BANK OF GREECE
EUROSYSTEM

Working Paper

Financial stability indicators and public debt developments

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MAY 2014

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Printed in Athens, Greece
at the Bank of Greece Printing Works.

ISSN 1109-6691

FINANCIAL STABILITY INDICATORS AND PUBLIC DEBT DEVELOPMENTS

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Abstract

This paper investigates the inter-linkages between financial stability and fiscal policy. It analyzes the effect of selected financial stability indicators on the probability of future debt deterioration, controlling for several macroeconomic variables. We find significant evidence that a fragile banking system can put at risk public finances. Weak bank profitability, low asset quality and a weak capital base increase the fragility of the banking system, thus, raising the probability of future fiscal troubles.

Keywords: Bank profitability; capital adequacy; asset quality; fiscal policy.

*JEL classification***:** E44, E58, G21, G28, E61, E62, H61, H62, E32.

Acknowledgements: I would like to thank Hadi Salehi Esfahani and two anonymous reviewers for their useful comments and suggestions. I would also like to thank Anindya Banerjee, Hamid Beladi, Martin Cihak, Paul Evans, Davide Furceri, Heather Gibson, Iftekhar Hasan, Maria Kasselaki, and Ike Mathur. The views of the paper are my own and do not necessarily reflect those of the Bank of Greece. All remaining errors are mine.

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1. Introduction

One of the major consequences of the recent financial crisis is its impact on government finances. Total support packages from governments and monetary authorities during the recent crisis have reached unprecedented levels. These actions coupled with the cyclical deterioration of fiscal positions and discretionary fiscal expansions have led to a substantial pick up in debt to GDP ratios in many OECD countries.

Although the recent crisis and the response to it was unprecedented, it certainly implies that policy makers from now on will put more of their attention on financial market developments and will try to avert analogous dramatic events in future years. Several actions towards this direction have already been agreed at the G20 and EU context (G20, 2009). For example, strengthening financial supervision and regulation, reforming international financial institutions to overcome the recent crisis and prevent future ones, creating the Financial Stability Board (FSB) to improve macro-prudential surveillance at the global level, and taking decisive and coordinated fiscal policy actions in order to restore confidence, growth and jobs etc.

Moreover, the Ecofin Council agreed on 9 June 2009 that "… an independent macro-prudential body covering all financial sectors, the European Systemic Risk Board (ESRB), should be established…".[1] In this context the European Commission on 12 September 2012 (European Commission, 2012) unveiled its proposals for a single supervisory mechanism for banks in the euro area, giving enhanced powers to the ECB, in an effort to strengthen the functioning of the Economic and Monetary Union (EMU) and break the vicious cycle between the banking sector vulnerabilities and sovereign debt financing problems. On 19 March 2013 the European Parliament and the Council reached an agreement on this major legislative package entrusting the European Central Bank with responsibility for the supervision of banks in the framework of the Single Supervisory Mechanism and adapting the operating rules of the European Banking Authority (EBA) to this new framework. Moreover, on 20 March 2014 a common ground was reached between involved parties for the creation of the Single Resolution

[1] Council of the European Union, Press release 2948th Council meeting Economic and Financial Affairs, Council Conclusions on Strengthening EU financial EU financial Supervision, 10737/09 (Presse 168) Luxemburg 9 June 2009.

Mechanism (SRM) and the Single Resolution Fund (SRF), moving one step ahead the Banking Union project loosening the bank-sovereigns nexus that has strengthened in the Euro Area crisis years.

Given the links between fiscal policy and the financial sector, it is of great importance to better understand the feedback loops between government activity and financial market stability. Financial market instability can have significant implication for public finances, either directly (to the extent that it requires government intervention, involving some short of bail out) or through its effects on economic activity. [2] An ailing banking system will mean that financial intermediation breaks down and credit extended to the private sector is substantially reduced impacting negatively on economic activity. At the same time, as we have observed in the recent crisis, the monetary policy channel could become dysfunctional. Given the banks' effort to reduce their activities and improve their balance sheets and capital base, lowering policy rates to kick-start economic activity is not automatically translated into increased lending to the private sector. Hence, fiscal intervention will be required to restore confidence in the stability of the banking and financial system (given the public good character of financial stability) and to sustain economic activity, as was indeed the case in the recent crisis.[3]

Given these important inter-linkages between financial stability and fiscal policy, this paper builds on financial soundness indicators (FSIs) of the banking system to investigate whether their evolution can provide an indication of the fiscal cost (in terms of higher debt ratio) that governments might have to incur in the event of financial instability. We are building on two recent strands of the literature. First, Cihak and Schaeck (2007, 2010) who use financial soundness indicators reported in the Global Financial Stability Report (GFSR) of the International Monetary Fund (IMF). These indicators refer to bank profitability (return on assets, return on equity), bank asset quality (non performing loans (NPLs) to total loans, loan loss provisions to non

[2] According to Peter Praet "…deteriorating fiscal positions stemming from government support measures to the banking sector – as particularly in the case of Ireland – have highlighted the linkage between financial sector stability and public debt and deficit levels…The fragility of a large multinational banking system can have a severe impact on public finances that were previously perceived to be sound…" See BIS (2011).

[3] Alternatively, unsound fiscal policies, by impacting negatively on market confidence and sovereign bonds, could represent a risk to financial and consequently economic stability. The government borrowing operations in financial markets and its tax decisions could also have repercussion for interest rates and asset price behaviour, which could become a risk to financial market stability (BIS, 2011).

performing loans), and bank capital adequacy (regulatory capital to risk weighted assets, capital to assets). The findings of Cihak and Schaek (2007, 2010) provide evidence that a certain subset of FSIs may help predict a banking crisis. The second strand of the literature relates to the study of Furceri and Zdizienicka (2012a) who show that banking crises are associated with significant and long lasting increases in government debt. Building on these two pieces of work we relate the evolution in FSIs to the accumulation of debt and claim that FSIs can be a relevant predictor of future debt crisis that are driven by the occurrence of a banking crisis and its related fiscal costs. The channels concerned involve both the direct effects (i.e., the bank recapitalization operations and other government interventions) and indirect effects (i.e., the decline in output due to the financial sector collapse).

Put it differently, the evolution of such indicators can have predictive power for the performance of the banking systems and can warn the relevant authorities on the likely macroeconomic and budgetary implications and risks that an event of financial instability might entail (e.g., in Ireland and in Spain banking sector vulnerabilities led to a sovereign debt problems).[4] Taking this into account, fiscal authorities, in close cooperation with financial supervisors, should keep track of the developments in the financial system.

Employing different modeling techniques (logit, logit fixed effects and instrumental variable probit analysis), and using data for 20 OECD countries over the period 1997-2010, we find significant econometric evidence that financial stability indicators can be linked with future debt deterioration episodes. Indicatively, a 1 percentage point (p.p.) increase in the returns on assets ratio reduces the probability of future fiscal troubles by about 0.084-0.124. Similarly, a 1 p.p. increase in the ratio of NPLs to total loans raises the probability of subsequent debt deterioration by about 0.015. Finally, a 1 p.p. increase in the regulatory-capital-to-risk-weighted-assets reduces the probability of debt deterioration by about 0.02-0.03. In addition, we find that the effect of higher regulatory-capital-to-risk-weighted-assets in lowering future fiscal risks increases as we pass from weak to more severe debt crisis episodes. Overall, FSIs can provide valuable information to the fiscal policy maker, both as regards their direct effect on the probability of future

[4] See IMF (2010) and Eurogroup (2012).

debt deterioration episodes, as well as indirectly through their likely impact on output growth and the debt ratio sub- components.

Our findings provide evidence that early signs of instability that can be used to initiate action that could involve creating additional fiscal space (fiscal buffers), in particular in good times, and putting in place appropriate supervisory and regulatory actions to avert a possible destabilization of the banking sector and subsequent fiscal troubles.

The rest of the paper is organized as follows: Section 2 discusses the direct and indirect fiscal costs of financial and banking crisis and overviews previous related studies. In Section 3 we provide data information related to the financial soundness indicators and the dependent variables considered in the empirical analysis. Section 4 presents the methodology, regression analysis, robustness checks and findings. Section 5 summarizes the main findings and concludes. A Data Appendix presents detailed information about the variables used in the analysis.[5]

2. Financial crises and fiscal policy implications : fiscal costs and previous studies

2.1 Direct and indirect fiscal costs

The recent economic and financial market crises have induced governments around the world to take decisive action in terms of sustaining economic activity and preventing the meltdown of the financial sector. These actions had direct and indirect fiscal costs. Direct fiscal costs are those involving permanent increases in government's net worth as a result of the financial system rescue packages (e.g., capital injections, purchases of toxic assets, subsidies, pay out to depositors, payments of called upon guarantees etc.). These interventions lead to higher public debt, which either shows up as an increase in stock flow or debt-deficit adjustments or as higher deficit (see e.g., Attinasi et al., 2010; European Commission, 2009b, 2011a; Eurostat, 2013).[6] These are called "gross" fiscal

[5] A supplementary material appendix presents additional empirical findings.

[6] Debt accumulation in each period is determined by: (i) the primary budget balance, (ii) the interest payments on debt, (iii) the nominal growth rate, and (iv) the stock-flow or debt-deficit adjustment (i.e., factors that do not affect the primary balance). The debt-deficit adjustment incorporates: (1) financial derivatives and other liabilities, (2) net

costs, because some of these costs are recovered after a period of time when financial asset are resold.

According to European Commission and ECB reports over the period 2003-2007 the stock-flow adjustment was on average 0.3% of GDP or less for euro area countries.[7] As a result of the financial crisis and several government operations this number has increased to 3.2% of GDP in 2008. Information unveiled by Eurostat (2013) puts the impact of financial sector support on general government deficit in the euro area at 0.08% of GDP in 2009, 0.72% of GDP in 2010, 0.1% of GDP in 2011 and 0.57% of GDP in 2012. The impact on government debt (gross government liabilities) in the euro area was 2.5% of GDP in 2009, 5.1% of GDP in 2010, 4.8% of GDP in 2011 and 5.5% of GDP in 2012.[8]

The overall direct medium term impact on the government balance sheet will depend on whether governments recover part of the resources devoted to acquire the financial asset during the time of crisis. However, this can take several years and it can have lead to quite different outcomes (e.g., Sweden recovered fast substantial part of the value of the private sector assets it acquired in the 1991 financial crisis, contrary to the Japanese 1997 experience; see European Commission, 2009b).

According to IMF (2013) the impact of the financial sector support on gross public debt was at 4.8% of 2012 GDP in the US, while 4.2% of GDP was recovered. In

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acquisition of financial assets, (3) differences in cash and accrual accounting, and (4) other adjustments (e.g., effects of face valuation, appreciation/depreciation of foreign currency debt and other changes in volume). Some of the measures (i.e., capital injections, loans, acquisitions of financial assets) taken during the financial crisis in support of the banking sector are recorded as impacting the stock-flow or debt-deficit adjustment term. For example, if these financial transactions are conducted at market price or yield sufficient return they will affect the debt (if they imply increased government borrowing), but they will not affect the primary balance. Government guarantees provided during the crisis represent contingent liabilities that do not have an immediate impact of government finances. They will impact the primary balance only if they are called upon, leading to a deficit increasing capital transfer. The government support packages do not come for free, governments receive fees, dividends or interest payments (e.g., on preferential shares). These are all recorded as deficit decreasing operations. See European Commission (2009a), Attinasi et al. (2010) and Eurostat (2013).

[7] See European Commission (2009a) and Attinasi et al. (2010).

[8] At the same time general government assets in the euro area increased by 2.4% of GDP in 2009, 4.2% of GDP in 2010, 3.7% of GDP in 2011 and 3.8% of GDP in 2011. While contingent liabilities that are outside the general government and not recorded in government debt increased as a consequence of financial sector support measures, by 8.7% of GDP in 2009, 6.3% of GDP in 2010, and 6.1% of GDP in both 2011 and 2012. These contingent liabilities contingent liabilities which may contribute to government liabilities in the future, but are not currently recorded as government debt. they result exclusively from guarantees granted on financial institutions' assets and (or) liabilities (see Eurostat 2013).

Germany the impact on gross debt was at 12.8% of GDP with only 2.0% of GDP being recovered. In Ireland the impact on gross debt reached 40.5% of 2012 GDP and only 4.4% of GDP was recovered, while in the UK the impact on gross debt reached 6.7% with 1.5% of GDP being recovered to date.

There are also indirect fiscal costs, i.e., due to the feedback loop from financial crisis to economic activity. These involve lower revenue due to falling profits and asset prices, higher expenditure in order to counterbalance the impact of the crisis, as well as interest rate and exchange rate effects due to market reactions (see European Commission, 2009b).

As a consequence of all these factors, discretionary fiscal intervention and the cyclical deterioration in economic activity debt ratios has been rising sharply in most OECD countries. According to European Commission (2011b) in 2007 debt stood at 66.2% of GDP in the euro area and at 62.3% of GDP in the United States. As reported by the Organization for Economic Cooperation and Development (henceforth OECD) (2013) the debt ratio in 2012 was 103.9% of GDP in the euro area and 106.3% of GDP in the US and is expected to rise even further in 2014, reaching 106.9% in the euro area and 110.4% in the US. The average debt ratio in OECD countries is expected to reach 113.1% in 2014 from about 79.3% in 2008 (OECD, 2013).

2.2. Fiscal costs of financial and banking crisis: Previous studies

Several previous studies have investigated the direct fiscal implications of past banking system support schemes (Honohan and Klingebiel, 2003), the determinants of fiscal recovery rates (European Commission, 2009b), as well as whether costly fiscal interventions reduce output loss (Claessens, Klingebiel, and Laeven, 2005; Detragiache and Ho, 2010). Other studies, building on a banking crisis data set identified by Laeven and Valencia (2008), have investigated the effect of financial crisis on the debt to GDP ratio and GDP growth (European Commission, 2009b, 2011b; Furceri and Zdzienicka, 2012a, 2012b; Reinhart and Rogoff, 2008, 2009, 2011). While the European Commission (2011a) considers ways to take into account the impact of banking losses on government

finances and the sustainability of their debt positions of EU Member States. The main findings of these studies are summarized in the remaining of this section.

Honohan and Klingebiel (2003) find that blanket guarantees, open-ended liquidity support, repeated partial recapitalizations, debtor bail-outs and regulatory forbearance all tend to add significantly and sizably to fiscal costs. Honohan and Klingebiel (2003) conclude that more "accommodative" policies tend to make banking crises costlier.

The European Commission (2009b) investigating the fiscal costs of financial crises finds that advanced economies have higher recovery rates; simultaneous banking and exchange rate crisis lead to lower recovery rates, while a stronger fiscal balance (bigger fiscal space) at the onset of the crisis leads to higher recovery rates. Improved institutional quality, reflecting greater government effectiveness, improves recovery rates. This is also relevant when the government sets up an asset management company to manage acquired private sector assets. Specific interventions such as bank recapitalization and provision of liquidity support are found to improve recovery of initial fiscal outlays. On the contrary, blanket guarantees, regulatory forbearance, mergers and bank closures were not found to improve recovery rates.

According to Claessens, Klingebiel, and Laeven (2005) policies that support the banking system do not to reduce the output cost of banking crises, while good institutions, captured by an index of overall quality of institutions, an index of corruption, and an index of judicial efficiency, tend to have a positive effect.

Similarly, Detragiache and Ho (2010) find that crisis response strategies that commit more fiscal resources (e.g. namely blanket guarantees, bank recapitalization with public funds, bank nationalization, or asset management companies) do not lower the economic costs of crises, and in some cases they lead to worse post crisis performance. Moreover, these authors find that parliamentary political systems are more prone to adopt bank rescue measures that impact heavily on the budget.

Reinhart and Rogoff (2009) show that financial and banking crisis have substantial implications, with the collapse of asset markets being deep and prolonged. As they point out "the big drivers of debt increases are the inevitable collapse in tax revenues that governments suffer in the wake of deep and prolonged output contractions, as well as

often ambitious countercyclical fiscal policies aimed at mitigating the downturn". According to Reinhart and Rogoff (2008), the widely cited costs of bailing out and recapitalizing the banking system are not the main cause of debt explosions.

Reinhart and Rogoff (2011) based on world aggregate levels and on an individual country information find that: [9] (1) private debt surges—fuelled by both domestic banking credit growth and external borrowing- are a recurring antecedent to domestic banking crises; governments quite often contribute to this stage of the borrowing boom; (2) banking crises (domestic ones and those in international financial centres) often precede or accompany sovereign debt crises and help predict them; (3) public borrowing accelerates markedly and systematically ahead of a sovereign debt crisis (be it outright default or restructuring).

European Commission (2009b) finds that in years of financial crisis public debt accelerates significantly, with the bulk of the effect taking place during the first two years of the crisis. On average, the increase in public debt to GDP ratio is equal to 1.7 and 5 p. p. for advanced and emerging market economies, respectively. Similarly, the long term effect was found to be 4% of GDP in advance economies and 9.2% of GDP in emerging market economies.[10]

Furceri and Zdzienicka (2012a) using an unbalanced panel of 154 countries from 1980 to 2006, show that banking crises are associated with a significant and long-lasting increase in government debt, with the effect being a function of the severity of the crisis. As the authors point out, "for severe crises, comparable to the most recent one in terms of output losses, banking crises are followed by a medium-term increase of about 37 percentage points in the government gross debt-to-GDP ratio."[11] Moreover as Furceri and

[9] The investigate several crisis definitions and concepts: (1) inflation (a 20% per annum threshold is used), hyperinflation (annual inflation rate exceeds 500 percent) and currency crises (annual depreciation exceed a threshold of 15 percent), (2) debt crises (involving default on payment obligations and repudiation or debt restructuring), (3) banking crisis (involving bank runs or large scale government assistance leading to closure, merger of financial institutions), (4) serial default, debt intolerance and the "this time is different syndrome".

[10] In addition, as reported by European Commission (2009b) financial crisis put a significant toll on real output, which can also lead to additional fiscal costs.

[11] Sweden and the UK experienced in the late 1980s-early 1990s a dramatic deterioration in fiscal balances by 9% and 16%, respectively. According to Schuknect and Eschenbanch (2004) 40-50% of this deterioration was due to asset price and financial instability related effects on revenues and financial sector bail-out costs. Moreover, the authors report that financial instability led to significant debt ratio increases in six industrialized countries (Sweden, Finland, Japan, France, UK, Switzerland) ranging from 11 to 50% of GDP.

Zdzienicka (2012a) point out the debt ratio increased more in countries with a higher initial gross debt-to-GDP ratio and with a higher initial foreign debt-to-GDP ratio.[12]

The European Commission driven by the significant role that the banking system instability had on the government finances in EU countries considers ways to take into account the impact of potential banking losses on government finances and on the sustainability of their debt positions. To this end it (see, European Commission, 2011a) calculates the probability distributions of aggregate banking losses and the direct impact on government finances in each country. Tentative results for Germany, Ireland and Portugal, show that there exists a non-negligible probability (above 0.1%) that a banking crisis could impact heavily on a country's debt sustainability position.

2.3 Previous studies that used the FSIs

A couple of earlier IMF studies have used the FSIs in empirical analysis. Babihuga (2007) analyze the macroeconomic determinants of financial soundness indicators (FSIs) for 96 countries covering the period 1998-2005.[13] Cihak and Schaeck (2007, 2010) working with financial soundness indicators investigate how well these aggregate banking system ratios identify systemic banking crises. The authors also estimate a duration model to investigate whether these ratios help determine the timing of a banking crisis. As is shown by the authors, bank regulatory capital to risk weighted assets does not show any variability prior to the crisis, it only increases as a consequence of the crisis, i.e., authorities impose or markets require a higher capital requirement after a financial crisis. The capital to asset ratio increases prior to the crisis possibly because banks build up capital buffers in anticipation of regulatory pressure. The non-performing loans to total loans increase prior to the crisis deteriorating the asset quality of institutions and gradually fall following the crisis. Consequently, bank provisions to non performing

[12] Furceri and Zdzienicka (2012b) using an unbalanced panel of 154 countries from 1970 to 2008, show that debt crises produce significant and long-lasting output losses, reducing output by about 10 percent after 8 years. Moreover, the authors find that debt crises tend to be more detrimental than banking and currency crises.

[13] She finds that the business cycle has a robust, negative relationship with capital adequacy, and non-performing loans (NPL), and a robust, positive relationship with profitability. Inflation, the real effective exchange rate, and real interest rates also emerge to different degrees as important determinants of FSIs. Cross country differences in income, size of the financial sector, and quality of banking supervision, and market concentration robustly explain cross country differences in the cyclicality of FSIs. More recently Kasselaki and Tagkalakis (2013) investigate the behaviour of these financial soundness indicators in times of financial crisis.

loans increase following the recognition of non performing loans. Finally, bank profitability (returns on earnings) is not much affected prior to the banking crisis, but deteriorates rapidly at the time of the crisis.

After controlling for macroeconomic conditions Cihak and Schaeck (2007) investigate, by estimating a logit regression, which financial soundness indicators can provide an accurate signal for the probability of observing systemic banking vulnerabilities. They use a sample of 100 countries of which 51 experience serious banking problems during the period 1994-2004. A high capital to risk weighted assets and a high return on equity lowers the probability of a systemic banking crisis occurring. On the contrary, declining asset quality, i.e., an increase in non performing loans to total loans is indicative of an impeding banking turmoil. The duration analysis performed by the authors reiterates that increasing profitability of financial institutions increases in a significant manner the survival time of banking systems. A low capital adequacy ratio and a high ratio of non performing loans to total loans decreases the survival time of the banking system, but the effect is not statistically significant.[14]

2.4 Other relevant studies

While the paper focuses exclusively on the fiscal costs of banking crises, where typically the link of causation goes from the banking sector to the government sector, there are additional strands of the literature that are related to the policy question studied here.

First, the current paper is also related to the studies investigating the determinants of sovereign debt accumulation, e.g., Nickel et al. (2010) and Baldacci et al. (2012). Nickel et al. (2010) using data for the period 1985-2009 identify factors determining major public debt reductions. They find that major debt reductions are mainly driven by decisive and lasting (rather than timid and short-lived) fiscal consolidation efforts focused on reducing government expenditure, in particular, cuts in social benefits and public

[14] Poghosyan and Cihak (2009) present a new database on individual bank distress across the European Union from mid-1990s to 2008. They find that the probability of banking distress is negatively associated with the level of bank capitalization and earnings. Moreover, the probability of distress is inversely related to asset quality, i.e., the higher loan loss provision profile implies a riskier loan portfolio.

wages. Second, robust real GDP growth also increases the likelihood of a major debt reduction because it helps countries to grow their way out" of indebtedness. Third, high debt servicing costs play a disciplinary role, strengthened by market forces, requiring governments to set up credible plans to stop and reverse the increasing debt ratios.

Baldacci et al. (2012) assess the determinants of the duration of debt reduction episodes in a large sample of countries over the last three decades using a survival model. They find that increases in the primary balances are the main source of debt reduction. Expenditure-based fiscal adjustments are key for reducing the length of debt consolidation spells, including in the aftermath of financial crises. Political fragmentation and the proximity of elections make debt sustainability more difficult to achieve, while structural reforms that help spur growth decrease the duration of debt reduction. In contrast to previous findings, however, they show that revenue-enhancing measures are more likely to accelerate debt reduction when adjustment needs are large.

Second the literature on the sovereign-banking sector spillovers. This involves contributions by e.g., Acharya et al. (2012), Ejsing and Lemke (2012), Mody and Sandri (2012). According to Acharya et al. (2012) there is strong nexus between the credit risks of financial sectors and their sovereigns in Western Economies. This can be understood in the context of two debt-overhang problems. The first one affecting the financial sector due to its under-capitalization following the crisis of 2007-08; while the second, affecting the non-financial sector, whose incentives are crowded out by high-sovereign debt and anticipated future taxes. As the authors points out: “the desire to resolve the financial sector overhang may make bailouts tempting”, however this will “raise the risk of exacerbating the overhang related to sovereign debt”. On the other hand “reduction of growth prospects due to sovereign debt overhang can make the financial sector riskier as it is highly exposed to sovereign debt both through direct holdings and indirectly through implicit government guarantees”. Acharya et al. (2012) point out it may be prudent (even in good times for well-rated sovereigns) to allow non-zero risk weights on sovereign bonds, and to require banks to fund sovereign bond holdings with reasonable quantities of capital.

As discussed by Ejsing and Lemke (2012) the introduction of governments' rescue packages for the financial system in autumn 2008 led to a "risk-trasnfer" from the financial to the public sector because, the levels of bank CDS premia decreased sharply, while those of sovereign issuers surged. Ejsing and Lemke (2012) show that in addition to this one-off level effect, the risk transfer from the financial sector to the governments also had a dynamic dimension: the sensitivity of bank CDS premia to further aggravations of the crisis declined after the packages, whereas the sovereign sensitivity sharply increased. Similarly Mody and Sandri (2012) by focusing on the evolutions of sovereign spreads investigate the inter-linkages between the sovereign and financial sector.

Finally, another piece of literature which is relevant is the one on early warning systems. There have been several recent contributions such as European Commission (2011a), IMF (2011), Baldacci et al. (2011a, 2011b), and Berti et al. (2012) based on the "signals approach" developed by Kaminksy et al. (1998) and Kaminky and Reinhart (1999). These studies discuss the use of fiscal crisis risk models and the identification of early warning signals for fiscal sustainability and debt distress problems based on individual and composite indicators.

Baldacci et al. (2011a) propose a set of fiscal indicators to assess rollover risks. These indicators provide early warning signals about the manifestation of these risks, giving policymakers the opportunity to adjust policies before extreme fiscal stress events. Two aggregate indices are calculated: an index of fiscal vulnerability and an index of fiscal stress. Results presented by Baldacci et al. (2011a) show "that both indices are elevated for advanced economies, reflecting unfavourable medium-term debt dynamics and aging-related spending pressures. In emerging economies, solvency risks are lower, but the composition of public debt remains a source of risk and the fiscal position is weaker than before the crisis."

Baldacci et al (2011b) develops a new index which provides early warning signals of fiscal sustainability problems for advanced and emerging economies. The index

assesses the determinants of fiscal stress periods, covering public debt default as well as near-default events and draws from work done by Kaminsky et al. (1998).[15]

European Commission (2011b) uses fiscal crisis risk models to gauge fiscal crisis risks by allowing for the determination of critical thresholds for a set of variables and for composite indicators combining them. The European Commission (2011b) calculates optimal thresholds based on a panel of 33 advanced countries for the period 1970-2010. The analysis includes a wide variety of both fiscal and macro-financial variables. As is shown "the overall composite indicator derived would have correctly identified 73 % of past crisis events and 83 % of past non-crisis events (i.e. correctly signalled that no crisis was imminent), highlighting quite a good overall performance for this type of methodology.[16]

Berti et al (2012) building on Baldacci et al (2011a) construct an early-warning index of fiscal stress, incorporating fiscal, financial and competitiveness variables, i.e., variables that are included in the scoreboard for the macroeconomic imbalance procedure of the EU. According to their findings financial-competitiveness variables (i.e. private sector credit flow, the current account balance, the yield curve, the net international investment position and the change in nominal unit labour costs) appear to be better leading indicators of fiscal stress that fiscal variables are. Moreover, a composite indicator incorporating fiscal and financial-competitiveness variables performs substantially better at fiscal stress prediction relative to individual variables taken in isolation.

[15] Results presented by Baldacci et al (2011b) show that " in advanced countries the top predictors of fiscal stress are indicators of gross financing needs and fiscal solvency risks. In emerging economies, the best predictors of fiscal stress are risks associated with public debt structure and exposure to spill-overs from financial markets. Fiscal stress risk has increased dramatically across the world as a consequence of the global financial crisis. Risks are higher in advanced economies than in emerging economies, but remain higher than before the crisis in the latter group."

[16] As stated "a fiscal crisis episode is identified if any of four different criteria is satisfied: high inflation rates, large sovereign bond yield spreads, public debt default or restructuring/rescheduling based on Standard & Poor's definition, large-scale IMF-supported programme in place". The identification of fiscal crisis events is based on Baldacci et al. (2011b).

3. Stylized facts and data description

Policy makers' increased interest in understanding what leads to systemic banking crises and the need to design early warning mechanisms to prevent them from occurring, as well as to containing their implications has led to the creation of the so-called macro-prudential analysis. As is stated in Cihak and Schaeck (2007) the tool-kit available to policy makers includes "macro-prudential indicators, stress tests, and qualitative analysis of the legal, regulatory, and institutional framework for the financial system". Financial soundness (or stability) indicators (FSIs) are at the heart of this analysis. According to Sundararajan et al. (2002) and Cihak and Schaeck (2007) they "include both aggregated information on financial institutions and indicators describing markets in which financial institutions operate".

The FSI data used in this study are drawn from successive IMF Global Financial Stability Reports.[17] Due to their wide coverage, FSIs are able to capture a range of factors that may pose risks to the financial system as a whole (Sundararajan et al., 2002). They provide important information on the performance and fragility of the banking system.

The paper employs the following core FSIs: capital adequacy (measured by the ratios of capital to assets and regulatory capital to risk weighted assets), asset quality (measured by the ratio of non-performing loans (NPLs) to total loans and by loan loss provisions to non performing loan), and profitability (measured by return on assets and return on equity). Capital adequacy, asset quality and profitability are all important indicators of bank performance and fragility. The FSI data start in 1997, reflecting the fact that many countries began collecting FSI data in the context of the IMF's Financial Sector Assessment Programme (FSAP), which began in 1999 (Babihuga, 2007). Despite the short time dimension of the dataset (1997-2010), the sample size (20 countries) is sufficient to allow for consistent estimators by taking into account the asymptotic properties (of the relatively larger sample of countries). [18]

[17] See Data Appendix. The IMF has created a website (http://fsi.imf.org/) disseminating data and metadata on selected FSI provided by several countries.

[18] The second drawback which is also stated in Babihuga (2007), Cihak and Schaeck (2007) and IMF (2009b) is that FSI metadata is sourced from national sources, implying that due to differences in national accounting, taxation, and supervisory regimes, FSI data might not be strictly comparable across countries. However, contrary to Babihuga (2007) and Cihak and Schaeck (2007) we decide to focus on a smaller sample, i.e., 20 industrialized countries (excluding other

Financial stability indicators are affected significantly in times of financial crisis. As shown in Table 1 bank profitability (returns on asset and returns on equity) has been reduced dramatically in the period from 2007 to 2010 compared to the pre-financial crisis period. Bank capital to assets ratios are somewhat smaller compared to the pre-crisis period. However, bank regulatory capital to risk weighted assets has been increased in the period 2007-2010 possibly reflecting regulatory authorities' requirements and interventions. Furthermore, asset quality deteriorates during (and after) financial crisis as reflected by the marginally higher value of non-performing loans to total loans in the period 2007-2010 compared to the pre-2007 period. At the same time loan loss provisioning to non performing loans remains well below the pre-2007 levels, implying increased riskiness and exposure on the side of banks. Therefore, the behavior of financial stability indicators can provide useful signals to policy makers on risks stemming from the banking sector and its likely consequences for public finances. If the deterioration of banking sector stability coincides with falling economic activity then fiscal risks could be much higher.

[Table 1 about here]

Turning now to the dependent variable used in the analysis we consider three cases, one where the debt ratio deteriorates by 8% of GDP or more in a single year (we call this "*sharp debt deterioration*"), a second one where the debt ratio deteriorates by 10% of GDP or more in a single year (we call this "*dramatic debt deterioration*"), and a third one where the debt ratio deteriorates by more than 5% of GDP in a single year while at the same time the nominal long term interest rate increases compared to the previous year (we call this "*debt deterioration with sovereign debt financing problems*"). These three definitions generate 32, 21 and 13 country-year observations, respectively.[19]

emerging market and developing economies for which the IMF reports analogous data). This way we try to avoid major problems in terms of data quality, as well as in terms of non comparability or great diversity and heterogeneity of national definitions.

[19] We have also tried to combine sharp and dramatic debt deterioration definitions with the requirement for a positive yearly change in the nominal long term interest rate, but unfortunately the episodes identified were insufficient to conduct the analysis. The supplementary material appendix presents the findings when we consider sharp debt deterioration with sovereign debt financing problems, i.e. debt increases more than 8% of GDP in a single year and at the same time the percentage change in the long term interest rate is positive. This definition yields only a few debt deterioration episodes, so the findings presented in the supplementary material appendix should be taken with a grain of salt.

The debt changes thresholds were chosen in order to generate sufficient data points to conduct the analysis. They reflect a trade off between the small time dimension of the dataset and the need to pick up the unusual and most important cases of fiscal deterioration where the soundness of the financial system might have played a role. Note that, the debt ratio in the euro area in 2008 increased by 3.3% of GDP, reaching 69.3% of GDP, reflecting a positive contribution from stock flow adjustment (3.2%). Moreover, the average change in the debt ratio across countries and time in the dataset used is 1.42% of GDP (see Table A.1, Data Appendix), while in the period 2008-2010 the average change in the debt ratio reached 6.9% of GDP. Therefore, the debt changes thresholds chosen can pick up part of the unusual and abnormal time developments, which might reflect increased risks for the soundness and sustainability of a country's fiscal position.

Additionally, imposing that the change in the nominal long term interest rate takes a positive value is a very restrictive condition because the average value in our sample across countries and time is about -0.39 p.p. (see Table A.1, Data Appendix). In the period 2008-2010 it was still negative, i.e., about -0.22 p.p. This is the reason why the third definition generates fewer data points although we have lowered the debt deterioration threshold. [20]

Table 2 displays the distribution of the debt deterioration definitions across countries and time. It can be clearly seen that they capture all well known acute debt accumulation problems in the early 2000s and late 2000s.

[Table 2 about here]

The hypothesis we want to investigate here is whether financial soundness indicators can provide valuable information on the future fiscal costs related to banking sector crisis. If financial soundness indicators of the banking sector can anticipate future fiscal costs, then an improvement in the capital base of the aggregate banking sector would diminish the probability of future public debt deterioration. Similarly, deterioration in the asset quality and the profitability of the aggregate banking sector could increase the

[20] A related strand of the literature links financial crisis and developments in government bond risk premiums. See for example, von Hagen et al. (2011) and references therein. As pointed out by Manganelli and Wolswijk (2009) spreads between euro area government bond yields are related to short-term interest rates, which are in turn related to market liquidity, to cyclical conditions, and to investors' incentives to take risk.

probability of banking crisis and subsequent public debt deterioration. In Figures 1-6 we link the evolution of the FSIs with debt deterioration episodes. We compare cases where debt episodes occurred at time t with cases where there were no debt episodes at time t. We consider only the sharp and dramatic debt deterioration episode definitions, because they generate more data points.

Both capital adequacy ratios are on average lower at time t-2 and t-1 when a debt crisis occurs at time t, compared to the case that there is no crisis at time t (see Figures 1 and 2). This implies that an adequately capitalized banking system reduces the probability of a debt crisis occurring at time t (driven by the banking system). Turning next to asset quality ratios, we observe that asset quality is much worse prior (at t-2 and t-1) to a debt crisis (in comparison to a case with no debt crisis at time t), i.e., non performing loans to total loans are higher and banks set aside lower provisions to non performing loans (see Figures 3-4). Hence, a more prudent behaviour on the part of the banking system as a whole at t-2 and t-1 would reduce the probability of a fiscal crisis occurring at time t (driven by the banking system). Last but not least, aggregate banking sector profitability deteriorates at t-2 and, in particular at t-1, raising the probability of a debt crisis occurring at time t (driven by the banking system), see Figures 5-6.

The visual inspection of the evolution of FSIs around sharp and dramatic debt deterioration episodes suggests that aggregate banking system indicators could provide valuable information and signals of future fiscal crisis driven by present financial sector vulnerabilities.

[Figures 1-6 about here]

4. Regression analysis

Using data for 20 OECD countries over the period 1997-2010 we investigate whether financial stability indicators can predict or can be associated with an increase in the debt to GDP ratio in the near future. This section draws on work done by European Commission (2011b), IMF (2011), Baldacci (2011a, 2011b) and Berti et al. (2012) based on the "signals approach". These studies discuss in great detail the use of fiscal crisis risk

models and the identification of early warning signals for fiscal sustainability and debt distress problems based on individual and composite macro-financial indicators.

Contrary to the aforementioned studies the current paper investigates the way financial soundness indicators, used for macro-prudential analysis (see Cihak and Schaeck 2007, 2010), are associated with and can provide signals about aggregate banking losses which can subsequently lead to public debt building up (if the losses are assumed by the government sector; Furceri and Zdzienicka, 2012a).

Financial market collapses, and in particular severe ones, like the 2008-2009 financial market crash, are rare episodes which are hard to predict. The same applies for the subsequent, on-going, sovereign debt crisis affecting the euro area. Nevertheless, what this paper does in the current and subsequent sections is to get a qualitative indication of whether a deterioration in the stability of the banking system could lead to future fiscal costs that have to be borne by society. This provides incentives to the fiscal policy maker to build up fiscal space in order to be able to handle possible bail out costs, as well as to strengthen financial supervision and regulation to prevent a financial-banking crisis from occurring.[21]

4.1 Methodology and data

Building on Esscolano (2010) and Baldacci et al. (2012) the debt ratio dynamics are described as follows:

$$d_t = \frac{(1+r_t)}{(1+g_t)} d_{t-1} - pb_t + sfa_t \qquad (1)$$

Where d is the debt ratio, pb the primary balance ratio, sfa stands fot stock flow adjustment and r and g correspond to the real interest rate and the the real output growth, respectively. This can then be written as:

$$\Delta d_t = d_t - d_{t-1} = \frac{(r_t - g_t)}{(1+g_t)} d_{t-1} - pb_t + sfa_t \qquad (2)$$

[21]The latter part could involve recommendations to adjust capital requirements or setting additional capital buffers in the banking system as a whole, or provide guidance in relation to leverage ratios and liquidity management. See Papademos (2009).

While we know from the fiscal policy rule literature (see e.g. Bohn, 1998; Gali and Perotti, 2003) that:

$$pb_t = \alpha + \beta * d_{t-1} + \gamma * pb_{t-1} + \sum_{j=1}^{J} \delta_j * X_{jt-1} + \varepsilon_t \quad (3)$$

i.e., the policy maker takes into account the initial debt ratio, while we also allow for persistence effects by including a lagged dependent variable; X includes other relevant factors that might affect the policy maker's decision.[22] We then substitute (3) into (2) and we have:

$$\Delta d_t = \frac{(r_t - g_t)}{(1+g_t)} * d_{t-1} + sfa_t - \left(\alpha + \beta * d_{t-1} + \gamma * pb_{t-1} + \sum_{j=1}^{J} \delta_j * X_{jt-1} + \varepsilon_t\right) (4)$$

This can then be simplified to:

$$\Delta d_t = \left[\frac{(r_t - g_t)}{(1+g_t)} - \beta\right] * d_{t-1} + sfa_t - \gamma * pb_{t-1} - \sum_{j=1}^{J} \delta_j * X_{jt-1} \quad (5)$$

As the recent financial and sovereign debt crisis revealed developments in the stock-flow adjustment term (sfa) could reflect fiscal interventions to address financial sector vulnerabilities and therefore can be considered as a function of aggregate banking sector financial stability indicators (see Attinasi et al. 2010; Eurostat, 2013). However, not all fiscal interventions to secure financial stability that were undertaken in the recent crisis were classified as 'below-the-line'. Indeed, in several occasions fiscal operations to address financial sector vulnerabilities were recorded immediately in the deficit (see Eurostat, 2013). This would imply that FSIs can also be part of the fiscal policy maker's response function, i.e., they could also be incorporated into vector X in eq. (3).[23] Therefore eq. (5) could be simplified to:

[22] For example the expectation at time t-1 of output growth at time t, which could be proxied with output growth at time t, as well as other political factors and structural reforms (see Tagkalakis, 2009; Baldacci et al. 2012).

[23] Alternatively, they could already be part of the fiscal policy makers' response to initial debt developments. We'll come to that point later on. Last but not least, it should be recalled that there are additional factors affecting the stock flow adjustment term such as valuation changes, errors and omissions.

$$\Delta d_t = \left[\frac{(r_t - g_t)}{(1+g_t)} - \beta\right] * d_{t-1} + FSI_{t-1} - \gamma * pb_{t-1} - \delta * x_{t-1} \quad (6)$$

Lower case x corresponds to the last left-hand-side component of eq. (5). Eq (6) will form the basis of our empirical analysis. Future changes in debt could reflect initial fiscal conditions (primary balance and debt ratio), real interest rates and real GDP growth developments, as well as development in the banking sector which are reflected in the evolution of financial stability indicators.

We shall consider several variants of the above specification. Although eq. (6) points to the use of contemporaneous (at t) values of output growth and real long term interest rates, we'll consider both lagged (at time t-1) and contemporaneous values (at time t) for both variables. We'll incorporate addition control variables in vector X (i.e., inflation rate and the current balance ratio, as well as the percentage change in the current account balance ratio) and we'll consider the percentage change (instead of the level) of the real long term interest rate. In addition, another variant of the above specification, instead of considering the lagged value of the primary balance ratio, will include the lagged value of the change in the debt to GDP ratio. However, as in European Commission (2009b) we have adjusted it for the snow-ball effect (because the output growth and real interest rate are already included in the specification) – henceforth, the lagged change in the adjusted debt ratio.[24]

4.2 Empirical specification

Given eq (6) and the fact that we are interested in linking the probability of future debt deteriotation to financial soundness indicators we set the probability of observing a debt deterioration episode in country i at time t to be a function of control variables at times t-1 or time t and the FSI indicator at time t-1:

[24] The variable used is:

$$(D_t/Y_t)-(D_{t-1}/Y_{t-1})-(D_{t-1}/Y_{t-1})*(i_t-y_t)/(1+y_t) = PB_t/Y_t + SFA_t/Y_t,$$

where t is a time subscript; D, PB, Y, and SFA are the stock of government debt, the primary balance, the nominal GDP, and the stock flow adjustment, respectively; i and y are the average nominal interest rate on debt and nominal GDP growth, respectively.

$$Debt\ deterioration_{it} = f(Controls_{it-1}, Controls_{it}, FSI_{it-1}) \quad (7)$$

Following Demirguc-Kunt and Detragiache (1998), Cihak and Schaeck (2010) we estimate the logit model without the inclusion of country fixed effects in order to include countries that never experienced any sort of debt deterioration episode. The estimated log-likelihood function is

$$lnL = \sum_{t=1}^{T}\sum_{i=1}^{N}\{\left(P(i,t)\ln\left[F\left(\beta' Z(i,t)\right)\right]\right) + (1-\left(P(i,t)\right))\ln\left[1-F\left(\beta' Z(i,t)\right)\right]\} \quad (8)$$

Where P(i,t) is a dummy variable that takes value 1 when there is a debt crisis and zero otherwise; β is the vector of coefficient and Z the vector of explanatory variables.

As an extension to the benchmark specification (7), and in order to control for unobserved heterogeneity, we estimate the logit model with country fixed effects.[25] However, in that case the countries that have not experience a debt deterioration episode drop out of the estimation. As point out above we use the lagged value of each FSI (FSI_{it-1}). This is done in order to address concerns that financial stability and debt deterioration indicators are endogenously determined.

4.2.1 Control variables

Driven by earlier studies, e.g., Nickel et al. (2011), Baldacci et al. (2012) our preferred specification uses the following control variables: budgetary conditions at t-1 i.e., the percentage change in the cyclically adjusted primary balances as a percent of potential GDP, which is a measure of the fiscal policy stance (represents discretionary fiscal policy choices), and the debt ratio. Lower primary surpluses (or higher primary deficits) and a high debt ratio raise the probability of a subsequent debt deterioration. In addition, we use the real GDP growth rate to control for cyclical economic conditions at time t-1 (an in some of the specifications we consider also the contemporaneous value at time t). When output growth falls the fiscal position deteriorates automatically due to the operation of automatic stabilizers. Moreover, expansionary discretionary fiscal policy

[25] See for example Schaltegger and Feld (2009) on the use of fixed effects in logistic regressions.

action in response to the output fall impact negatively of fiscal balances, increasing the likelihood of future debt deterioration.

Alternatively, in some of the specifications we include the percentage change in the adjusted debt ratio (at t-1) instead of the cyclically adjusted primary balances ratio (at t-1). This reflects the fact that financial markets might react to the incremental change in the debt ratio driven by primary balance and stock-flow-adjustment changes. This relates to the issue of debt tolerance, if financial markets perceive that a high debt ratio is sustainable they will not react negatively. However, an additional, even if incremental, increase driven possibly by the assumption of financial sector liabilities could spark a negative reaction.

We include the long term real interest rate (at t-1 and in some specifications at time t); an increase in the long term interest rate raises debt servicing costs, worsening the budgetary and debt position. However, it could also provide a signal of prospective fiscal costs that might act as a discipline device for fiscal policy makers.[26] Alternatively, we consider the percentage change in long term interest rates. Sometimes an abrupt incremental change in debt servicing costs puts significant pressure on the debt ratio.

Driven from the findings of the early warning literature (Baldacci et al., 2011a,b ; Berti et al., 2012) we also include in the analysis additional explanatory variables to control for omitted variable bias and the non-inclusion of country effects (in the baseline logit specifications). We include the current account balance-to-GDP ratio (and/or the percentage change in the current account balance ratio). A high and/or rising current account deficit reflects weak competitive performance which is associated with a negative investment position and substantial dependence from external financing. In the event of an abrubt change in market sentiment, this increased external dependent could translate into increased future fiscal costs. Finally, we include the GDP deflator based inflation rate; higher inflation (at t-1) signals increased domestic demand but it could also reflect competitiveness pressures due to domestic structural rigidities in labour and

[26] Nickel et al. (2010) have shown that high debt servicing costs play a disciplinary role for governments. Tagkalakis (2011) has shown that an increase in the differential between long and short term nominal interest rates (the steepening of the slope of the yield curve) acts as a discipline device increasing incentives for expenditure based fiscal consolidation.

product markets. The latter could put a toll on growth impacting adversely the debt ratio. On the other hand, an increase in the inflation rate lowers the real value of public debt.

As regards the FSI variables of interest, the likely impact of the FSIs on the fiscal positions is the following: a banking system with a sound capital base and increased profitability poses fewer risks for the fiscal policy maker. On the contrary, a riskier loan portfolio and a deteriorating asset quality represent a significant source of risk for the stability of the banking system, which in turn can have negative implications on fiscal balances.

4.3 Findings

4.3.1 Baseline specification

Table 3 presents the findings for the baseline specification which excludes financial soundness indicators and incorporates only the core determinants of sovereign debt accumulation as described in earlier studies such as Escolano (2010), Nickel el al (2010) and Baldacci et al. (2012).

Columns 1-4 correspond to the "sharp debt deterioration" definition and columns 5-8 to the "dramatic debt deterioration" definition. We consider various specifications. Namely, in columns 1 and 5 we consider only lagged values, and we control for initial fiscal conditions by adding the lagged value of the debt ratio and the lagged value of the change in the cyclically adjusted primary balance ratio. In columns 2 and 6 we substitute the latter variable with the lagged value of the change in the adjusted debt ratio, while we also control for the lagged value of the change in the real long term interest rate (instead of the level). Finally, in columns 3-4 and 7-8 we consider the contemporaneous (time t) values of real GDP growth rate and the real long term interest rate (in columns 3 and 7 we include the lagged value of the change in the cyclically adjusted primary balance ratio, while in columns 4 and8 we control for the lagged value of the change in the adjusted debt ratio).

Our findings indicate the following: an increase in the lagged value of the cyclically adjusted primary balance (surplus) as a percent of potential GDP lowers the

probability of debt deterioration (column 5), but the findings are not always significant. A higher debt ratio at t-1 is associated positively, but not significantly with more pronounced future fiscal risks. There is statistically significant evidence that an increase in the percentage change of the adjusted debt ratio at t-1 is associated with higher probability of future fiscal troubles (columns 2, 4, 6 and 8). A higher real GDP growth rate (at both t-1 and t) is associated negatively with the probability of debt deterioration (see columns 1-8). An increase in the contemporaneous value of the real long term interest rate implies increased probability of fiscal troubles (column 3); there is no particular evidence as regards the percentage change and the lagged value of the real long term interest rate. An improvement in the current account balance position is associated with lower future fiscal problems; the effect is more significant for the lagged current account balance to GDP ratio than the percentage change in the current account ratio. The lagged value of the inflation rate has limited effects on the probability of future debt problems (there is a positive but insignificant coefficient estimate in case of dramatic debt deteriorations).

[Table 3 about here]

4.3.2 The role of FSIs

As a next step in the analysis we augment the baseline specifications with the lagged values of the financial soundness indicators in order to anticipate a sharp debt deterioration. In Tables 4-6 we present the findings for the capital adequacy ratios, the asset quality ratios, and the profitability ratios, respectively.

Capital adequacy ratios

In columns 1-4 (5-8) of Table 4 we present the findings for bank regulatory-capital-to-risk-weighted-assets (bank capital-to-assets ratio). In all cases we consider lagged control variables. For each FSI we consider 4 different specifications; in columns 1 and 5 we control for the initial fiscal conditions by including the lagged value of the debt ratio and the lagged value of the percentage change in the cyclically adjusted primary balance ratio. In columns 2 and 6 we control for the initial fiscal conditions by including only the

lagged value of the change in the cyclically adjusted primary balance ratio.[27] In columns 3 and 6 we control for initial fiscal conditions by considering the lagged value of the debt ratio and the lagged value of the percentage change in the adjusted debt ratio (while in columns 4 and 8 we include only the lagged value of the percentage change in the adjusted debt ratio).

Starting from the bank regulatory-capital-to-risk-weighted-assets we see that it exerts a negative effect on the probability of sharp debt deterioration (Table 4, columns 1-4). Nevertheless, the effect is significant only in columns 3-4. A 1 p.p. increase in the regulatory capital to risk weighted assets reduces the probability of subsequent sharp debt deterioration by about 0.023-0.024. Turning to the other capital adequacy indicator (capital-to-assets ratio) we find that it has no particular effect on the probability of future debt deterioration (see columns 5-8, Table 4).

Regarding the control variables we see that it is primarily the lagged value of real GDP growth rate and the lagged value of the percentage change in the adjusted debt ratio that are relevant for predicting future debt deterioration episodes (see Table 4, columns 1-8). Looking in particular at column 3 in Table 4, which is the FSI-augmented version of column 2 in Table 3, we observe that the inclusion of bank regulatory capital to risk weighted assets ratio improves our ability to predict future debt deterioration episodes because the average marginal effects of the remaining control variables that are statistically significant (real GDP and adjusted debt ratio) are about the same with and without the FSIs.

[Table 4 about here]

Asset quality ratios

In columns 1-4 (5-8) of Table 5 we present the finding for bank non-performing-loans-to-total loans ratio (bank provisions-to-non-performing-loans). In columns 1, 3, 5 and 7 we control for the initial fiscal conditions by adding the lagged debt ratio and the lagged percentage change in the cyclically adjusted primary balance ratio. In columns 2, 4, 6 and 8 we control for the initial fiscal conditions by adding the lagged debt ratio and

[27] We exclude the lagged value of the debt ratio because of possible correlation between capital adequacy ratios and debt developments, i.e., a deterioration in the capital adequacy ratios of the aggregate banking system could be captured by the debt ratio. We'll come to that point later on.

the lagged value of the percentage change in the adjusted debt ratio. In columns 1-2 and 5-6 we control for the lagged values of real GDP growth rate and the lagged values of the real long term interest rate (and the lagged value of the percentage change in real interest rate). In columns 3-4 and 7-8 we control for the contemporaneous values of the real GDP growth rate and the real long term interest rate.[28]

Non-performing loans to total loans have a positive effect on the probability of debt deterioration. However, the findings are significant only when considering the contemporaneous output growth variable (see column 3; Table 5). An increase in non-performing-loans-to-total-loans can pose significant risks for fiscal policy makers as it might lead to government intervention and assumption of private sector liabilities. A 1 p.p. increase in the ratio of NPLs to total loans raises the probability of subsequent sharp debt deterioration episode by about 0.015.

An increase in loan-loss-provision-to-non-performing-loans implies that banks set aside increasing amounts of money to cover potential losses, impacting negatively on their profitability. This can be an indicator of a riskier behavior on the part of the banking system. However, the impact on public finances can go both ways, i.e., a riskier profile might lead to government intervention, increasing the debt ratio. Alternatively, adequate provisioning on non-performing loans by the banking system might reduce the likelihood of government intervention and subsequent debt deterioration. Our empirical evidence points to a negative coefficient estimate which is in favor of the second argument i.e., adequate provisioning reduces the risks of fiscal policy interventions. However, the coefficient estimates are not statistically significant (see Table 5, columns 5-8).[29]

[Table 5 about here]

[28] We include lagged FSIs and the contemporaneous value of real GDP and real long term interest rates to avoid any possible contemporaneous correlation between FSIs and these control variables. For example, as known non-performing loans (NPLs) increase when economic conditions decline and when interest rates rise. In this case adding both NPLs, output growth and interest rates at time t-1 would possibly impact negatively on the predictive ability of the NPL variable to anticipate a future debt problem (Babihuga, 2007; Kasselaki and Tagkalakis, 2013) On the other hand, if both interest rates and output growth enter in the specification with their contemporaneous value, while FSIs with their lagged values we break the causality effect from economic activity and interest rates to NPLs.

[29] The findings for the remaining control variables are qualitatively similar to those reported previously.

Bank profitability ratios

In columns 1-2 (3-4) of Table 6 we present the findings for return on assets (return on equity) ratio. We incorporate only the lagged values of all control variables. In addition in columns 1 and 3 we control for the initial fiscal conditions by adding the lagged debt ratio and the lagged percentage change in the cyclically adjusted primary balance ratio. In columns 2 and 4 we control for the initial fiscal conditions by adding the lagged debt ratio and the lagged value of the percentage change in the adjusted debt ratio.

An increase in bank profitability (a higher return on assets and on equity) improves the footing of the banking system to weather external shocks and remotes the possibility of government intervention. Moreover, a more profitable banking system raises government revenues impacting directly on deficit and debt ratios. Consequently, increased bank profitability reduces the probability of debt deterioration. We find statistically significant evidence that higher returns on assets (on equity) reduce the probability of future fiscal troubles, i.e., a 1 p.p. increase in the returns on assets reduces the probability of future debt problems by 0.124 (see column 1); while a 1 p.p. increase in the returns on equity reduces the probability of sharp debt deterioration by 0.006 (see column 3).[30]

[Table 6 about here]

4.4 Robustness checks

4.4.1 Alternative debt crisis definitions

As a robustness check in this section we consider the two stricter debt deterioration definitions that generate fewer debt deterioration data points. In the first case we estimate a logit model where the dependent variable takes value 1 when the change in debt ratio is

[30] The findings for the remaining control variable are qualitatively similar to those reported before, though the significance level and the magnitude of the average marginal effect of the lagged value of the output growth have been reduced. This could imply that there is some correlation between the profitability ratio and the output growth variable, because output growth reflects increased demand in an economy affecting positively banks' activities and profitability. This could mean that the contemporaneous inclusion of both the lagged values of the profitability ratios and output growth in the model specification downsize the impact of output growth effect on the probability of debt deterioration. We will examine this further in subsequent sections, where we examine alternative debt deterioration definitions and alternative estimation techniques.

at least 10%, and zero otherwise ("*dramatic debt deterioration*"). In the second case the dependent variable takes value 1 when the change in debt ratio is more that 5% while at the same time the change in the nominal long term interest rate takes a positive value, and zero otherwise ("*debt deterioration with sovereign debt financing problems*").

Starting from the capital adequacy indicators we find statistically significant evidence that a 1 p.p. increase in the regulatory capital to risk weighted assets ratio reduces the probability of subsequent dramatic debt deterioration episodes by about 0.03 (see Table 7, columns 3-4). The effect is much more pronounced when we consider the stricter debt deterioration definition "*debt deterioration with sovereign debt financing problems*" (see Table 8, columns 1-4). Turning to the other capital adequacy indicator (capital to assets ratio) we find that it has a negative effect on the probability of observing subsequent debt problems, however, its coefficient estimate is not statistically significant (see Tables 7-8, columns 5-8).

[Tables 7 and 8 about here]

In case of asset quality ratios, a 1 p.p increase in non-performing-loans-to-total-loans for the aggregate banking system raises the probability of a dramatic debt deterioration episode by about 0.014 (see columns 3-4, Table 9). However, an increase in NPLs cannot anticipate debt deterioration episodes that are accompanied by sovereign debt financing problems. The ratio of provisions to NPLs has no particular impact on the probability of subsequent debt problems (see Tables 9 and 10; columns 5-8).

[Tables 9 and 10 about here]

An increase in the profitability of the banking system as a whole reduces the probability of future fiscal risks. A 1 p.p. increase in return-on-assets (return-on-equity) lowers the probability of dramatic debt deterioration (debt deterioration with sovereign debt financing problems) episodes by about 0.084 (0.046); see column 1 in Tables 11-12. Whereas a 1 p.p. increase in the return-on-equity reduces the probability of dramatic debt deterioration (debt deterioration with sovereign debt financing problems) episodes by about 0.004 (0.002); see column 3 in Tables 11-12.

[Tables 11 and 12 about here]

4.4.2 Joint effects FSIs

As an additional robustness check we analyze the joint effect of financial soundness indicators in anticipating future debt deterioration episodes. We take into account the following FSIs: regulatory capital to risk weighted assets, non-performing loans to total loans and returns on equity. The results are presented in Table 13.

We find statistically significant evidence that an increase in bank profitability reduces the probability of sharp debt deterioration (dramatic debt deterioration/debt deterioration with debt financing problems) episodes (see columns 1, 4, 7 in Table 13). Namely a 1 p.p increase in the returns on equity ratio lowers the probability of sharp debt deterioration (dramatic debt deterioration/debt deterioration with debt financing problems) by 0.006 (0.004/0.002, respectively).[31] While the coefficient estimate of the profitability ratio is statistically significant under all debt deterioration definitions, the coefficient of the capital adequacy variable proves to be more relevant determinant of stricter debt deterioration definitions. A 1 p.p. increase in the regulatory capital to risk weighted assets reduces the probability of dramatic debt deterioration (debt deterioration with sovereign debt financing problems) episode by 0.021 (0.019-0.027) (see columns 5 and 7-9 in Table 13). The relevance of non-performing loans to total loans as determinant of future debt developments is limited (the average marginal effect is marginally insignificant in case of dramatic debt deterioration episodes; see column 6).

[Table 13 about here]

4.4.3 Alternative estimation techniques

As an extension to the benchmark specifications, and in order to control for unobserved heterogeneity, we estimate the logit model with country fixed effects.[32] However, in that case the countries that have not experience a debt deterioration drop out

[31] Following the discussion in footnote 30 notice that this effect is on top of the impact of output growth, which is statistically significant. Hence, aggregate bank profitability ratios provide additional valuable information on future debt ratio developments, on top, and independently of the output growth effect.

[32] See for example Schaltegger and Feld (2009) on the use of fixed effects in logistic regressions.

of the estimation. Therefore, when we take into account only the countries that experienced sharp and dramatic debt deterioration episodes we find evidence that financial soundness indicators are relevant predictors of future debt developments (see Table 14). Contrary to the findings presented in Table 13, we find evidence that it is primarily non-performing loans to total loans that can anticipate future debt accumulation (see columns 2-3 and 6 in Table 14), and to a lesser extent regulatory-capital-to risk-weighted-assets (see column 5 in Table 14). Bank profitability appears to be of limited relevance in predicting debt accumulation episodes when considering only the countries that experienced sharp and dramatic debt deterioration episodes.[33]

[Table 14 about here]

Overall, we find evidence that the evolution of FSIs is relevant determinants of the probability of future fiscal troubles. In most cases the coefficient estimate of FSIs diminishes (or stays about the same) when moving, from sharp to dramatic debt deterioration and then to debt deterioration with increasing debt servicing costs. This implies that improvements in bank profitability and reductions in NPLs could reduce the risk of future fiscal problems, but their effect weakens when considering more severe debt deterioration episodes. On the contrary, the effect of higher regulatory-capital-to-risk-weighted-assets in lowering future fiscal risks increases as we pass from weak to more severe debt deterioration episodes.

This implies that supervisory authorities have a very significant role (on top of monitoring the NPLs and the systems profitability) in ensuring that the banking system is adequately capitalized. They should remain in close cooperation with fiscal authorities, because they can take actions that could reduce the fragility of the banking system, and at the same time reduce the likely future fiscal risks that might have to be borne by society.

[33] In the supplementary material appendix we examine various logit fixed effects specifications for each FSI. We find evidence that regulatory capital to risk weight assets is relevant determinant of the dramatic and to lesser extent of the sharp debt deterioration episodes. Actually, both capita adequacy ratios impact significantly on the probability of future dramatic debt deterioration events. Non performing loans to total loans, as well as returns on assets are relevant variables for the anticipation of future debt developments; however, this refers primarily to broader debt accumulation definitions. The coefficient estimates are not presented here due to space limitations but can be found in the supplementary material appendix.

4.4.4 Further considerations

Government debt ratios are affected by output growth developments. At the same time FSIs that could signal concerns on banking sector stability could impact on debt developments both directly (through bank recapitalization costs) and indirectly by affecting output growth.

To take this indirect channel into account we re-estimate our baseline specification without FSIs, but this time we instrument the lagged output growth with the lagged FSIs.[34] We consider the joint effect of the following FSIs: regulatory capital to risk weighted asset, non-performing loans to total loans and return on equity.

Our findings are presented in columns 1-4 in Table 15 and should be contrasted with those reported in Table 3 (without the FSIs). The average marginal effect of the coefficient estimate of the lagged output gap is more pronounced when it is instrumented with the lagged FSIs. Therefore, the combination of three indicators on capital adequacy, asset quality and profitability of the banking system are relevant determinants of economic developments and could be taken into account to assess the probability of subsequent debt crisis episodes. The lower panel of Table 15 shows the first stage regression coefficient estimates of the three FSIs. An adequately capitalized banking system, characterized by good asset quality and high profitability is associated with improved economic conditions (though only the coefficient of the profitability variable is significant). However, the Wald test of exogeneity of the instrumented variable is not significant in columns 2 and 4 of Table 15, so there is not sufficient information in the sample to reject the null that there is no endogeneity. Thus the baseline logit specifications in Table 3 are more appropriate and their effects continue to hold. This is not the case in columns 1 and 3 of Table 15 where we do reject the null of no endogeneity.

Overall, the findings are mixed, but there is evidence that FSIs can be used to assess the probability of future debt deterioration, either directly or indirectly through their impact on output growth.

[34] This is done in STATA12 using the ivprobit command; the variance-covariance matrix is estimated by means of the Huber-White sandwich (robust) estimator.

As was discussed earlier the stability of the banking system can be part of the fiscal policy maker's reaction function. However, given that financial sector interventions could affect future debt developments via current debt ratios it might redundant to take into account both debt ratio and FSIs in an empirical specification. Nevertheless, our baseline specification (in Table 3) has shown that the initial debt ratio has no explanatory power in predicting future debt deterioration episodes. To address this we re-estimate the baseline model by instrumenting the lagged debt ratio with the lagged FSIs, i.e., we consider the joint effect of lagged regulatory capital to risk weighted assets, non-performing loans to total loans and returns on equity.

Our findings, presented in columns 5-8 in Table 15, indicate that the average marginal effect of the lagged debt ratio is much more pronounced and significant compared to the baseline estimations without FSIs in Table 3. The coefficient estimates are more significant in columns 5 and 7. Therefore, the combination of these three FSIs is relevant determinant of debt ratio developments. The lower panel of Table 15 shows the first stage regression coefficient estimates of the three FSIs. An adequately capitalized banking system, characterized by good asset quality and high profitability is associated with lower debt ratio.

The Wald test of exogeneity of the instrumented variable is not significant in columns 6 and 8 of Table 15. Thus there is not sufficient information in the sample to reject the null that there is no endogeneity. The baseline logit specifications in Table 3 are more appropriate and their effects continue to hold. This is not the case in columns 5 and 7 of Table 15, where we do reject the null of no endogeneity.

According to the evidence presented in Table 3 the inclusion of the percentage change in the adjusted debt ratio in the baseline specification without FSIs makes the debt ratio variable insignificant. This implies that the adjusted debt ratio variable is more relevant determinant of future debt developments. Driven by this evidence, we repeat the abovementioned exercise by instrumenting the lagged percentage change in the adjusted debt ratio (which incorporates the stock flow adjustment term) with the combination of three lagged FSIs. The findings are presents in columns 9-10 in Table 15. The average

marginal effect of the change in the adjusted debt ratio is significant and much more pronounced compared to the estimates in Table 3.

Additionally, the first stage regressions in the lower panel of Table 15 reveal that declining bank profitability and increasing NPLs are associated with higher debt burden on the part of the government. The capital adequacy ratio variable is not significant. The Wald tests present a mixed picture; however, in both cases there is not strong evidence in favor of endogeneity of the instrumented variables.[35]

Overall, FSIs can provide valuable information to the fiscal policy maker, both as regards their direct effect on the probability of future debt deterioration episodes, as well as indirectly through their likely impact on output growth and the debt ratio sub-components.

[Table 15 about here]

5. Summary and conclusions

This paper tries to shed some light on the inter-linkages between financial stability and fiscal policy. It builds on two pieces of empirical evidence. On the one hand, the findings of Cihak and Schaek (2007, 2010) provide some evidence that a certain subset of FSIs may help predict a banking crisis. On the other hand, the study of Furceri and Zdizienicka (2012a) shows that banking crises are associated with significant and long lasting increases in government debt. Building on this evidence we relate the evolution of FSIs to the accumulation of debt.

We analyze the relationship between selected financial stability indicators of the banking sector (taken from the GFSR of the IMF) and debt ratio developments. More specifically, we investigate to what extent financial stability indicators can provide information on future debt deterioration episodes, controlling for other fiscal and macroeconomic variables. Logit, logit fixed effects and IV probit analysis suggests that regulatory capital to risk weighted assets, non-performing loans to total loans, loan loss

[35] A similar exercise has been performed with the three FSIs being used as instruments of the other fiscal variable, i.e., the cyclically adjusted primary balance ratio, though the findings are insignificant and not relevant.

provisions to NPLs and bank profitability indicators (returns on assets and on equity) exert a statistically significant effect on the probability of debt deterioration.[36]

An increase in the regulatory-capital-to-risk-weighted-assets leads to a sound capital base for the aggregate banking system and reduces the risks of subsequent banking sector vulnerabilities which could be translated into increased fiscal burden. Alternatively, an eroding capital base signals future fiscal risks. The deterioration of the asset quality of the banking sector can pose a very significant risk for fiscal policy makers as it might lead to government intervention and assumption of private sector liabilities. We find statistically significant evidence that higher returns on assets (on equity) reduce the probability of future fiscal troubles.

The effect of higher regulatory capital to risk weighted assets in lowering future fiscal risks increases as we pass from weak to more severe debt deterioration episodes. This implies that macro-prudential authorities have a very significant role in ensuring that the banking system is adequately capitalized in order to reduce the likely future fiscal risks that might have to be borne by society. Moreover, we find evidence that the FSIs can provide valuable information to the fiscal policy maker, both as regards their direct effect on the probability of future debt deterioration episodes, as well as indirectly through their likely impact on output growth and the debt ratio sub-components.

Overall, a fragile and ill-performing banking system poses risks to the soundness of public finances. These findings are particularly relevant because during the 2008-9 financial crisis policymakers around the globe were faced with a triple task, to safeguard the stability of the financial system, to ensure that unsound banking practices were punished and that they will not be repeated in the future, and that the fiscal consequences of the bail out operations will be contained. Nevertheless, the fiscal cost of banking sector rescue plans were, at time, immense, and have put increased pressure on public finances

[36] Though as Cihak and Schaeck (2010) point out "analyzing individual ratios in isolation does not allow distinguishing precisely between weak and strong systems"

in many industrialized countries, and have now contributed to the on-going euro area sovereign debt crisis[37].

Therefore, our findings imply that if aggregate bank ratios provide signals for the build up of imbalances in banking systems (Cihak and Schaeck, 2007, 2010), they can also provide valuable information on prospective fiscal costs that a country might have to incur in the event of financial instability. Although our findings do not directly link aggregate bank ratios with the cost of past banking crises as those identified by Laevan and Valencia (2008), they do carry qualitative information on the importance of the inter-linkages between financial stability concerns and fiscal policy risks. These early signs of instability can be used to initiate action that could involve creating additional fiscal space (fiscal buffers), in particular in good times, and putting in place appropriate supervisory and regulatory action to avert the collapse of the banking sector.[38]

Hence, while underscoring the preliminary character of our conclusions and the data limitation (both in terms of comparability across countries and in terms of the time series dimension, as also discussed in Babihuga, 2007, and Cihak and Schaek, 2007, 2010), we have shown that aggregate bank ratios that reflect financial soundness are relevant for policy analysis and their developments should be kept on track by fiscal policy makers. Alternatively, macro-prudential supervisors should be in close coordination with fiscal policy makers to monitor the links between financial market and fiscal policy developments, i.e., financial stability and fiscal policy risks should be jointly analyzed.

Moreover, the mandate of a macro-prudential body could also involve monitoring and assessing the potential feedback effects between the financial system and fiscal policy making [39] This is particularly relevant in view of the significant feedback effects

[37] However, Reinhart and Rogoff (2008) claim that financial sector support have not been the major source of debt explosion.

[38] As stated by Steve Cecchetti "…we should adopt a more prudent approach to budgeting, including the creation of buffers both to guard against the consequence of forecasting errors and as contingencies. …To create such buffers against contingencies, fiscal authorities could accumulate budget surpluses in good times in order to provide a government with the ability and the debt capacity to respond in times of financial crisis….". See BIS (2011).

[39] In this context the European Commission on 12 September 2012 (European Commission, 2012) unveiled its proposals for a single supervisory mechanism for banks in the euro area, giving enhanced powers to the ECB, in an effort to strengthen the functioning of the Economic and Monetary Union (EMU) and break the vicious cycle between the banking sector vulnerabilities and sovereign debt financing problems. In March 2013 the European Parliament and

that exist between fiscal policy and financial stability, which can work either directly or indirectly though the real economy and could also have significant consequences in terms of the additional burden to borne by society in the event of a systemic banking crisis. Further research is needed on this front to better understand and disentangle the various channels through which banking and financial stability intertwines with fiscal policy decisions and outcomes.

the Council reached an agreement on this major legislative package entrusting the European Central Bank with responsibility for the supervision of banks in the framework of the Single Supervisory Mechanism and adapting the operating rules of the European Banking Authority (EBA) to this new framework.

A. Data Appendix

We used a yearly unbalanced panel data set (1997-2010) of 20 OECD economies: Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, UK, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Sweden, and the US.

A.1 Financial soundness indicators

The financial soundness indicators are taken from successive issues of the IMF's Global Financial Stability Report (GFSR) from March 2002 to October 2010 (see e.g. the statistical appendix of the October 2010 GFSR, tables 22-27; IMF, 2010c) and from the relevant IMF website (http://fsi.imf.org/).

Capital adequacy is measured by the following variables: Bank capital to assets and bank regulatory capital to risk-weighted assets. We measure asset quality with the ratio on bank non performing loans to total loans and bank provisions to non performing loans. Return on assets and return on equity measure bank profitability**.**

The FSI data start in 1997, reflecting the fact that many countries began collecting FSI data in the context of the IMF's Financial Sector Assessment Programme (Babihuga, 2007), which began in 1999. Despite the short time dimension of the dataset (1997-2010), the sample size (20 countries) is sufficient to allow for consistent estimators by taking into account the asymptotic properties (of the relatively larger sample of countries).

The second drawback which is also stated in Babihuga (2007), Cihak and Schaeck (2007) and IMF (2009b) is that FSI metadata is sourced from national sources, implying that due to differences in national accounting, taxation, and supervisory regimes, FSI data might not be strictly comparable across countries. However, contrary to Babihuga (2007) and Cihak and Schaeck (2007) we decided to focus on a smaller sample, i.e., 20 industrialized countries (excluding other emerging market and developing economies for which the IMF reports analogous data). This way we try to avoid major problems in terms of data quality, as well as in terms of non comparability or great diversity and heterogeneity of national definitions.

A.2 Macroeconomic variables

The fiscal and macroeconomic variables used extent from 1997 to 2010 and are taken from the Economic Outlook of the OECD (OECD, 2011).

The percentage change in cyclically adjusted primary balances as a percent of potential GDP is calculated as the difference between cyclically adjusted primary balances as a percent of potential GDP in period t and t-1. The percentage change in current account balance to GDP ratio is difference between current account ratio at t and at t-1. The percentage change in the real long term interest rate is difference between the real long term interest rate at t and at t-1. The real long term interest rate is difference between the nominal long term interest rate and inflation rate. The inflation rate is calculated as the GDP deflator based inflation rate. The descriptive statistics of the variables used in the analysis are shown in Table A.1.

[Table A.1 about here]

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Table A.1: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Regulatory capital/risk weighted assets	12.22697	1.747894	9.1	19.3
Capital/assets	5.794231	1.680344	2.4	12.7
Non performing loans/total loans	2.749242	2.45631	.2	15.5
Provisions to non performing loans	77.67251	44.36529	24.1	322.1
Return on assets	0.6368518	0.4796338	-1.6	2.4
Return on equity	11.45811	9.038004	-40.6	30.6
Sharp debt deterioration	0.1181102	0.323163	0	1
Dramatic debt deterioration	0.0682415	0.2524914	0	1
Debt deterioration with financing problems	0.0472441	0.2124395	0	1
Sharp debt deterioration with financing problems	0.0288714	0.1676652	0	1
Percentage change in the cyclically adjusted primary balance as a % of potential GDP	-0.1701521	1.881457	-13.73699	7.344592
Debt –to- GDP ratio	70.68833	31.58582	13.74293	199.9699
Percentage change in debt ratio	1.42433	5.603738	-11.72749	27.25287
Real GDP growth rate	2.182804	2.470521	-8.36819	11.37675
Nominal long term interest rate	5.817143	2.916855	0.8109583	21.28333
Percentage change in nominal long term interest rate	-0.3937669	0.9216406	-6.381667	3.9175
Current account-to-GDP ratio	0.7385295	5.192644	-14.94073	17.68803
Percentage change in the current account ratio	0.083909	1.691881	-7.110287	9.455567
Inflation rate	2.270114	2.104575	-5.554451	15.65119

Table 1: FSIs in crisis and non crisis periods – average effects for the 20 OECD countries of the sample

	1	2	3
	Before the 2007 financial crisis	**2007-2010**	**Whole sample average**
Regulatory capital/risk weighted assets	11.95132	12.89487	12.22697
Capital/assets	5.856216	5.641333	5.794231
Nonperforming loans/total loans	2.746809	2.755263	2.749242
Provisions to non performing loans	80.86076	68.16792	77.67251
Return on assets	0.7292553	0.4112432	0.6368518
Return on equity	13.15638	7.311692	11.45811

Table 2: Country-year episodes of debt deterioration

	Sharp debt deterioration (debt increases more than 8% of GDP in a single year)	Dramatic debt deterioration (debt increases more than 10% of GDP in a single year)	Debt deterioration with sovereign debt financing problems (debt increases more than 5% of GDP in a single year and at the same time the change in the long term interest rate is positive)
Australia	-	-	-
Austria	-	-	2008
Belgium	-	-	-
Canada	2009	2009	-
Switzerland	-	-	-
Germany	2010	-	-
Denmark	2008, 2009	-	-
Spain	2009	2009	2008
Finland	2009	2009	-
France	2009	2009	-
UK	2008, 2009, 2010	2008, 2009	-
Greece	2000, 2009, 2010	2000, 2009, 2010	2009, 2010
Ireland	2008, 2009, 2010	2008, 2009, 2010	2008, 2009, 2010
Italy	2009	2009	-
Japan	1998, 1999, 2000, 2001, 2002, 2005, 2009	1998, 1999, 2009	1999, 2004
Netherlands	2008	2008	-
Norway	2003, 2006	2006	2002, 2006
Portugal	2009, 2010	2009, 2010	2008, 2010
Sweden	-	-	-
US	2008, 2009, 2010	2009	-
Total country-year episodes	**32**	**21**	**13**

Figure 1: Regulatory capital to risk weighted assets (behaviour when debt deterioration occurs at time t)

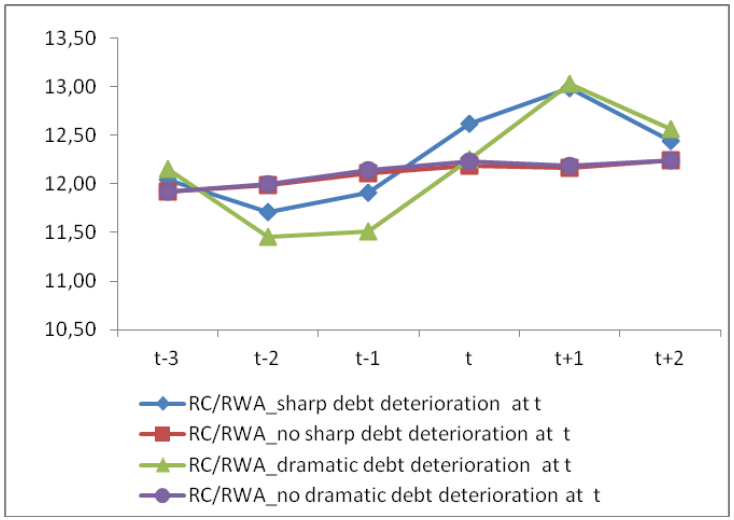

Figure 2: Capital to assets (behaviour when debt deterioration occurs at time t)

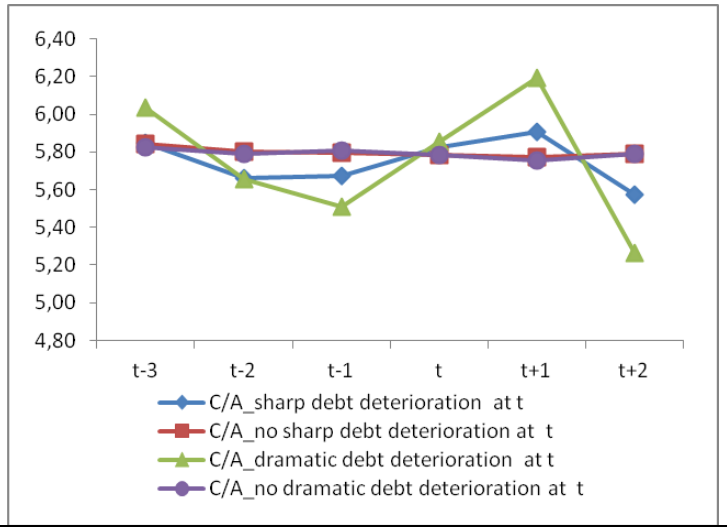

Figure 3: Non-performing loans to total loans (behaviour when debt deterioration occurs at time t)

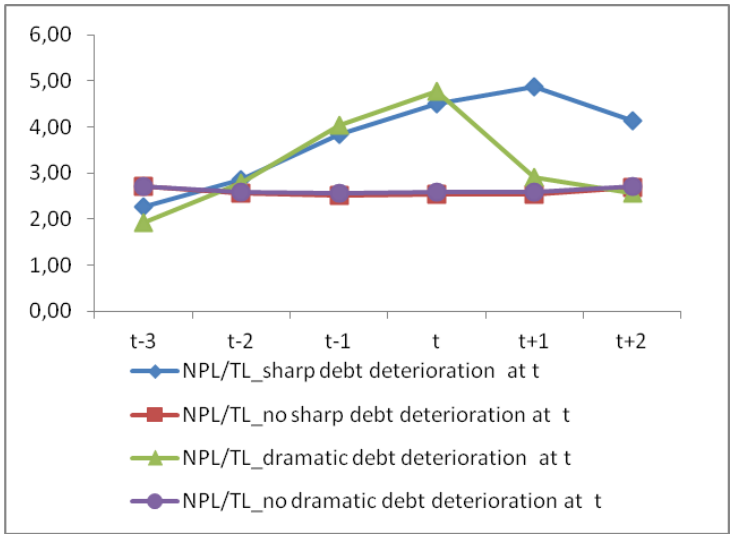

Figure 4: Provisions to non performing loans (behaviour when debt deterioration occurs at time t)

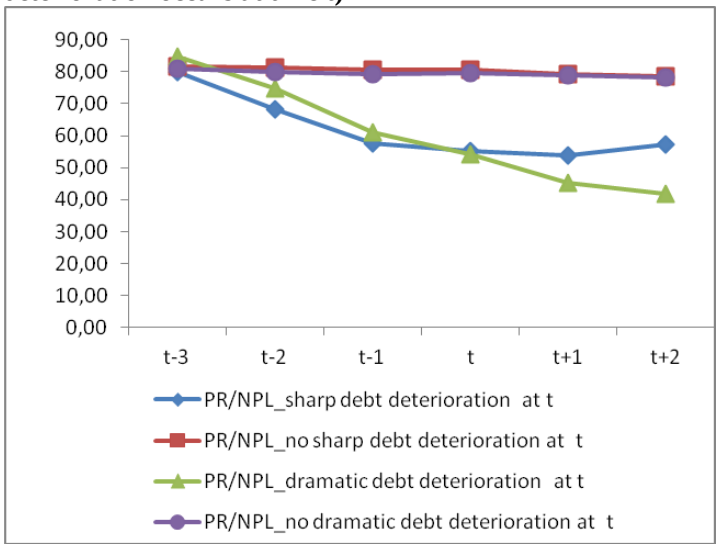

Figure 5: Return on assets (behaviour when debt deterioration occurs at time t)

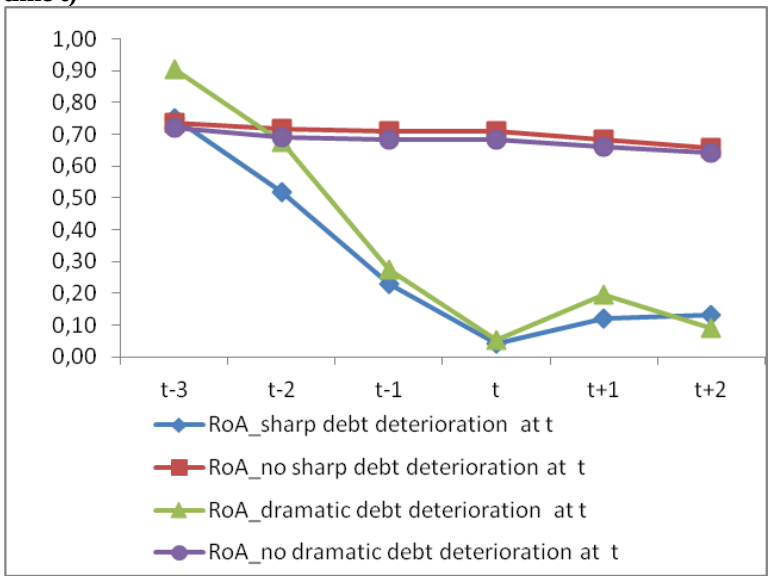

Figure 6: Return on equity (behaviour when debt deterioration occurs at time t)

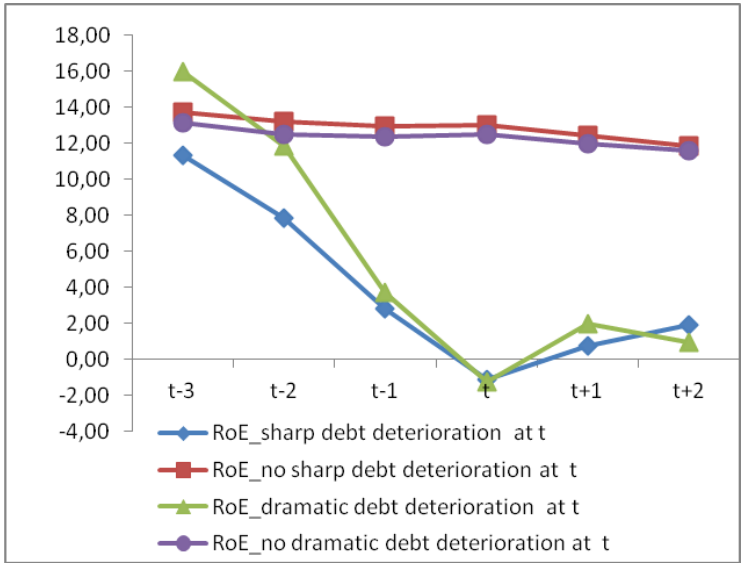

Table 3: Probability of debt deterioration –baseline specification without FSIs

	1	2	3	4	5	6	7	8
Dependent variable:	**Probability of sharp debt deterioration**				**Probability of dramatic debt deterioration**			
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects								
ΔCAPBPY (t-1)	-0.0134 (-1.37)		-0.009 (-1.05)		-0.015 (-2.20)**		-0.008 (-1.24)	
D/Y (t-1)	0.0004 (0.72)	0.0003 (0.60)	0 .0004 (1.09)	0.0004 (0.97)	0.00009 (0.19)	0.0003 (0.76)	0.0002 (0.87)	0.0002 (0.91)
ΔY (t-1)	-0.027 (-3.92)***	-0.019 (-2.52)**			-0.016 (-3.32)***	-0.012 (-2.44)**		
ΔY (t)			-0.038 (-7.19)***	-0.033 (-6.96)***			-0.024 (-6.73)***	-0.024 (-6.98)***
ΔAD/Y (t-1)		0.014 (4.14)***		0.012 (3.60)***		0.009 (3.60)***		0.006 (2.45)**
r (t-1)	0.0004 (0.04)				-0.002 (-0.30)			
r (t)			0 .0143 (1.71)*	0.010 (1.13)			0.007 (1.17)	0.005 (0.83)
Δr (t-1)		0.006 (0.65)				0.005 (1.03)		
CAB/Y (t-1)	-0.007 (-1.90)*		-0.005 (-1.59)		-0.007 (-2.49)**		-0.004 (-2.12)**	
ΔCAB/Y (t-1)		-0.011 (-1.22)		-0.006 (-0.58)		-0.006 (-0.83)		-0.0004 (-0.06)
π (t-1)	0.002 (0.14)	0.007 (0.64)	-0.009 (-0.96)	-0.003 (-0.49)	***0***.008 (0.99)	***0***.011 (1.41)	***0***.001 (0.27)	***0***.003 (0.58)
No. obs	362	343	362	361	362	343	362	361
Wald Chi2 (p-value)	Wald chi2(6) = 34.73 (0.000)	Wald chi2(6) = 42.88 (0.000)	Wald chi2(6) = 46.87 (0.000)	Wald chi2(6) = 47.77 (0.000)	Wald chi2(6) = 35.65 (90.000)	Wald chi2(6) = 34.03 (0.0000)	Wald chi2(6) = 47.95 (0.0000)	Wald chi2(6) = 44.51 (0.0000)
Pseudo R-square	0.1633	0.2005	0.3198	0.3571	0.2167	0.1764	0.4838	0.4630
Log- pseudolik.	-110.399	-98.758	-89.752	-84.749	-73.251	-71.628	-48.276	-50.176

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. ΔCAPBPY: Change in cyclically adjusted primary balance as a % of potential GDP ; D/Y : Debt-to GDP ratio;; ΔY : Real GDP growth rate (t-1); ΔAD/Y : Change in adjusted debt ratio ;r : Real long term interest rate ; Δr : Change in long term interest rate;CAB/Y : Current account ratio;ΔCAB/Y: Change in the current account ratio ; π : Inflation rate .

Table 4: Probability of sharp debt deterioration –core estimations with FSIs

	1	2	3	4	5	6	7	8
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects								
ΔCAPBPY (t-1)	-0.019 (-1.53)	-0.019 (-1.52)			-0.019 (-1.43)	-0.019 (-1.37)		
D/Y (t-1)	-1.42e-06 (-0.00)		0.0002 (0.25)		0.0003 (0.41)		0.0004 (0.61)	
ΔY (t-1)	-0.023 (-2.71)***	-0.023 (-2.70)***	-0.018 (-2.11)**	-0.018 (-2.12)**	-0.021 (-2.44)**	-0.021 (-2.43)**	-0.015 (-1.73)*	-0.015 (-1.72)*
ΔAD/Y (t-1)			0.018 (4.14)***	0.019 (4.28)***			0.018 (3.94)***	0.019 (4.11)***
r (t-1)	-0.036 (-1.28)	-0.035 (-1.50)			-0.029 (-1.09)	-0.034 (-1.35)		
Δr (t-1)			0.002 (0.27)	0.002 (0.17)			0.003 (0.33)	0.001 (0.12)
CAB/Y (t-1)	-0.006 (-1.28)	-0.006 (-1.27)			-0.007 (-1.38)	-0.007 (-1.53)		
ΔCAB/Y (t-1)			-0.011 (-0.94)	-0.011 (-0.94)			-0.007 (-0.68)	-0.007 (-0.70)
π (t-1)	-0.037 (-1.37)	-0.037 (-1.60)	-0.002 (-0.15)	-0.003 (-0.27)	-0.032 (-1.18)	-0.037 (-1.45)	-0.0007 (-0.06)	-0.004 (-0.30)
RC/RWA (t-1)	-0.021 (-1.31)	-0.021 (-1.42)	-0.023 (-1.69)*	-0.024 (-1.79)*				
C/A(t-1)					0.002 (0.15)	0.002 (0.15)	0.001 (0.08)	***0***.0007 (0.06)
No. obs	249	249	248	248	245	245	244	244
Wald Chi2 (p-value)	Wald chi2(7) = 25.01 (0.000)	Wald chi2(6) = 25.01 (0.0000)	Wald chi2(7) = 35.05 (0.000)	Wald chi2(6) = 34.68 (0.000)	Wald chi2(7) = 26.52 (0.000)	Wald chi2(6) = 26.96 (0.000)	Wald chi2(7) = 34.96 (0.000)	Wald chi2(6) = 34.02 (0.000)
Pseudo R-square	0.1959	0.1959	0.2625	0.2621	0.1791	0.1782	0.2424	0.2401
Log- pseudolik.	-76.796	-76.796	-70.335	-70.372	-77.939	-78.027	-71.830	-72.048

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. ΔCAPBPY: Change in cyclically adjusted primary balance as a % of potential GDP ; D/Y : Debt-to GDP ratio;; ΔY : Real GDP growth rate (t-1); ΔAD/Y : Change in adjusted debt ratio ;r : Real long term interest rate ; Δr : Change in long term interest rate; CAB/Y : Current account ratio;ΔCAB/Y: Change in the current account ratio ; π : Inflation rate; RC/RWA : Bank regulatory capital to risk weighted assets;C/A: Bank capital to assets .

Table 5: Probability of sharp debt deterioration –core estimations with FSIs

	1	2	3	4	5	6	7	8
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects								
ΔCAPBPY (t-1)	-0.015 (-1.25)		-0.017 (-1.39)		-0.017 (-1.24)		-0.018 (-1.39)	
D/Y (t-1)	-0.0006 (-0.67)	0.0003 (0.36)	0.0002 (0.30)	-0.00002 (-0.05)	-0.0001 (-0.16)	0.0001 (0.16)	0.0005 (1.04)	0.0001 (0.27)
ΔY (t-1)	-0.019 (-2.44)**	-0.015 (-1.85)*			-0.023 (-2.60)***			
ΔY (t)			-0.039 (-6.44)***	-0.033 (-5.96)***		-0.018 (-2.08)**	-0.035 (-4.93)***	-0.031 (-4.48)***
ΔAD/Y (t-1)		0.017 (3.88)***		0.014 (3.68)***		**0**.018 (3.68)***		0.016 (4.60)***
r (t-1)	-0.048 (-1.60)				-0.029 (-1.05)			
r(t)			0.0004 (0.03)	-0.002 (-0.18)			0.009 (0.72)	0.005 (0.32)
Δr (t-1)		0.003 (0.31)				-0.002 (-0.23)		
CAB/Y (t-1)	-0.008 (-1.60)		-0.003 (-0.71)		-0.008 (-1.59)		-0.004 (-0.96)	
ΔCAB/Y (t-1)		-0.005 (-0.49)		***0***.0008 (0.07)		-0.010 (-0.92)		-0.004 (-0.35)
π (t-1)	-0.047 (-1.73)*	-0.0005 (-0.04)	-0.015 (-1.00)	-0.009 (-1.01)	-0.028 (-1.00)	-0.00001 (-0.00)	-0.014 (-1.06)	-0.008 (-0.95)
NPL/TL(t-1)	***0***.017 (1.51)	***0***.005 (0.48)	*0*.015 (1.65)*	***0***.009 (1.14)				
PR/NPL(t-1)					-0.002 (-1.42)	-0.001 (-1.15)	-0.001 (-1.07)	-0.0007 (-0.95)
No. obs	247	246	247	246	211	210	211	210
Wald Chi2 (p-value)	Wald chi2(7) = 34.38 (0.000)	Wald chi2(7) = 36.33 (0.000)	Wald chi2(7) = 51.24 (0.000)	Wald chi2(7) = 49.29 (0.000)	Wald chi2(7) = 27.69 (0.000)	Wald chi2(7) = 35.32 (0.0000)	Wald chi2(7) = 42.28 (0.000)	Wald chi2(7) = 47.95 (0.0000)
Pseudo R-square	0.2139	0.264	0.4008	0.4628	0.2554	0.3133	0.3770	0.4688
Log- pseudolik.	-73.346	-68.578	-55.905	-50.052	-61.506	-56.623	-51.4667	-43.804

Notes: Logit model estimates with robust variance covariance matrix ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. ΔCAPBPY: Change in cyclically adjusted primary balance as a % of potential GDP ; D/Y : Debt-to GDP ratio;; ΔY : Real GDP growth rate (t-1); ΔAD/Y : Change in adjusted debt ratio ;r : Real long term interest rate ; Δr : Change in long term interest rate;CAB/Y : Current account ratio;ΔCAB/Y: Change in the current account ratio ; π : Inflation rate; NPL/TL: Bank non-performing loans to total loans;PR/NPL) : Bank provisions to non-performing loans.

Table 6: Probability of sharp debt deterioration –core estimations with FSIs

	1	2	3	4
Estimation	Logit	Logit	Logit	Logit
Average Marginal effects				
ΔCAPBPY (t-1)	-0.016 (-1.40)		-0.017 (-1.51)	
D/Y (t-1)	-0.0002 (-0.28)	0.0002 (0.30)	-0.0002 (-0.27)	0.0002 (0.31)
ΔY (t-1)	-0.012 (-1.38)	-0.010 (-1.19)	-0.138 (-1.44)	-0.011 (-1.36)
ΔY (t)				
ΔAD/Y (t-1)		0.016 (3.57)***		**0**.016 (3.36)***
r (t-1)	-0.028 (-1.07)		-0.030 (-1.11)	
r(t)				
Δr (t-1)		0.006 (0.74)		0.005 (0.72)
CAB/Y (t-1)	-0.008 (-1.78)*		-0.007 (-1.57)	
ΔCAB/Y (t-1)		-0.008 (-0.77)		-0.007 (-0.70)
π (t-1)	-0.022 (-0.91)	***0***.006 (0.47)	-0.023 (-0.93)	0.005 (0.39)
RoA(t-1)	-0.124 (-2.02)**	-0.069 (-1.17)		
RoE(t-1)			-0.006 (-2.20)**	-0.003 (-1.28)
No. obs	248	247	248	247
Wald Chi2 (p-value)	Wald chi2(7) = 28.91 (0.000)	Wald chi2(7) = 39.14 (0.000)	Wald chi2(7) = 29.44 (0.000)	Wald chi2(7) = 38.83 (0.000)
Pseudo R-square	0.2194	0.2572	0.2225	0.2555
Log- pseudolik.	-74.439	-70.735	-74.145	-70.896

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. ΔCAPBPY: Change in cyclically adjusted primary balance as a % of potential GDP ; D/Y : Debt-to GDP ratio;; ΔY : Real GDP growth rate (t-1); ΔAD/Y : Change in adjusted debt ratio ;r : Real long term interest rate ; Δr : Change in long term interest rate;CAB/Y : Current account ratio;ΔCAB/Y: Change in the current account ratio ; π : Inflation rate; RoA: Bank return on assets (t-1); RoE: Bank return on equity (t-1).

Table 7: Probability of dramatic deterioration –core estimations with FSIs

	1	2	3	4	5	6	7	8
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects								
ΔCAPBPY (t-1)	-0.022 (-2.59)**	-0.022 (-2.50)**			-0.022 (-2.30)**	-0.022 (-2.17)**		
D/Y (t-1)	0.00002 (0.04)		0.0001 (0.30)		0.005 (0.57)		0.0003 (0.68)	
ΔY (t-1)	-0.015 (-2.28)**	-0.015 (-2.28)**	-0.015 (-2.67)**	-0.015 (-2.61)**	-0.013 (-2.04)**	-0.013 (-2.04)**	-0.011 (-1.81)*	-0.011 (-1.76)*
ΔAD/Y (t-1)			0.012 (3.39)***	0.012 (3.46)***			0.011 (3.30)***	0.012 (3.46)***
r (t-1)	-0.012 (-0.56)	-0.012 (-0.69)			0.003 (0.14)	-0.002 (-0.13)		
Δr (t-1)			0.007 (1.10)	0.006 (0.97)			0.009 (1.35)	0.007 (1.05)
CAB/Y (t-1)	-0.005 (-1.64)	-0.005 (-1.57)						
ΔCAB/Y (t-1)			-0.009 (-1.14)	-0.009 (-1.14)	-0.007 (-1.98)**	-0.008 (-2.07)**	-0.005 (-0.60)	-0.005 (-0.63)
π (t-1)	-0.005 (-0.23)	-0.005 (-0.29)	*0*.011 (1.27)	*0*.011 (1.23)	***0***.011 (0.55)	***0***.005 (0.26)	***0***.013 (1.32)	***0***.011 (1.17)
RC/RWA (t-1)	-0.022 (-1.38)	-0.022 (-1.52)	-0.030 (-2.29)**	-0.031 (-2.36)**				
C/A(t-1)					-0.014 (-1.03)	-0.014 (-1.00)	-0.008 (-0.66)	-0.008 (-0.66)
No. obs	249	249	248	248	245	245	244	244
Wald Chi2 (p-value)	Wald chi2(7) = 28.66 (0.000)	Wald chi2(6) = 28.15 (0.000)	Wald chi2(7) = 29.12 (0.000)	Wald chi2(6) = 28.84 (0.0000)	Wald chi2(7) = 28.60 (0.000)	Wald chi2(6) = 28.29 (0.000)	Wald chi2(7) = 30.03 (0.000)	Wald chi2(6) = 30.26 (0.0000)
Pseudo R-square	0.2225	0.2225	0.2301	0.2295	0.s049	0.2027	0.1822	0.1787
Log- pseudolik.	-55.998	-55.998	-55.383	-55.426	-56.979	-57.135	-58.531	-58.783

Notes: Logit model estimates in columns with robust variance covariance matrices ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. See notes in Table 4.

Table 8: Probability of debt deterioration with soveregeign debt financing problems –core estimations with FSIs

	1	2	3	4	5	6	7	8
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects								
ΔCAPBPY (t-1)	-0.018 (-2.55)**	-0.018 (-2.54)**			-0.020 (-2.19)**	-0.019 (-2.10)**		
D/Y (t-1)	-0.0001 (-0.30)		0.0003 (1.01)		0.0001 (0.40)		0.0005 (1.30)	
ΔY (t-1)	-0.007 (-1.21)	-0.006 (-1.10)	-0.002 (-0.53)	-0.004 (-0.70)	-0.003 (-0.64)	-0.003 (-0.67)	-0.001 (-0.30)	-0.001 (-0.32)
ΔAD/Y (t-1)			0.004 (2.56)**	0.005 (2.46)**			0.006 (2.63)**	0.006 (2.91)***
r (t-1)	-0.005 (-0.30)	-0.003 (-0.21)			0.003 (0.14)	0.0001 (0.01)		
Δr (t-1)			0.017 (3.88)***	0.016 (3.42)***			0.017 (3.68)***	0.014 (3.34)***
CAB/Y (t-1)	-0.0008 (-0.23)	-0.0007 (-0.20)			-0.003 (-0.62)	-0.003 (-0.67)		
ΔCAB/Y (t-1)			0.015 (2.49)**	0.014 (2.41)**			0.012 (2.52)**	0.011 (2.32)**
π (t-1)	-0.005 (-0.27)	-0.003 (-0.18)	0.005 (0.90)	0.004 (0.61)	0.002 (0.08)	-0.0009 (-0.04)	0.007 (0.97)	0.004 (0.65)
RC/RWA (t-1)	-0.029 (-3.29)***	-0.028 (-3.33)***	-0.032 (-3.36)***	-0.033 (-3.30)***				
C/A(t-1)					-0.005 (-0.75)	-0.005 (-0.75)	-0.005 (-0.80)	-0.006 (-0.78)
No. obs	249	249	248	248	245	245	244	244
Wald Chi2 (p-value)	Wald chi2(7) = 26.86 (0.000)	Wald chi2(6) = 26.30 (0.0000)	Wald chi2(7) = 44.94 (0.000)	Wald chi2(6) = 39.80 (0.000)	Wald chi2(7) = 20.35 (0.004)	Wald chi2(6) = 20.08 (0.002)	Wald chi2(7) = 43.09 (0.0000)	Wald chi2(6) = 33.21 (0.000)
Pseudo R-square	0.2492	0.2485	0.3446	0.3369	0.1663	0.1651	0.2271	0.2127
Log- pseudolik.	-38.319	-38.353	-33.416	-33.807	-42.371	-42.431	-39.239	-39.969

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. See notes in Table 4.

Table 9: Probability of dramatic debt deterioration –core estimations with FSIs

	1	2	3	4	5	6	7	8
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects								
ΔCAPBPY (t-1)	-0.019 (-2.13)**		-0.015 (-2.10)**		-0.022 (-2.37)**		-0.018 (-2.09)**	
D/Y (t-1)	-0.0004 (-0.49)	0.0002 (0.30)	-0.00006 (-0.12)	-0.0001 (-0.29)	0.0001 (0.27)	0.0004 (0.70)	0.0006 (2.31)**	0.0005 (1.69)*
ΔY (t-1)	-0.013 (-2.10)**	-0.012 (-2.04)**			-0.015 (-2.05)**	-0.015 (-2.31)**		
ΔY (t)			-0.029 (-4.87)***	-0.028 (-6.28)***			-0.023 (-4.63)***	-0.024 (-5.83)*
ΔAD/Y (t-1)		0.010 (3.10)***		0.005 (2.11)**		0.011 (3.05)***		0.009 (4.02)***
r (t-1)	-0.022 (-1.08)				0.0003 (0.02)			
r(t)			0.002 (0.16)	0.001 (0.10)			0.011 (1.02)	0.011 (0.86)
Δr (t-1)		0.007 (1.12)				0.0062 (1.01)		
CAB/Y (t-1)	-0.007 (-2.15)**		-0.004 (-1.47)		-0.007 (-2.27)**		-0.005 (-1.79)*	
ΔCAB/Y (t-1)		-0.004 (-0.46)		*0*.002 (0.21)		-0.007 (-0.86)		-0.007 (-0.59)
π (t-1)	-0.012 (-0.62)	0.011 (1.24)	*0*.004 (0.51)	*0*.003 (0.66)	*0*.012 (0.63)	0.014 (1.42)	0.005 (0.62)	0.005 (0.84)
NPL/TL(t-1)	*0*.012 (1.13)	*0*.006 (0.81)	*0*.014 (2.02)**	*0*.014 (2.34)**				
PR/NPL(t-1)					-0.0007 (-0.90)	-0.0003 (-0.46)	0.00005 (0.10)	***0***.0003 (0.80)
No. obs	247	246	247	246	211	210	211	210
Wald Chi2 (p-value)	Wald chi2(7) = 33.98 (0.000)	Wald chi2(7) = 34.05 (0.000)	Wald chi2(7) = 41.17 (0.0000)	Wald chi2(7) = 45.87 (0.000)	Wald chi2(7) = 32.50 (0.000)	Wald chi2(7) = 29.49 (0.000)	Wald chi2(7) = 22.24 (0.002)	Wald chi2(7) = 34.21 (0.0000)
Pseudo R-square	0.2352	0.2079	0.5731	0.5317	0.3021	0.2488	0.5450	0.5104
Log- pseudolik.	-53.110	-54.939	-29.643	-32.478	-41.257	44.341	-26.956	-28.902

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses.See notes in Table 5.

Table 10: Probability of debt deterioration with sovereign debt financing problems –core estimations with FSIs

	1	2	3	4
Estimation	Logit	Logit	Logit	Logit
Average Marginal effects				
ΔCAPBPY (t-1)	-0.020 (-2.19)**	-0.013 (-1.66)*	-0.023 (-2.23)**	-0.014 (-1.47)
D/Y (t-1)	-0.0001 (-0.26)	0 .0002 (0.68)	0.00008 (0.19)	0.0003 (0.98)
ΔY (t-1)	-0.003 (-0.55)		-0.0047 (-0.66)	
ΔY (t)		-0.006 (-2.03)**		-0.009 (-2.01)**
ΔAD/Y (t-1)				
r (t-1)	-0.006 (-0.29)		0.0007 (0.04)	
r(t)		0 .0154 (1.75)*		0.019 (1.93)*
Δr (t-1)				
CAB/Y (t-1)	-0.002 (-0.52)	-0.002 (-0.55)	-0.002 (-0.47)	-0.002 (-0.45)
ΔCAB/Y (t-1)				
π (t-1)	-0.006 (-0.28)	0 .0003 (0.04)	-0.0008 (-0.03)	-0.001 (-0.17)
NPL/TL(t-1)	0.005 (1.06)	0 .001 (0.36)		
PR/NPL(t-1)			-0.00003 (-0.08)	0.0003 (1.16)
No. obs	247	247	211	211
Wald Chi2 (p-value)	Wald chi2(7) = 19.10 (0.007)	Wald chi2(7) = 23.17 (0.000)	Wald chi2(7) = 16.78 (0.018)	Wald chi2(7) = 26.29 (0.000)
Pseudo R-square	0.1690	0.2752	0.1580	0.2790
Log- pseudolik.	-42.319	-36.914	-41.107	-35.198

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses.See notes in Table 5.

Table 11: Probability of dramatic debt deterioration –core estimations with FSIs

	1	2	3	4
Estimation	Logit	Logit	Logit	Logit
Average Marginal effects				
ΔCAPBPY (t-1)	-0.019 (-2.17)**		-0.020 (-2.24)**	
D/Y (t-1)	-0.00006 (-0.10)	0.0002 (0.45)	-0.00005 (-0.09)	0.0003 (0.48)
ΔY (t-1)	-0.007 (-1.02)	-0.008 (-1.33)	-0.007 (-1.29)	-0.009 (-1.57)
ΔY (t)				
ΔAD/Y (t-1)		0.009 (2.76)***		**0**.009 (2.70)***
r (t-1)	-0.007 (-0.38)		-0.009 (-0.48)	
r(t)				
Δr (t-1)		0.009 (1.50)		0.009 (1.50)
CAB/Y (t-1)	-0.008 (-2.40)**		-0.007 (-2.27)**	
ΔCAB/Y (t-1)		-0.006 (-0.75)		-0.006 (-0.72)
π (t-1)	*0*.007 (0.35)	*0*.016 (1.60)	*0*.004 (0.24)	0.015 (1.58)
RoA(t-1)	-0.084 (-1.65)*	-0.048 (-1.05)		
RoE(t-1)			-0.004 (-1.97)**	-0.002 (-1.26)
No. obs	248	247	248	247
Wald Chi2 (p-value)	Wald chi2(7) = 29.62 (0.000)	Wald chi2(7) = 32.75 (0.000)	Wald chi2(7) = 31.26 (0.000)	Wald chi2(7) = 33.45 (0.000)
Pseudo R-square	0.2294	0.1914	0.2261	0.1897
Log- pseudolik.	-55.431	-58.089	-55.671	-58.217

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. See notes in Table 6.

Table 12: Probability of debt deterioration with sovereign debt financing problems –core estimations with FSIs

	1	2	3	4
Estimation	Logit	Logit	Logit	Logit
Average Marginal effects				
ΔCAPBPY (t-1)	-0.018 (-2.24)**		-0.019 (-2.29)**	
D/Y (t-1)	-0.00003 (-0.08)	0.0003 (0.97)	-0.00004 (-0.11)	0.0003 (1.00)
ΔY (t-1)	-0.00003 (-0.01)	**0**.001 (0.27)	-0.0001 (-0.03)	**0**.0008 (0.20)
ΔY (t)				
ΔAD/Y (t-1)		0.0044 (2.14)**		**0**.004 (1.96)*
r (t-1)	-0.001 (-0.08)		-0.002 (-0.14)	
r(t)				
Δr (t-1)		0.018 (3.81)***		0.017 (3.76)***
CAB/Y (t-1)	-0.003 (-0.68)		-0.003 (-0.63)	
ΔCAB/Y (t-1)		0.011 (2.56)***		0.012 (2.51)**
π (t-1)	0.0007 (0.03)	0.009 (1.31)	0.0004 (0.02)	0.009 (1.31)
RoA(t-1)	-0.046 (-1.91)*	-0.041 (-1.75)*		
RoE(t-1)			-0.002 (-2.13)**	-0.002 (-1.99)**
No. obs	248	247	246	247
Wald Chi2 (p-value)	Wald chi2(7) = 18.98 (0.008)	Wald chi2(7) = 48.96 (0.000)	Wald chi2(7) = 21.21 (0.003)	Wald chi2(7) = 51.93 (0.000)
Pseudo R-square	0.1855	0.2403	0.1906	0.2431
Log- pseudolik.	-41.527	-38.692	-41.266	-38.547

Notes: Logit model estimates with robust variance covariance matrices.***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. See notes in Table 6.

Table 13: Probability of debt deterioration –joint effects of FSIs

	1	2	3	4	5	6	7	8	9
Dependent variable:	**Probability of sharp debt deterioration**			**Probability of dramatic debt deterioration**			**Probability of debt deterioration with sovereign debt financing problems**		
Estimation	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Average Marginal effects									
ΔCAPBPY (t-1)	-0.016 (-1.48)		-0.015 (-1.26)	-0.017 (-2.36)**			-0.017 (-2.49)**		-0.013 (-2.06)**
D/Y (t-1)	-0.001 (-0.96)	-0.0007 (-0.77)	0.00008 (0.15)	-0.0007 (-0.76)	-0.0006 (-0.51)	-0.0001 (-0.28)	-0.0003 (-0.62)	-0.0003 (-0.52)	0.0001 (0.36)
ΔY (t-1)	-0.015 (-1.92)*	-0.013 (-1.72)*		-0.010 (-1.98)**	-0.011 (-2.18)**		-0.003 (-0.70)	-0.006 (-1.40)	
ΔY (t)			-0.036 (-5.01)***			-0.026 (-5.81)***			-0.005 (-1.83)*
ΔAD/Y (t-1)		0.014 (3.00)***			0.008 (2.85)***	0.006 (1.61)		0.004 (1.99)**	
r (t-1)	-0.045 (-1.54)	-0.026 (-0.89)		-0.025 (-1.27)	-0.018 (-0.96)		-0.008 (-0.38)	-0.007 (-0.32)	
r(t)			0.0007 (0.05)			0.002 (0.14)			0.012 (1.17)
CAB/Y (t-1)	-0.006 (-1.41)	-0.004 (-1.37)	-0.003 (-0.73)	-0.006 (-2.53)**	-0.006 (-2.82)***	-0.003 (-1.14)	-0.001 (-0.33)	-0.002 (-0.56)	-0.001 (-0.36)
π (t-1)	-0.035 (-1.53)	-0.022 (-1.06)	-0.012 (-0.69)	-0.007 (-0.46)	-0.004 (-0.26)	*0.*002 (0.26)	-0.003 (-0.17)	-0.003 (-0.17)	*0.*0008 (0.09)
RC/RWA (t-1)	-0.021 (-1.13)	-0.019 (-1.37)	*0.*003 (0.21)	-0.020 (-1.38)	-0.021 (-1.78)*	-0.008 (-0.76)	-0.026 (-3.11)***	-0.027 (-3.11)***	-0.019 (-2.69)***
NPL/TL(t-1)	0.012 (0.59)	0.006 (0.38)	0.014 (1.28)	0.009 (0.51)	0.006 (0.38)	0.012 (1.63)	0.0009 (0.24)	0.0003 (0.07)	-0.0008 (-0.24)
RoE(t-1)	-0.006 (-2.26)**	-0.003 (-1.45)	-0.002 (-0.60)	-0.004 (-1.90)*	-0.002 (-1.26)	0.0006 (0.44)	-0.002 (-1.99)**	-0.001 (-1.20)	-0.0008 (-0.52)
No. obs	246	245	246	246	245	245	246	245	246
Wald Chi2 (p-value)	Wald chi2(9) = 34.00 (0.0001)	Wald chi2(9) = 39.86 (0.0000)	Wald chi2(9) = 56.19 (0.0000)	Wald chi2(9) = 33.75 (0.0000)	Wald chi2(9) = 32.18 (0.000)	Wald chi2(9) = 54.04 (0.000)	Wald chi2(9) = 25.62 (0.002)	Wald chi2(9) = 23.01 (0.006)	Wald chi2(9) = 31.11 (0.000)
Pseudo R-square	0.2655	0.3077	0.4058	0.2987	0.3016	0.5692	0.2636	0.2204	0.3159
Log- lik.	-68.434	-64.409	-55.363	-48.642	-48.377	-29.839	-37.466	-39.622	-34.803

Notes: Logit model estimates with robust variance covariance matrices. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses. See notes in Tables 4-6.

Table 14: Probability of debt deterioration –joint effect of FSIs

	1	2	3	4	5	6
Estimation	Logit-FE	Logit-FE	Logit-FE	Logit-FE	Logit-FE	Logit-FE
	Probability of sharp debt deterioration			**Probability of dramatic debt deterioration**		
ΔCAPBPY (t-1)	-0.205 (-1.24)	-0.183 (-0.86)		-0.272 (-1.48)		
D/Y (t-1)	-0.046 (-1.63)	0.002 (0.06)	-0.012 (-0.38)	-0.040 (-1.43)	-0.027 (-1.08)	-0.007 (-0.15)
ΔY (t-1)	-0.366 (-2.42)**			-0.339 (-2.20)**	-0.359 (-2.25)**	
ΔY (t)		-0.749 (-4.39)***	-0.856 (-3.97)***			-1.692 (-2.50)**
ΔAD/Y (t-1)			0.198 (2.09)**		**0**.084 (0.97)	0.165 (1.02)
r (t-1)	-0.361 (-0.85)			-0.308 (-0.65)	-0.254 (-0.52)	
r(t)		-0.149 (-1.01)	-0.122 (-0.83)			-0.407 (-1.81)*
ΔCAB/Y (t-1)	-0.233 (-1.29)	-0.108 (-0.45)	-0.001 (-0.00)	-0.190 (-0.91)	-0.185 (-0.93)	0.231 (0.55)
π (t-1)	-0.148 (-0.32)	0.165 (0.73)	-0.096 (-0.40)	-0.075 (-0.15)	-0.081 (-0.16)	0.023 (0.06)
RC/RWA (t-1)	-0.347 (-1.19)	0.176 (0.60)	-0.038 (-0.12)	-0.519 (-1.40)	-0.679 (-1.87)*	0.018 (0.03)
NPL/TL(t-1)	0.204 (1.04)	0.551 (2.48)**	0.494 (2.11)**	0.144 (0.66)	0.115 (0.52)	1.179 (1.78)*
RoE(t-1)	-0.043 (-0.88)	-0.044 (-0.96)	0.030 (0.51)	-0.033 (-0.60)	-0.011 (-0.21)	-0.008 (-0.06)
No. obs	175	175	174	151	150	150
Wald Chi2 (p-value)	LR chi2(9) = 37.79 (0.000)	LR chi2(9) = 67.69 (0.000)	LR chi2(9) = 71.42 (0.000)	LR chi2(9) = 28.04 (0.000)	LR chi2(9) = 26.22 (0.001)	LR chi2(9) = 70.10 (0.000)
Log- lik.	-38.452	-23.498	-21.349	-28.764	-29.388	-7.449

Notes: Fixed effects logit models -the observed information matrix was used to estimate the variance covariance matrix. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses.See notes in Tables 4-6.

Table 15: Probability debt deterioration –core estimations with FSIs

	1	2	3	4	6	6	7	8	9	10
	Probability of sharp debt deterioration		Probability of dramatic debt deterioration		Probability of sharp debt deterioration		Probability of dramatic debt deterioration		Probability of sharp debt deteriorati on	Probability of dramatic debt deterioration
Estimation	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit	IV-probit
Average Marginal effects										
ΔCAPBPY (t-1)	0.003 (0.17)		-0.006 (-0.48)		-0.026 (-2.00)**		-0.024 (-2.33)**			
D/Y (t-1)	0.00001 (0.02)	-0.0001 (-0.21)	0.0001 (0.20)	0.00002 (0.04)	0.002 (2.08)**	0.0009 (0.90)	0.002 (1.68)*	0.0009 (1.01)	-0.0001 (-0.23)	-0.00001 (-0.02)
ΔY (t-1)	-0.063 (-3.86)***	-0.038 (-2.02)**	-0.042 (-2.74)***	-0.028 (-1.63)	-0.022 (-2.59)***	-0.015 (-2.01)**	-0.015 (-2.32)**	-0.013 (-2.13)**	-0.005 (-0.43)	-0.005 (-0.53)
ΔAD/Y (t-1)		**0**.012 (1.87)*		0.007 (1.55)		0.017 (3.83)***		0.010 (2.94)***	0.031 (3.20)***	0.022 (2.22)**
r (t-1)	-0.006 (-0.25)	-0.010 (-0.44)	-0.002 (-0.13)	-0.006 (-0.34)	-0.008 (-0.34)	-0.009 (-0.42)	-0.004 (-0.22)	-0.006 (-0.37)	-0.009 (-0.39)	-0.006 (-0.33)
Δr (t-1)										
CAB/Y (t-1)	-0.007 (-1.72)*	-0.005 (-1.57)	-0.008 (-2.90)***	-0.008 (-2.85)***	-0.003 (-0.79)	-0.004 (-1.05)	-0.006 (-1.92)*	-0.006 (-2.41)**	-0.002 (-0.71)	-0.006 (-2.02)**
ΔCAB/Y (t-1)										
π (t-1)	0.007 (0.28)	-0.003 (-0.14)	0.019 (0.89)	0.010 (0.53)	-0.0008 (-0.03)	-0.007 (-0.31)	0.015 (0.69)	0.008 (0.42)	-0.013 (-0.68)	0.002 (0.14)

Table 15: (continued)

First stage regression										
Dependent variable/ instrument	**ΔY (t-1)**	**ΔY (t-1)**	**ΔY (t-1)**	**ΔY (t-1)**	**D/Y (t-1)**	**D/Y (t-1)**	**D/Y (t-1)**	**D/Y (t-1)**	**ΔAD/Y (t-1)**	**ΔAD/Y (t-1)**
RC/RWA (t-1)	-0.115 (-1.19)	-0.132 (-1.31)	-0.128 (-1.31)	-0.137 (-1.35)	-1.811 (-2.55)**	-1.628 (-2.10)**	-1.872 (-2.62)***	-1.666 (-2.16)**	0.112 (0.67)	0.115 (0.68)
NPL/TL(t-1)	-0.110 (-1.63)	-0.057 (-0.78)	-0.105 (-1.49)	-0.055 (-0.74)	6.696 (10.84)***	7.138 (12.07)***	6.757 (11.03)***	7.140 (12.14)***	0.378 (2.26)**	0.381 (2.26)**
RoE(t-1)	0.109 (5.00)***	0.102 (4.12)***	0.109 (5.06)***	0.102 (4.11)***	-0.508 (-2.59)***	-0.546 (-2.60)***	-0.466 (-2.34)***	-0.540 (-2.60)***	-0.181 (-4.35)***	-0.181 (-4.31)***
No. obs	246	245	246	245	246	245	246	245	245	245
Wald Chi2 (p-value)	Wald chi2(6) = 58.29 (0.000)	Wald chi2(6) = 50.32 (0.000)	Wald chi2(6) = 46.48 (0.000)	Wald chi2(6) = 39.50 (0.000)	Wald chi2(6) = 40.86 (0.000)	Wald chi2(6) = 40.85 (0.000)	Wald chi2(6) = 40.75 (0.000)	Wald chi2(6) = 33.67 (0.000)	Wald chi2(6) = 62.66 (0.000)	Wald chi2(6) = 42.65 (0.000)
Pseudo R-square										
Log- lik.	-583.693	-579.411	-564.966	-564.441	-1179.371	-1169.362	-1159.770	-1154.152	-722.911	-707.976
Wald test of exogeneity -(p-value)	0.0025	0.1798	0.0240	0.2801	0.0268	0.1990	0.0973	0.2475	0.0953	0.1597

Notes: The IV probit models have robust variance covariance matrix.. ***,**,* denote significance at 1%, 5%, and 10%, respectively; z-values in paretheses.See notes in Tables 4-6.

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