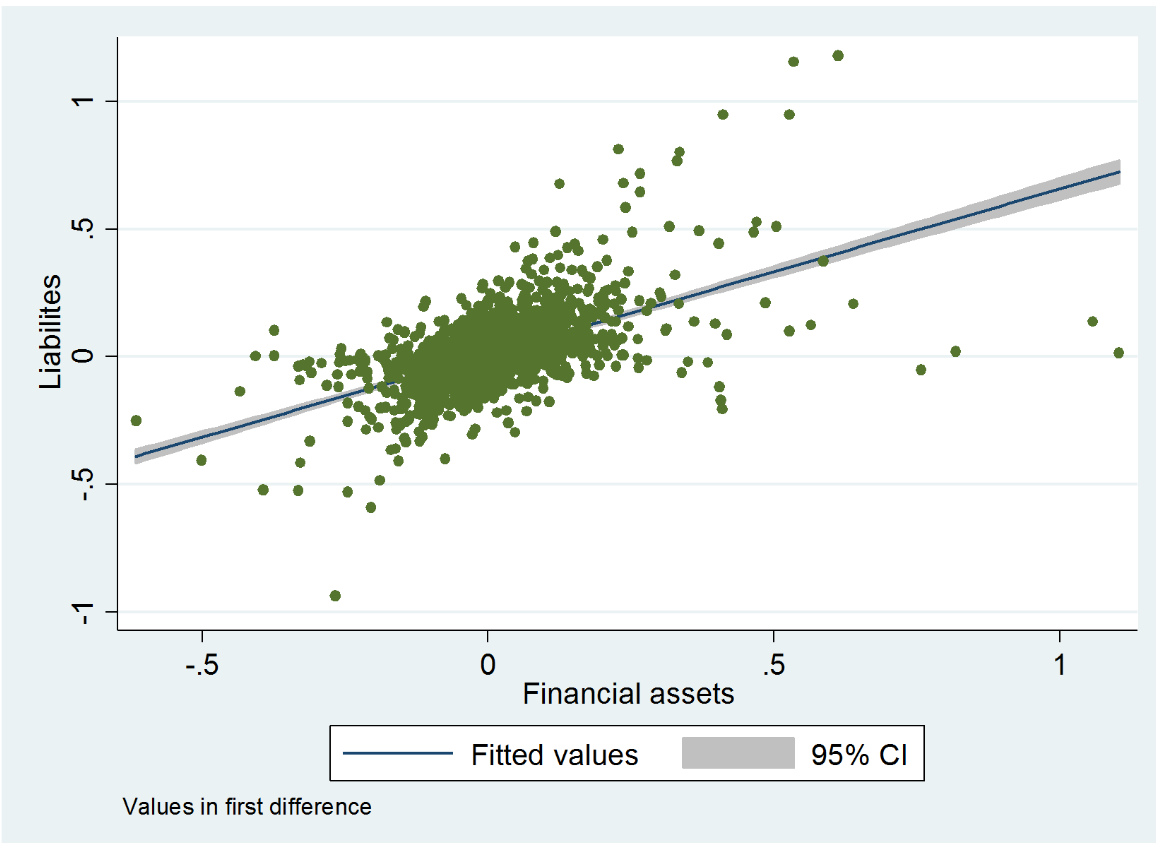
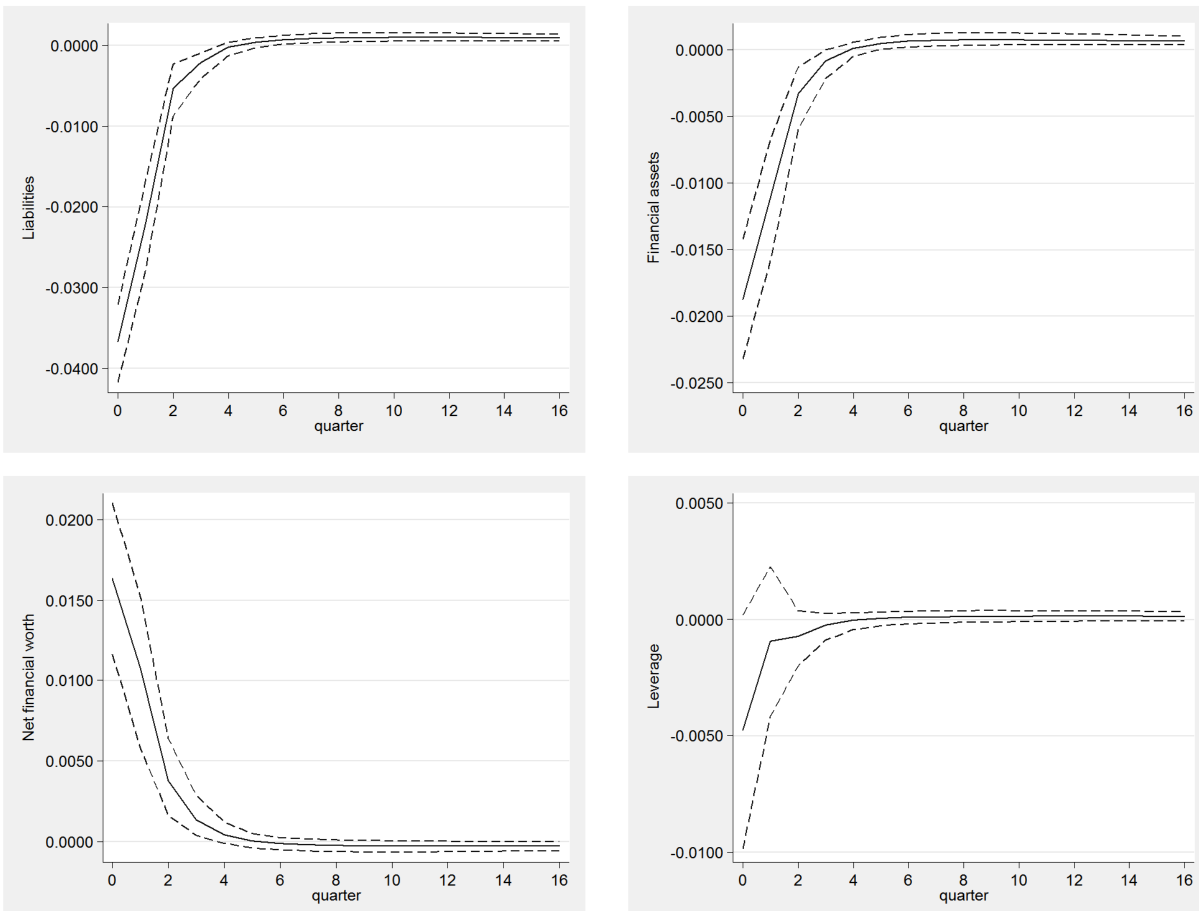
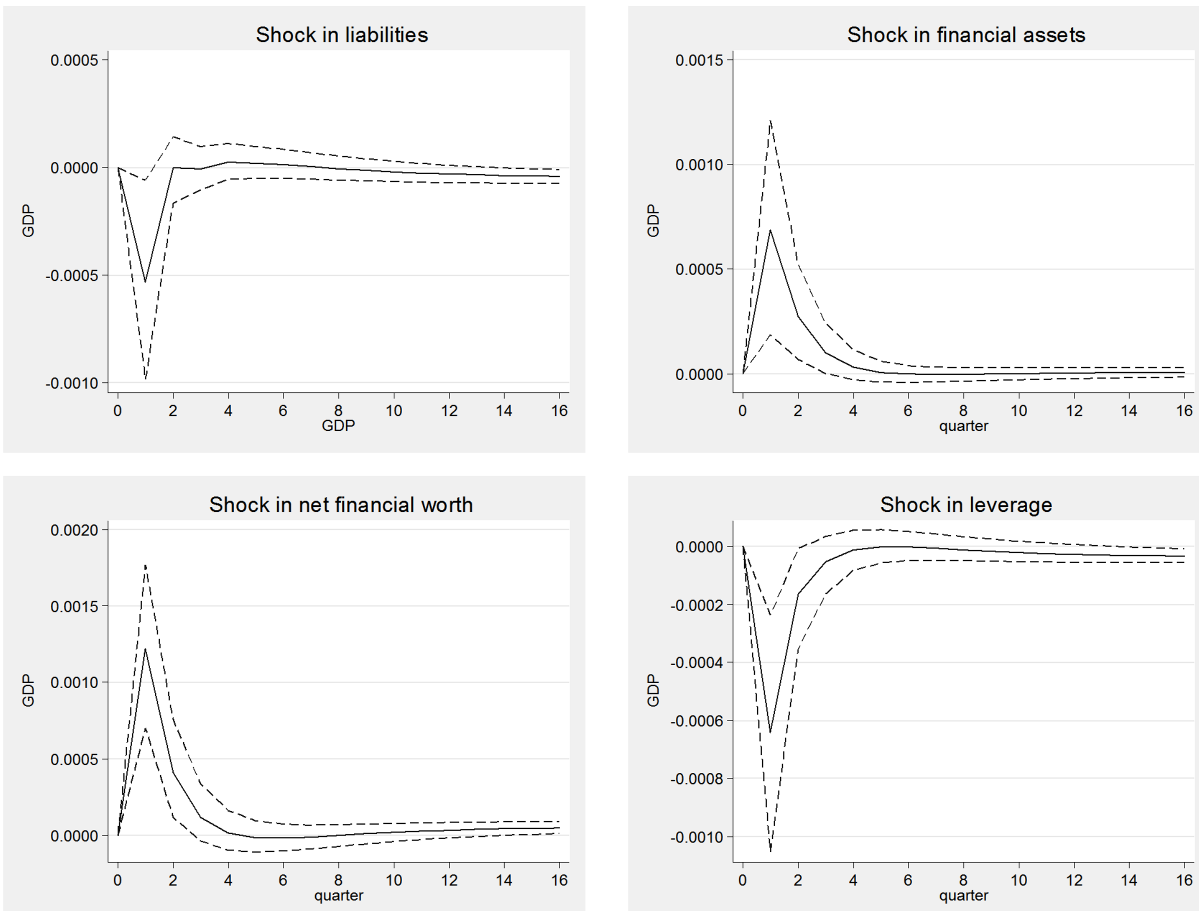


Figure 3: Impulse response functions to a GDP growth shock



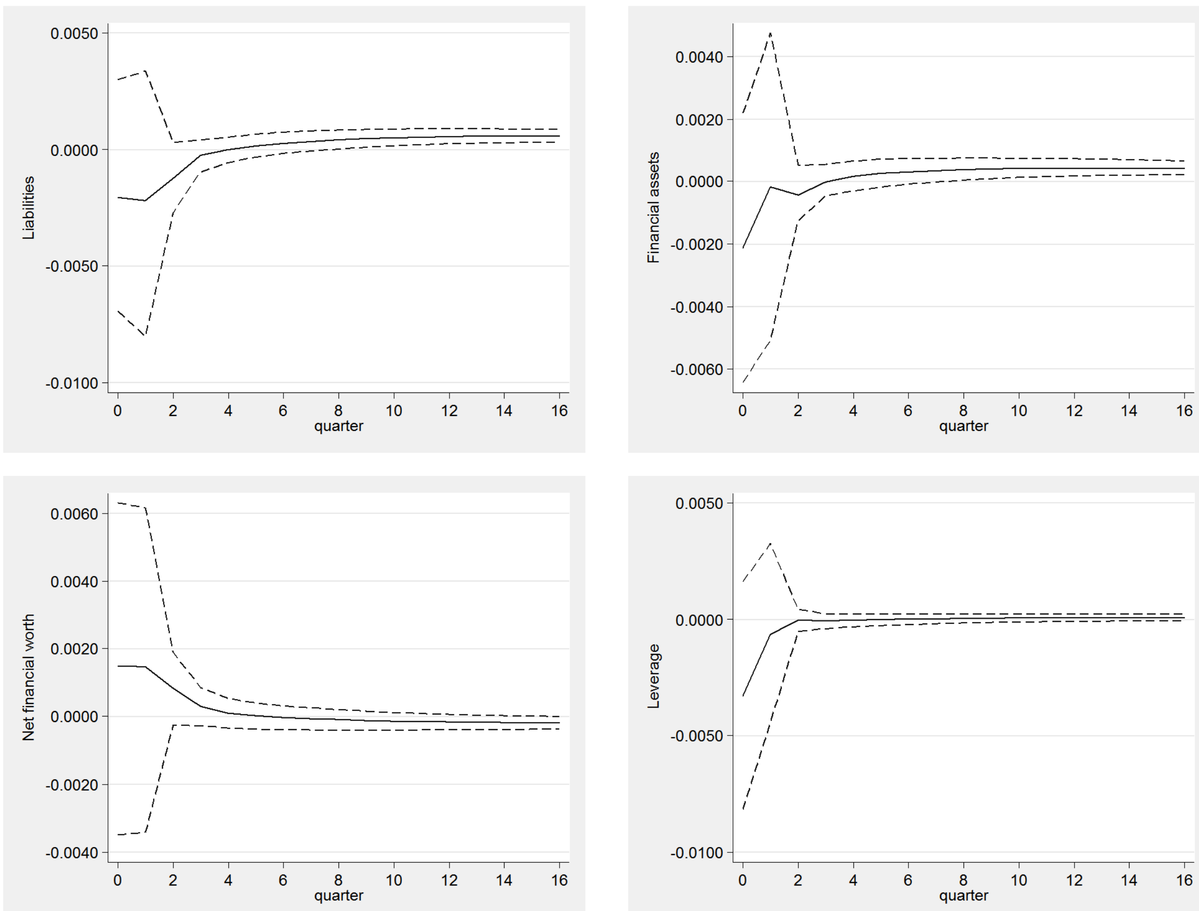
Note: IRFs are estimated using GMM on the system of equations, which includes real GDP, price level, government balance sheet variables, short-term interest rate, and the VIX index. We use one lag; we control for country fixed effects, seasonal dummies, and episodes of financial crisis; we cluster standard errors at the country level. One standard deviation shocks in GDP are orthogonalized recursively according to Cholesky decomposition. Error bands are 5% on each side and are generated by Monte-Carlo simulations with 1000 replications.

Figure 4: GDP response to ‘government balance sheet’ shocks



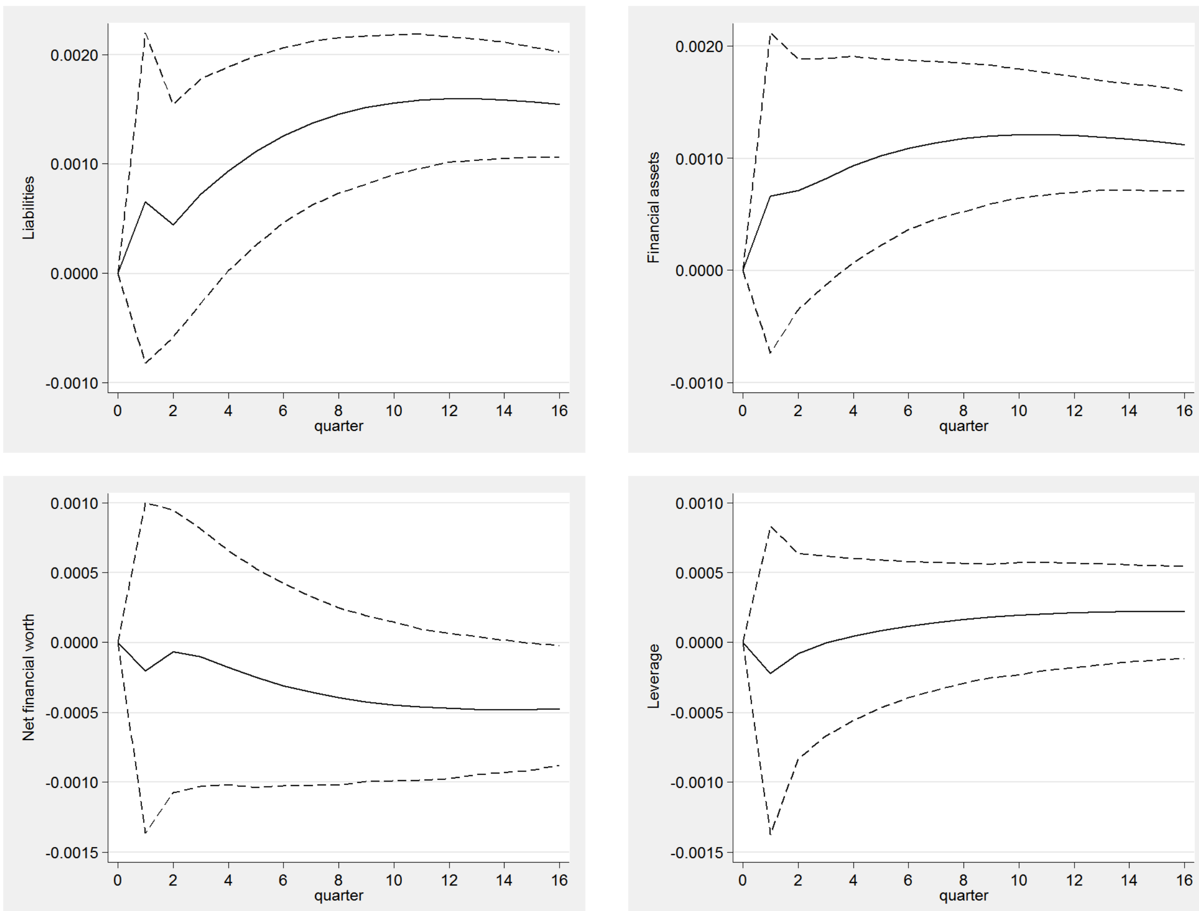
Note: IRFs are estimated using GMM on the system of equations, which includes real GDP, price level, government balance sheet variables, short-term interest rate, and the VIX index. We use one lag; we control for country fixed effects, seasonal dummies, and episodes of financial crisis; we cluster standard errors at the country level. One standard deviation shocks are orthogonalized recursively according to Cholesky decomposition. Error bands are 5% on each side and are generated by Monte-Carlo simulations with 1000 replications.

Figure 5: Impulse response functions to an inflation shock



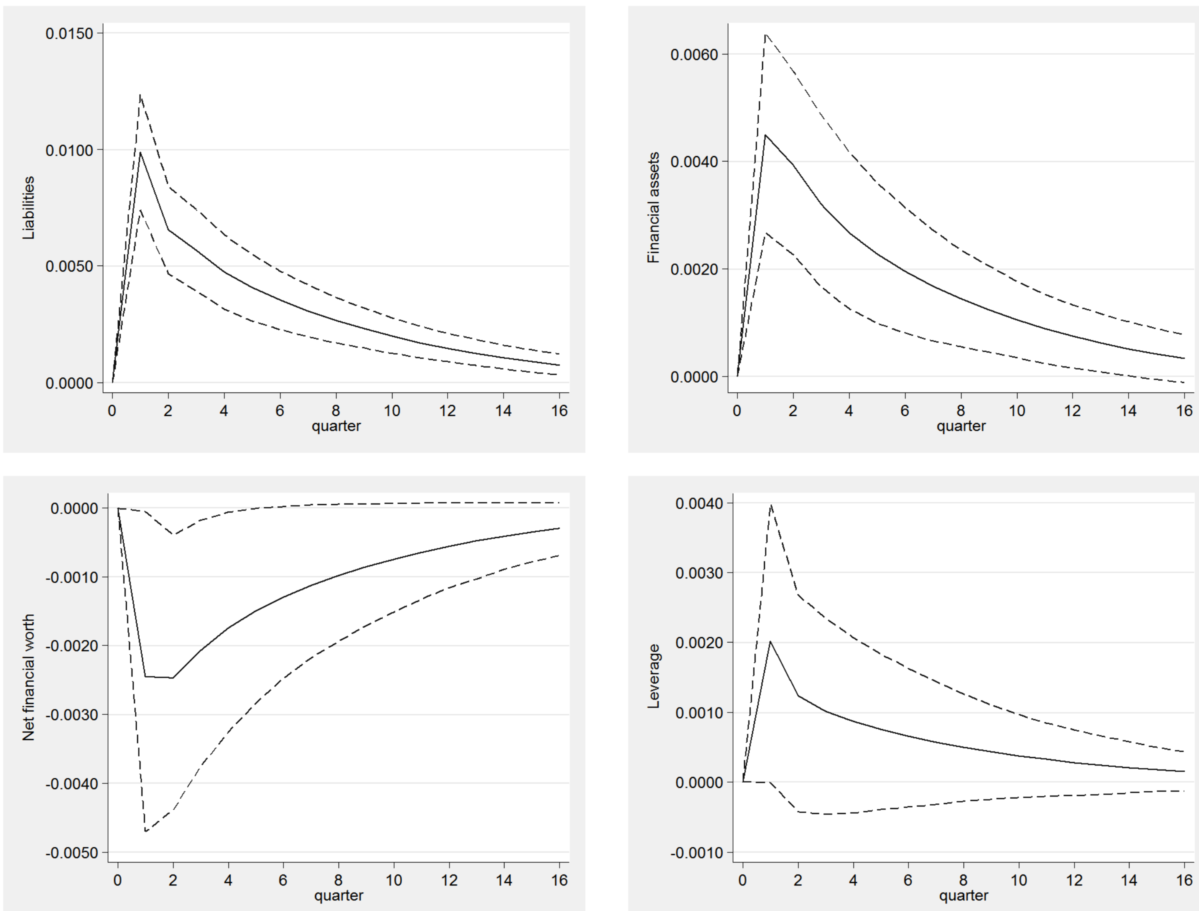
Note: IRFs are estimated using GMM on the system of equations, which includes real GDP, price level, government balance sheet variables, short-term interest rate, and the VIX index. We use one lag; we control for country fixed effects, seasonal dummies, and episodes of financial crisis; we cluster standard errors at the country level. One standard deviation shocks in inflation are orthogonalized recursively according to Cholesky decomposition. Error bands are 5% on each side and are generated by Monte-Carlo simulations with 1000 replications.

Figure 6: Impulse response functions to an interest rate shock



Note: IRFs are estimated using GMM on the system of equations, which includes real GDP, price level, government balance sheet variables, short-term interest rate, and the VIX index. We use one lag; we control for country fixed effects, seasonal dummies, and episodes of financial crisis; we cluster standard errors at the country level. One standard deviation shocks in interest rate are orthogonalized recursively according to Cholesky decomposition. Error bands are 5% on each side and are generated by Monte-Carlo simulations with 1000 replications.

Figure 7: Impulse response functions to a VIX shock



Note: IRFs are estimated using GMM on the system of equations, which includes real GDP, price level, government balance sheet variables, short-term interest rate, and the VIX index. We use one lag; we control for country fixed effects, seasonal dummies, and episodes of financial crisis; we cluster standard errors at the country level. One standard deviation shocks in VIX are orthogonalized recursively according to Cholesky decomposition. Error bands are 5% on each side and are generated by Monte-Carlo simulations with 1000 replications.