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ABSTRACT

The recent financial crisis was characterized by the sizeable fiscal cost of banking sector bail out operations and the significant automatic and discretionary fiscal policy response to shrinking output, which have put increased pressure on public finances in many industrialized countries. This paper tries to evaluate the impact of financial crisis episodes on debt developments. The findings indicate that severe financial crisis episodes increase the stock of debt by 2.7%-4.0% of GDP, on average in the 20 OECD countries examined. In countries with big financial sectors it ranges from 4.2%-5.3% of GDP and in countries with smaller financial sectors it is about 1.4%-1.7% of GDP. The primary balance and the cyclically adjusted fiscal policy stance ease by about 2.6% of GDP and 1.6% of potential GDP, respectively, in the event of a severe financial market crash. Expansionary fiscal interventions are more pronounced in countries with sizable financial sectors. I find significant evidence that a financial market collapse paves the way for a subsequent deterioration in debt ratios.

Keywords: fiscal policy, public debt, financial market, crisis, credit.
JEL classification: E61, E62, H61, H62, H63, E32.

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1. Introduction

The recent financial market crisis was a quite unprecedented episode in terms of its severe and world-wide implications and because of the strong and coordinated global policy responses that followed it. These actions involved both discretionary demand boosting measures and monetary easing, as well as measures to restore financial stability in the banking sector, involving equity injections, subsidies, asset purchases, loan guarantees and other forms of assistance.

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, i.e., about 74 per cent of GDP in the U.K., 73 per cent of GDP in the U.S., and 18 per cent of GDP in the Euro area (Detragiache and Ho, 2010).

These actions coupled with the cyclical deterioration of fiscal positions have led to a substantial pick up in debt to GDP ratios in many OECD countries. According to European Commission (2011) euro area debt stood at 66.2% of GDP in 2007 and is expected to reach 87.7% of GDP in 2011 and to increase further in 2012 to 88.5% of GDP. The United States, starting from a debt level of 62.3% of GDP in 2007, is expected to end up with a debt level of 102.4% of GDP in 2012 (European Commission, 2011). More recently the Organization for Economic Cooperation and Development (henceforth OECD) (2011b) projected that debt ratios will rise even further in 2012, reaching 97.2% in the euro area and 103.8% in the US.[1]

Although the recent crisis and the response to it was unprecedented, it certainly implies that fiscal policy makers will put more of their attention on financial market developments and will try to avert analogous events in the future. Several of these actions, involving 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

[1] According to OECD (2011a) the debt ratio in OECD countries is expected to reach 105.4% in 2012 from 79.3% in 2008.

the global level, and taking decisive and coordinated fiscal policy actions in order to restore confidence, growth and jobs etc. have already been agreed within the G20 context.[2]

The links between the real economy, the financial sector and government activity need to be examined further. One of the issues arising, following the recent crisis, is to better understand the feedback loops between government activity and financial market developments. For example, unsound fiscal policies, by impacting negatively on market confidence, could represent a risk to economic and consequently financial stability. Government borrowing operations in financial markets and tax decisions could also have repercussion for interest rates and asset price behaviour, which could become a risk to financial market stability.[3] Financial instability can have significant implication for public finances, either directly or through its effects on economic activity.

Therefore, it is of real interest to better understand the fiscal policy implications of financial market developments and in particular of financial market crisis. This is likely to have significant implication on fiscal balances, to the extent that it requires an intervention from the government, involving some sort of bail out. Moreover, 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 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.

All in all, 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. However, this should be done in a manner that punishes unsound practices in the financial and banking system, i.e., reducing the risk of moral hazard, while also trying to contain the fiscal consequences of the rescue.

[2] G20 (2009a). Leaders' statement: The Pittsburg summit, November, Pittsburg. G20 (2009b), Global plan for recovery and reform: The communiqué from the London summit, April, London.

[3] IMF (2009) discusses links between tax policy issues, excessive leveraging and the development of asset price bubbles.

Given the important inter-linkages between financial markets and fiscal policy, the present paper builds on recent work by European Commission (2009b), Furceri and Zdzienicka (2010 and 2011) and Reinhart and Rogoff (2009 and 2010) to investigate the impact of financial market crises on fiscal positions in 20 OECD countries in the period 1990-2010. In addition, the paper investigates whether the size of the financial sector is an important determinant of the impact that financial crisis have on fiscal positions, and on whether the magnitude of the fiscal intervention in the event of financial crisis differs depending the size of the financial sector. The findings of the paper provide an indication of what fiscal costs the OECD countries examined will, on average, have to bear, and how likely it is that they will have to bear these costs following a severe financial market crash. However, the quantitative estimate of the fiscal costs is indicative, and it could be significantly different depending on starting positions and other vulnerabilities faced by individual OECD countries. Nevertheless, their fiscal positions should be sound enough to cope with and absorb, at a minimum, these average fiscal cost effects.

Employing different modeling techniques (Pooled OLS, instrumental variable fixed effects, one-step system GMM estimator, logit and logit fixed effects analysis), and using data for 20 OECD countries over the period 1990-2010, I find significant econometric evidence that fiscal positions deteriorate during financial crisis. Severe financial crisis episodes, like the recent financial crises, increase the stock of debt by an average of 2.7% to 4.0% of GDP in the 20 OECD countries under examination. The effect is much more pronounced in countries with big financial sectors, i.e., it ranges from 4.2% to 5.3% of GDP, while in countries with smaller financial sectors it ranges between 1.4% to 1.7% of GDP.

Both the primary balance and the fiscal policy stance (the cyclically adjusted primary balance) indicate that fiscal policy remains intentionally expansionary when financial markets collapse; i.e., they are both reduced, the first one by about 2.6% of GDP and the second by about 1.6% of potential GDP. In some cases fiscal policy remains expansionary in the subsequent year of the financial crisis, contributing to deficit bias and the build up of fiscal imbalances. Fiscal interventions in the event of a severe financial crisis are more pronounced in countries with big financial sector, i.e., the cyclically adjusted balance as a per cent of potential GDP and the primary balance as a per cent of

GDP ease by about 2.5%-2.6% and 3.6%-3.8%, respectively. In countries where the financial sector has smaller size, the fiscal expansion (in times of financial crisis) of the cyclically adjusted primary balance as a per cent of potential GDP and the primary balance and a per cent of GDP ranges from 0.8% to 2.2%, respectively.

I also find significant positive association between financial market crashes and subsequent deteriorations in debt ratios. This is the case both when I examine only the debt ratio and when I combine it with sovereign debt financing problems, e.g., increasing nominal long term interest rates.

The rest of the paper is organized as follows: Section 2 overviews recent experience and previous studies that deal with the fiscal policy implications of financial crisis. Section 3 presents the empirical methodology, data information and findings. Finally, Section 4 summarizes the main findings and concludes.

2. Financial crises and implications for fiscal policy: recent experience and previous studies

The recent economic crisis was driven and exacerbated by the financial market turmoil, which has led to falling asset prices and a large number of bank defaults. These developments have induced governments around the globe 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 decreases 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).[4] These are called "gross" fiscal costs, because some of these costs are recovered after a period of time when financial asset are resold.

[4] As discussed in European Commission (2009a) and Attinasi et al. (2010) 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 acquisition of financial assets, (3)

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.[5] As a result of the financial crisis and several government operations this number has increased to 3.2% of GDP in 2008 and returned to 0.6% of GDP in 2009. Moreover, 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 the stock flow adjustment (3.2%), the so-called snow ball effect (1.1%; which is decomposed to interest expenditure (3.0%), growth effect (-0.4), and inflation effect (-1.5)), and a negative contribution from the primary surplus of 1.0% of GDP. In 2009 the euro area debt ratio increased even further i.e., by 8.9% of GDP, reaching 78.2% of GDP. This is due to a primary deficit of 3.4% of GDP, a snow-ball effect of 4.9% of GDP (3.0% due to interest expenditure, 2.9% due to the growth effect and -1.0 due to the inflation effect), and a stock flow adjustment of 0.6% of GDP.

Therefore, in particular in 2008, the debt-to-GDP ratio increased due to financial rescue packages. 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).

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

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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.

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

interest rate and exchange rate effects due to market reactions (see European Commission, 2009b).

2.1. 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; Furceri and Zdzienicka, 2010, 2011; Reinhart and Rogoff, 2008, 2009, 2010). The main findings of these studies are summarized in the remaining of this section.

The seminal work by Honohan and Klingebiel (2003) based on a sample of 38 crisis episodes investigates the fiscal cost implications of an accommodating approach to banking crisis. The authors regress gross direct fiscal costs on crisis resolution and containment variables and variables that capture the depth of the crisis, and 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) in its Public Finance Report building on Honohan and Klingebiel (2003) investigates the fiscal costs of financial crises. Besides focusing on previous case studies, such as Finland, Norway, Sweden, Japan and Korea it resorts also to econometric estimations based on data from Laeven and Valencia (2008) to investigate the determinants of the fiscal recovery rate. As recovery rate is defined as the amount recovered between the start of the crisis and t+5 as a per cent of gross fiscal outlays. Advanced economies are found to have higher recovery rates, a simultaneous banking and exchange rate crisis leads to lower recovery rates, and 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.

Claessens, Klingebiel, and Laeven (2005) explore the relationship between intervention policies and the economic and fiscal costs of crises. Costs are measured by the output loss relative to trend during the crisis episode. The main finding is that policies that support the banking system do not seem 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.

Based on 40 banking crises identified by Laevan and Valencia (2008), 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, the authors find that parliamentary political systems are more prone to adopt bank rescue measures that impact heavily on the budget.

Reinhart and Rogoff (2009), building on Laeven and Valencia (2008), show that financial and banking crisis have substantial implications, with the collapse of asset markets being deep and prolonged. Reinhart and Rogoff (2009) find that "on a peak-to-trough basis, real housing price declines average 35 per cent stretched out over six years, while equity price collapses average 55 per cent over a downturn of about three and a half years." Output falls by about 9 per cent, but the duration of the downturn last only two years. In the aftermath of several financial crises the real value of government debt rose on average by 86 per cent in a panel of developed and developing economies. As the authors 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 (2010) investigate the links between debt and banking crises, inflation and currency crisis using a long-term historical database spanning two centuries and including data from seventy countries from around the globe. Based on world aggregate levels and on an individual country information Reinhart and Rogoff (2010) find that: (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).[6]

The European Commission (2009b) investigates econometrically the impact of financial crisis on public debt and on the output gap. Building on fiscal reaction functions in the spirit of Gali and Perotti (2003) and after purging the debt ratio from the effect of nominal growth it finds that in years of financial crisis public debt accelerated significantly. The bulk of the effect of financial crisis on debt changes takes place during the first two years. Moreover, the results of this study indicate that the impact of the financial crisis on the change in debt is higher in case of emerging market countries than for the EU and the OECD countries. On average, the increase in public debt to GDP ratio is equal to 1.7 and 5 percentage points 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.[7]

Furceri and Zdzienicka (2010) using an unbalanced panel of 154 countries from 1980 to 2006, show that banking crises are associated with a significant and long-lasting

[6] A related strand of the literature has investigated the determinants of sovereign default. For example, Giordano and Tommasino (2011) motivated by the Reinhart and Rogoff studies claim that sovereign default is less likely to happen if domestic debt-holders are politically strong and/or the costs of the financial turmoil typically triggered by a sovereign bankruptcy are large. They show that these conditions are more likely to be satisfied if a country has a strong middle class and/or a sufficiently independent central bank.

[7] In addition, the analysis revealed significant persistence of budgetary outcomes (positive effect from lagged change in debt), when output falls below potential the fiscal position deteriorates automatically due to the operation of automatic stabilizers (negative effect from the output gap), lagged debt ratio reduces the growth rate of debt in line with a debt stabilization motive (negative effect from lagged debt ratio). Finally, as reported by the European Commission (2009b) financial crisis put a significant toll on real output, which can also lead to additional fiscal costs.

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."[8] Moreover as Furceri and Zdzienicka (2010) 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.[9]

3. Econometric analysis, data information and findings

In this section, I investigate the effect that financial crisis indicators have on fiscal positions. In line with Furceri and Zdzienicka (2010), my variable of interest is the change in the debt to GDP ratio; however as in European Commission (2009b) I have adjusted it for the snow-ball effect – henceforth, change in adjusted debt ratio.

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.

Therefore, the dependent variable reflects changes in debt positions that are not driven by nominal GDP and interest rate movements. It captures changes in fiscal position that reflect the fiscal policy maker's will, i.e., changes in the primary balance and stock-flow adjustments; with the last component reflecting, as in the recent crisis, the direct support of the state to the banking system.[10]

[8] 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.

[9] Furceri and Zdzienicka (2011) 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 per cent after 8 years. Moreover, the authors find that debt crises tend to be more detrimental than banking and currency crises.

[10] For example, weak performance on the part of the banking system might induce government's discretionary response which could affect the deficit or it could solely involve below-the-line operations, i.e., impacting only on the debt ratio (i.e., financial operation recorded as stock-flow adjustments).

However, not all movements in the stock-flow adjustment component reflected fiscal interventions to support the financial and banking system. Hence, for robustness purposes I consider two alternative dependent variables which capture the change in fiscal policy stance in the event of financial crisis. The first is the change in the primary balance to GDP ratio, the second one is the change in the cyclically adjusted primary balance to potential GDP ratio. The first definition reflects changes in fiscal stance driven by both cyclical and discretionary policy reason, while the second one captures solely discretionary fiscal policy decisions.

My point of departure in terms of modelling choices is the literature on fiscal policy reaction functions (e.g., Gali and Perotti, 2003; Celasun et al, 2006; Celasun and Kang, 2006; European Commission 2009b and 2011; Golinelli and Momigliano, 2009, Afonso and Hauptmeir, 2009, Beetsma and Giuliodori, 2010; Candelon et al., 2010; Tagkalakis, 2011). Fiscal policy reaction functions usually have been examined for two reasons, (1) to investigate whether authorities are driven by debt stabilization and sustainability motives, and (2) to examine the cyclical stabilization properties of fiscal policy.[11]

Using data for 20 OECD countries over the period 1990-2010, [12] I estimate a fiscal policy reaction function as in (1), where i (i=1…N) stands for country and index t (t=1…T) indicates period:

$$\Delta ADebt_{it} = \alpha_1 \Delta ADebt_{it-1} + \alpha_2 Debt_{it-1} + \alpha_3 ygap_{it} + \alpha_4 FC_{it} + \alpha_5 X_{it-1} + \lambda_i + \varepsilon_{it} \qquad (1)$$

λ_i stand for unobserved country effects, $\Delta ADebt_t$ is the change in the adjusted debt to GDP ratio (net of the snow-ball effect),[13] $\Delta A Debt_{t-1}$ stands for the lagged change in the adjusted debt ratio, $Debt_{t-1}$ stands for the lagged debt ratio, $ygap_t$ is the cyclical indicator

[11] Fiscal policy reaction functions have been examined for additional reasons (see e.g., Claeys, 2006; Celasun et al., 2006).

[12] I limit the analysis in the period 1990-2010 because as several studies have suggested (e.g. Perotti, 1999, Gali et al, 2007, Blanchard and Perotti, 2002, Tagkalakis, 2008) financial market development surged since the 1990s possibly reducing the effectiveness of fiscal policy; this will have certainly affected the response of fiscal policy makers. Moreover, the creation of (and the run up to) the EMU has been in itself a structural change for euro area countries, affecting also other advance economies. I consider the following OECD countries: Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, UK, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Sweden, and the US, see Data Appendix.

[13] It should be acknowledged that during the recent crisis some part of government operations where off-balance sheet operations, i.e., they have not been accounted as government liabilities and they do not show up in the debt.

(output gap),[14] FC_{it} stands for the financial market crisis indicators, and X_{t-1} are additional control variables that are likely to affect the change in the adjusted debt ratio. These are the percentage change in real share prices, the long-term nominal interest rate, and trade openness (see Data Appendix). These additional explanatory variables were also included to reduce the omitted variables problem and because they are likely to impact on the debt ratio either through the primary balance or through the stock flow adjustment term. ε_{it} is the random component, which could be perceived as reflecting the non-systematic policy response or the fiscal policy shocks, which are independent across countries.

The financial market crisis (FC_{it}) indicator captures the 2008-2009 financial market crash, which in 2010 and thereafter led to the ongoing euro area sovereign debt crisis impacting heavily on Greece, Ireland and Portugal. As can be seen in Table 1, on average, in the 20 OECD countries considered in the sample, real share prices fell by 24.7% per year in crisis episodes, whereas in non-crisis episodes real share prices increased on average by 8.8%. At the same time during crisis years real GDP fell, on average, by 1.7% per year, while in non-crisis years it increased by 2.6%. Automatic and discretionary fiscal policy responses resulted in debt increasing, on average, by 7.7% of GDP per year in crisis episodes, compared to an increase of 0.46% of GDP in non-crisis times. Furthermore, in 2009, due to the global nature of the crisis, trade collapsed. As can be seen in Table 1 trade openness (exports plus imports as a per cent of GDP) fell by about 10% of GDP, compared to 1.6% of GDP increase in non-crisis years.[15] Hence, during the recent financial crises, we observed a substantial fall in real GDP, a collapse in asset prices, a significant worsening of fiscal positions and the collapse of trade flows (only in 2009).

[Table 1 about here]

Therefore, the financial crisis indicator that I use captures the effects of the 2008-2009 Great Recession in all 20 OECD countries, as well as the 2010 financial and sovereign debt crisis effects on a subset of the OECD countries (Greece, Ireland and

[14] Several other authors have used the output gap as an indicator of cyclical economic conditions, see e.g., Tagkalakis (2011), Candelon et al. (2010), and Gollineli and Momigliano (2009).

[15] Trade collapsed in 2009 but recovered in 2010.

Portugal).[16] The financial market crisis definition used captures in total 43 country year observations (those corresponding to 2008 and 2009 for all 20 OECD countries and those corresponding to 2010 for Greece, Ireland and Portugal).[17]

The recent financial crisis can be thought of as a systemic crisis with consequences of a global nature. Therefore, it could be considered as a rare event, which might not be repeated or it might not resemble to recurring weaker financial market crisis, i.e., crisis that do not have world wide or systemic implications. Nevertheless, the results obtained using this severe crisis definition can be of use to policy makers as they reveal the magnitude of the impact effect in terms of public debt accumulation that society might have to bear when extreme "tail" events materialize.

This will induce policy makers to take appropriate precautionary action on several fronts to minimize future implications of such unforeseen events. These actions should involve better regulation and supervision of the financial sector as well as improved surveillance procedures on the early identification and correction of external and internal imbalances which might constitute future fiscal risks.

To ensure robustness of my results I consider three different estimation techniques, pooled OLS, an instrumental variable fixed effects (IV-FE) estimator and a dynamic panel data one-step system GMM estimator. The findings corresponding to the pooled OLS estimator reflect average effect; however, they do not take into account country effects. The next estimator (IV-FE) takes into account country heterogeneity and at the same time corrects problems arising from the endogeneity of the output gap in the fiscal policy rule pointed out by Gali and Perotti (2003). In line with Gali and Perotti (2003), the output gap is instrumented with the lagged value of the output gap and the lagged value of the US output gap (whereas in the US case we use the EU-15 output gap).

However, in the previous specification fixed effects are correlated with the lagged dependent variable leading to inconsistent estimates. To address this I estimate equation (1) with a dynamic panel data one-step system GMM estimator (see Blundell and Bond

[16] Greece and Ireland received financial assistance from the EU and the IMF in 2010, whereas Portugal received financial assistance in 2011, but the signs of instability of the Portuguese economy were already visible in 2010 with debt ratio increasing by 10%, and the long term interest rate increasing from 4.2% in 2009 to 5.4% in 2010.

[17] See Katsimi and Moutos (2010) on a political economy perspective of the EMU and Greek debt crisis.

1998; Roodman, 2009b) in line with Celasun et al. 2006, Golinelli and Momigliano 2009, and Tagkalakis, 2011).[18] In line with Gollinelli and Momigliano (2009) and Celasun et al. (2006) I use a (collapsed) subset of the available instrument matrix, i.e., in our benchmark model we use the t-2 to t-3 lags of the output gap, the lagged change in the adjusted debt ratio, and the t-1 to t-3 lags of the lagged debt ratio. [19,20] In the specifications where I add additional control variables, I use also the t-2 to t-3 lags of the change in real share prices, the long term interest rate and trade openness. The specific decision on the subset of instruments to be used in each case that will be presented below takes into account the performance of the Hansen test of overidentifying restrictions and the absence of second order autocorrelation in first difference errors (i.e., that moment conditions are valid).[21]

3.1. Findings

The estimation results of my baseline specification (see Table 2, specifications 1-6) indicate that there is a significant persistence of budgetary outcomes, i.e., the lagged change in the adjusted debt ratio influences debt outcomes; an increase in the output gap (i.e. output increasing above potential) improves automatically budgetary and debt outcomes; whereas the lagged debt ratio exerts a negative effect on the dependent variable in line with the debt stabilization hypothesis.

The financial crisis indicator exerts a quite significant effect on the change in the adjusted debt ratio. For example, as shown in Table 2 (column 3) during a severe financial crisis, controlling for other factors, debt increases by about 2.7% of GDP, with the long term effect ($\alpha_5/(1-\alpha_1)$, see equation 1) being about 3.5% of GDP. However, as shown in Columns 4-6 of Table 2 the financial crisis impacts on debt ratio both

[18] As is pointed out by Celasun and Kang (2006) "if other regressors in the fiscal reaction function such as the output gap are potentially endogenous to contemporaneous primary balance shocks and would need to be instrumented", then the Blundell and Bond (1998) GMM estimator is "the best performing estimator for the coefficients of the endogenous variables".

[19]The system GMM estimator is less affected by the weak instrument problem compared to the differenced GMM Arellano and Bond 1991). See discussion in Celasun and Kang (2006), and Gollineli and Momigliano (2009). Omitting the more distant lags might not lead to significant loss of information, see Bond (2002) and Roodman (2009a) on the implication of using too many instruments.

[20] When we specify that lagged levels of the left and right hand side variables dated t-a to t-b are used as instruments in the difference equation, then in the level equation we use as instruments the first difference dated at t-a+1 of the left and right hand side variables.

[21]In all specifications, the test on overidentifying restrictions indicates that the hypothesis that instruments are valid cannot be rejected and that there is no higher-order autocorrelation.

contemporaneously (at time t) and at time t+1. In particular, as shown in column 6 of Table 2, a financial crisis episode increases debt by about 1.9% of GDP contemporaneously and by about 2.5% of GDP in the subsequent year.

[Table 2 about here]

As a robustness check I include in the analysis additional control variables that could affect a country's fiscal position. I include the change in real share prices, which I expect to exert a negative effect on the dependent variable as improved financial conditions and economic climate are associated with more robust revenue performance.[22] Second, I include the long-term nominal interest rate, which I anticipate will be associated positively with the change in debt variable (however, it could be associated negatively with the dependent variable if an increase in the long term nominal interest rate induces budgetary discipline).[23] Finally, I include trade openness; this could either lead to worse budgetary positions (e.g., because governments are more active in order to stabilize the economy in the event of external shocks) or it could lead to better budgetary position in the event that external dependence (and pressure) induces greater budgetary discipline.

The results of estimations are shown in Table 2 (see columns 7-12). The findings for the originally used control variables (lagged dependent variable, output gap, and debt ratio) are qualitatively similar to those reported in columns 1-6 of Table 2. The results are not always clear cut. However, it appears that increases in real share prices are associated with better budgetary outcomes. The evidence is mixed as regards long-term nominal interest rates and trade openness. Higher long-term interest rates either increase fiscal pressure (see columns 9 and 12) or have no statistically significant effect on adjusted debt. A high degree of trade openness is either associated with reduced fiscal pressures (see columns 7 and 10) or has no statistically significant effect on adjusted debt.

[22] Tagkalakis (2011) has shown that asset prices have a significant positive effect on fiscal positions, be it cyclically adjusted or not.
[23] Keep in mind that the change in debt ratio is net of the snow-ball effect, so the interest rate change is not directly impacting the dependent variable.

The findings related to the financial crisis variables are quite robust. More specifically, a financial crisis episode increases the debt stock, on average, by about 3.0% of GDP (see column 9, Table 2); the long-term impact ($\alpha_5/(1-\alpha_1)$, see equation 1) on the debt stock is about 4.0% of GDP. Moreover, there is statistically significant evidence that financial crisis increases the debt stock by 2.5% of GDP at time t and by about 2.1% at time t+1 (see column 12, Table 2).

3.2. Fiscal reaction functions

As a next step, and an additional robustness test, I investigate how fiscal policy makers adjust the fiscal policy stance in the event of a financial crisis, be it severe or not. The results are presented in Table 3. In columns 1-6, I use as dependent variable the change in the primary balance ratio, while, in columns 7-12, I use the change in the ratio of cyclically adjusted primary balance to potential GDP. Hence, in the latter case the fiscal policy stance is unaffected by automatic or cyclical movements in economic activity.

According to my findings the primary balance is reduced by about 2.6% of GDP in a financial crisis episode (e.g., see column 3, Table 3), i.e., fiscal policy becomes expansionary to counteract the negative effects of the financial crisis. There is some evidence that the adjustment of the primary balance in the event of a financial crisis episode takes place both at time t and at time t+1, with the immediate impact effect being about 3.7% of GDP and the next period effect being 0.9% of GDP (see column 5, Table 3).[24]

[Table 3 about here]

Similarly, a severe financial crisis episode induces fiscal policy makers to ease the cyclically adjusted fiscal policy stance (columns 7-12, Table 3) by about 1.6% of

[24] Turning to the control variables, the lagged dependent variable is, at most times, not significant, indicating limited persistence effects. The output gap variable is positively associated with the change in primary balance, i.e., improving economic conditions relative to potential boost primary balances reflecting an automatic response to cyclical conditions. An increase in debt ratio is associated with higher primary balances, in line with the debt stabilization objective.

potential GDP (see column 9, Table 3). In this case there is no evidence that discretionary fiscal policy reacts both at time t and at t+1.[25]

My estimates on fiscal and debt deterioration following a financial market crisis are indicative and it could be significantly different depending on starting positions and other vulnerabilities faced by individual OECD countries. Nevertheless, they show that fiscal positions can deteriorate abruptly in a single year. If this occurs in a country that already faces serious fiscal challenges and imbalances, then debt deterioration could also lead to loss of confidence and lack of market access, which can lead, as we recently witnessed, to a sovereign debt crisis. [26]

3.3. Country heterogeneity

The results presented thus far assume that the recent financial crisis had homogeneous effects across all OECD countries considered and that a similar future event will lead to these average effects across countries. However, in real life results vary according to certain country characteristics.

Policy makers (e.g. Bini-Smaghi, 2010) have pointed out that the size of the financial sector has grown too big paving the way for the recent financial crisis. Relevant literature e.g., Arcand et al (2011) claim that, when credit to the private sector exceeds 110% of GDP, there are negative effects on growth. Similarly, Easterly et al (2000) show that output volatility starts increasing when credit to private sector reaches 100% of GDP. Building on these earlier studies, I will take into account the size of the financial sector, which I proxy this with the ratio of credit to the private sector to GDP.[27] For robustness reasons I use two sets of indicators on the credit to private sector as a per cent of GDP. The first one is taken from the World Development Indicators of the World Bank

[25] Turning to the control variables it should be noted that the findings reported reflect only the discretionary fiscal policy response, i.e., they are not driven by cyclical or automatic changes in economic conditions. That is why the coefficient estimate of the output gap is on average smaller (and not statistically significant) in columns 7-12 vis-à-vis those reported in columns 1-6. The output gap coefficient estimates reported in columns 1-6 of Table 3 incorporate both automatic and discretionary fiscal policy changes, whereas those in columns 7-12 reflect only discretionary fiscal policy changes. The same applies for the debt ratio coefficient.

[26] I have repeated the same exercise with dependent variables the change in the primary balance ratio and the change in the ratio of cyclically adjusted primary balance to potential GDP, including additional control variables, i.e. the per centage change in real share prices, nominal long term interest rate and trade openness. The results for the financial market crisis indicators are qualitatively similar to those presented in the main text. Results are not shown in order to save space, but are available upon request.

[27] I would like to thank the referee for this useful suggestion.

(2011)[28] and the second from the Financial Development and Structure Database of Beck et al. (2010).[29]

Building on the aforementioned studies, and in order to better investigate the likely effects of the size of financial sector on the magnitude of the effect of financial crisis on debt positions, I split the domestic credit to private sector to GDP ratio into two parts. Observations where the domestic credit to private sector over GDP is equal or above 120% are classified as country-years with big financial sector, whereas those where domestic credit to GDP is below 120% are classified as having small financial sector. I deviate marginally from the aforementioned studies in choosing a threshold of 120% of GDP instead of 100% or 110% because the mean value of the sample across countries and times is already a bit higher than 110% (about 111% to 112% depending on the definition chosen, see Table 1). Moreover, the size of the financial sector gotten "too large" in the 2008-2010 period, i.e., the mean value across countries and time is above 150% of GDP. Therefore, in order to remain as close as possible to earlier studies which capture more "normal" or non crisis periods and accommodate recent developments the threshold value is set slightly higher that was indicated by previous studies, at 120% of GDP. I then interact the financial crisis indicator with the big/small financial sector variable.

The findings displayed in columns 1-6 of Table 4 reveal that the size of the financial sector matters for impact of the financial crisis on the debt ratio. Namely, in countries with big financial sectors the impact effect of the financial crisis on the debt ratio was about 4.2%-4.4% of GDP, whereas in those with smaller financial sector the impact effect on debt was about 1.4% of GDP. These findings are verified by relevant Chi-square tests (see columns 3 and 6 in Table 4). It is worth-noting that the long term

[28] Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. See World Development Indicators of the World Bank (2011), http://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS

[29] See financial institutions and markets across countries and over time: The updated financial development and structure database, Beck et al (2010) and http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/FinStructure_2009.xls. These are claims on private sector by deposit money banks and other financial institutions. The Beck et al (2010) database runs until 2009 so we have updated it till 2010 by using information from the World Development Indicators (World Bank, 2011).

impact[30] is about 5.0-5.3% of GDP in countries with big financial sector and about 1.7% of GDP in countries with smaller financial sectors.

[Table 4 about here]

Moreover, the estimates reported in columns 1-12 of Table 5 show that there is some evidence that the size of the financial sector affects the size of the fiscal intervention. More specifically, in countries with big financial sectors the cyclically adjusted primary balance to potential GDP ratio eased by about 2.5% to 2.7% of GDP, whereas in those counties with small financial sector it eased by about 0.8% of GDP. Relevant Chi-square tests verify these findings; see columns 2 and 5 of Table 5. Turning next to primary balance to GDP ratio, which encompasses both cyclically and discretionary responses, there is evidence that the bigger the size of the financial sector the bigger the magnitude of fiscal intervention in the midst of the financial crisis, i.e. the primary balance eases by about 3.6% to 3.8% of GDP, while in countries with less developed financial sector the fiscal intervention is about 2.2% of GDP (see columns 8 and 11).

[Table 5 about here]

3.4. Logit regression analysis

As a next step I want to investigate whether financial crisis episodes can predict or can be associated with a sharp deterioration in fiscal positions in the near future, i.e., a significant increase in the debt ratio. This section draws on work done by European Commission (2011)[31], IMF (2011), Baldacci (2011a, 2011b) [32] based on the "signals approach" developed by Kaminsky et al. (1998) and Kaminsky and Reinhart (1999) and

[30] The long term impact is $(\alpha_5/(1-\alpha_1)$, see equation 1.

[31] European Commission (2011) discusses in detail the use of fiscal crisis risk models that aim at timely detection of risks of debt distress. As is shown the overall composite indicator derived by European Commission to gauge fiscal risks "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".

[32] Baldacci et al (2011a) propose a set of fiscal indicators to assess rollover risks using the conceptual framework developed by Cottarelli (2011). 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) shows 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."

Cihak and Schaeck, (2010). 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 indicators. [33]

However, contrary to the aforementioned studies, the current paper does not aiming at identifying specific fiscal or macroeconomic indicators that could serve as early warning signals to future debt sustainability and debt crisis problems, rather it tries to identify the way financial market crisis episodes are associated with subsequent debt developments. It complements the analysis in the previous section in order to get a better sense of whether it is likely to have fiscal policy implication following financial market turmoil.

Financial market collapses, and in particular severe ones, like the 2008-2009 financial market crash, are rare episodes which are in themselves 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 previous and current sections is to get a quantitative and qualitative indication of how likely is to have fiscal policy implications (fiscal costs) following a financial market crash and to what extent is the magnitude of these fiscal costs significant in terms of subsequent debt ratio deterioration. The findings provide an indication of what fiscal costs the OECD countries examined will, on average, have to bear, and how likely is that they will have to bear these costs following a financial market crash. However, the quantitative estimate of the fiscal costs is indicative, and it could be significantly different depending on starting positions and other vulnerabilities faced by OECD countries. Nevertheless, their fiscal positions should be sound enough to absorb, at minimum, these average fiscal cost effects.

I consider three cases, one where the debt ratio deteriorates by 8% of GDP or more in a single year (I call this "*sharp debt deterioration*"), a second one where the debt ratio deteriorates by 10% of GDP or more in a single year (I call this "*dramatic debt deterioration*"), and a third one where the debt ratio deteriorates by more than 5% of GDP in a single year and at the same time the nominal long term interest rate increases

[33] Cihak and Schaeck (2010) investigate whether aggregate macro-prudential ratios can identify banking crisis, the banking crisis variable draws from work done by Demirguc-Kunt and Detragiache (2005) and Laeven and Valencia (2008).

compared to the previous year (I call this "*debt deterioration with sovereign debt financing problems*"). These three definitions generate 45, 26 and 18 country-year observations, respectively.[34] I then estimate a logit model where the dependent variable, in the first case, takes value one when the change in debt ratio is at least 8%, and zero otherwise ("*sharp debt deterioration*"). In the second case the dependent variable takes value 1 when the change in debt ratio is at least 10%, and zero otherwise ("*dramatic debt deterioration*"). In the third case the dependent variable takes value 1 when the change in debt ratio is more that 5% and 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*").

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, as stated beforehand, 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 1.4% of GDP (see Table 1), 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 -0.4% (see Table 1). In the period 2008-2010 it was still negative, i.e., about -0.2%. That's why the third definition generates fewer data points although I have lowered the debt deterioration threshold. [35]

[34] I 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.

[35] 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.

Table 6 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 1990s and late 2000s.

[Table 6 about here]

Hence, the probability of observing a (sharp, dramatic or other) debt deterioration in country i at time t is a function of control variables at times t-1 and the financial crisis indicator at time t (or t-1):

$$Debt\ deterioration_{it} = f(Controls_{it-1}, FC_{it\ or}\ FC_{it-1}) \qquad (2)$$

Following Cihak and Schaeck (2011) and Demirguc-Kunt and Detragiache (1998), I estimate the logit model without the inclusion of country fixed effects in order to include countries that never experienced a sharp/dramatic debt deterioration or debt deterioration with sovereign debt financing problems. As an extension to my benchmark specification (2), and in order to control for unobserved heterogeneity, we estimate the logit model with country fixed effects[36] however in that case the countries that have not experience a sharp, dramatic or other debt deterioration drop out of the estimations.

The baseline specification uses the following control variables: budgetary conditions at t-1 i.e., the cyclically adjusted primary balances as a per cent of potential GDP, which is a measure of the fiscal policy stance (represents discretionary fiscal policy choices), and the debt ratio. In addition, I use the output gap to control for cyclical economic conditions at time t-1, and the financial crisis indicators. I consider two specifications each time, one where I use the financial crisis indicator contemporaneously and another one where I use its lagged value. This is done in order to address concerns that the financial crisis indicators and the debt deterioration indicators are endogenously determined.

As shown in Table 7, an increase in the lagged value of the cyclically adjusted primary balance as a per cent of potential GDP lowers the probability of debt deterioration (columns 1-12). The level of the debt ratio at t-1 provides mixed signals and is not particularly significant. The coefficient estimate of the output gap gives mixed

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

signals, but when it is statistically significant it has a negative value, which means that when output falls below potential the fiscal position is likely to deteriorate automatically, due to the operation of automatic stabilizers and possible discretionary action, increasing the likelihood of a debt rise (see columns 1, 3, 5, 7, and 9).

Turning to the financial crisis indicators, there is significant evidence that they increase the likelihood of subsequent debt deterioration. For example, the average marginal effect of sharp debt deterioration at time t for a discrete change in the financial crisis indicator (at time t) from 0 to 1 (the realization of a financial crisis) is 0.45 (see column 1), when considering the lagged financial crisis indicator the average marginal effect diminishes to 0.28 (see column 2). In the case of a dramatic debt deterioration the respective average marginal effects are smaller, i.e., 0.37 and 0.24 respectively (see columns 5 and 6). They diminish further in terms of both magnitude and significance when considering the rarer event, i.e., debt deterioration with simultaneous sovereign debt financing problems. The average marginal effect of debt deterioration at time t for a discrete change in the financial crisis indicator from 0 to 1 (in the event of a financial crisis) is reduced to 0.16 (see column 9).

[Table 7 about here]

It is worth noting that the effect of financial crisis on the probability of debt deterioration increases in terms of magnitude when I exclude the countries that never experienced such debt deterioration (see columns 3, 4, 7, 8 and 11). In that case the average marginal effects of a dramatic debt deterioration are more pronounced compared to those of sharp debt deterioration (see columns 3, 4 and 7, 8). However, it is still true that the rarer event of debt deterioration with sovereign debt financing problems generates the smallest average marginal effects (see column 11).

As a robustness check I include in the analysis additional explanatory control variables. First, I include the change in real share prices (at t-1), which I expect to reduce the likelihood of debt deterioration because it is associated with improved economic and financial market prospects improving fiscal positions. Secondly, the long-term nominal interest rate (at t-1), which implies higher debt servicing costs and will most likely worsen the budgetary and debt position. However, if a high nominal long-term interest

rate at t-1 is perceived as an early signal of instability by policy makers then it might persuade them to consolidate public finances, reducing future fiscal risks. Thirdly, I include trade openness (at t-1), which I expect to reduce the likelihood of a debt deterioration occurring, if a country that is more integrated in the global international goods and services markets is more prone to fiscal discipline.

The estimation results are displayed in Table 8. The findings for the originally used control variables (lagged fiscal stance, output gap and debt ratio) are qualitatively similar to those presented in Table 7. Turning to the new control variables, I find that real share prices have a negative but mostly insignificant effect. The long term interest rate exerts a positive and significant effect in some of the estimations concerned (see columns 4, 5, and 6). However, in other cases is insignificant and has a negative sign. Trade openness has a negative and at times significant effect on debt deterioration (see columns 1-4, and 7-8).

Most importantly the financial crisis indicator still has a quite significant effect, i.e., the occurrence of a severe financial crisis episode increases the probability of subsequent sharp/dramatic debt deterioration. The average marginal effects of debt deterioration in the event of financial crisis range from 0.19 in the event of dramatic debt deterioration with sovereign financing problems, to about 0.40 in dramatic debt increases and to 0.47 in sharp debt increases (see columns 9, 5 and 1, respectively). When controlling for unobserved heterogeneity by means of country fixed effects, the average marginal effects are not always significant, i.e., they are statistically significant only when examining lagged effects of sharp and dramatic debt deterioration definitions (see columns 4 and 8).

[Table 8 about here]

4. Summary and conclusions

The recent financial crisis was characterized by the sizeable fiscal cost of banking sector bail out operations and the significant automatic and discretionary fiscal policy response to shrinking output. These have put increased pressure on public finances in many industrialized countries and led to the sovereign debt crisis problem in the euro

area. This paper tries to evaluate the impact of financial market crisis episodes on debt developments.

More specifically, I investigate what is the average impact of weak and severe financial crisis episodes on fiscal positions and second, to what extent the occurrence of a financial crisis, controlling for other fiscal and macroeconomic variables, could be associated with a subsequent sharp deterioration of the debt ratio.

The results obtained based on our baseline specification involving the change in the adjusted debt ratio, indicate that severe financial crisis episodes, like the 2008-2009 crisis, increase the stock of debt by, an average, of 2.7% to 4.0% of GDP in the 20 OECD countries under examination. Moreover, there is significant evidence that severe financial crisis episodes impact the debt ratio both contemporaneously (at time t) and in the subsequent period (at time t+1), with the effects being 1.9% of GDP and 2.5% of GDP, respectively.

The size of the financial sector affects significantly the effect of financial crisis on debt positions. In particular, this effect is much more pronounced in countries with big financial sectors, i.e., it ranges from 4.2% to 5.3% of GDP, while in countries with smaller financial sectors it ranges between 1.4% to 1.7% of GDP.

Focusing on primary balance developments, one can obtain information on the discretionary policy choices of the fiscal policy maker. According to my findings, the primary balance is reduced by about 2.6% of GDP in the event of a severe financial market crash, i.e., automatic and discretionary fiscal policy changes result in an expansionary fiscal policy stance. The fiscal policy stance, clean of cyclical effects, is still highly expansionary in the event of financial crisis. The cyclically adjusted fiscal policy stance eases by about 1.6% of potential GDP in the event of a severe financial market crash.

In some cases fiscal policy remains expansionary in the subsequent year of the financial crisis, contributing to deficit bias and the build up of fiscal imbalances. However the full blown fiscal expansion occurs at the time of the crisis – possibly because of the severity of the event the policy maker has to deal with.

Fiscal interventions in the event of a severe financial crisis are more pronounced in countries with big financial sector, i.e., the cyclically adjusted balances as a per cent of potential GDP and the primary balances as a per cent of GDP ease by 2.5%-2.6% and 3.6%-3.8%, respectively. In countries where the financial sector has smaller size, the fiscal expansion in times of financial crisis of the cyclically adjusted primary balance as a per cent of potential GDP and the primary balance and a per cent of GDP ranges from 0.8% to 2.2%, respectively.

Hence, the fact that the primary balance (surplus), cyclically adjusted or not, is reduced in the event of a financial crisis, reflects that part of the increase in the adjusted debt ratio is due to stock flow adjustment, which could be linked to fiscal operations in support of the financial and banking system.

Second, my analysis has also revealed that, controlling for other factors, there is significant evidence that there is a positive association between financial crisis episodes and subsequent deteriorations in debt positions. My findings suggest that the occurrence of a severe financial crisis episode increase the probability of a subsequent debt deterioration, both when we examine only the debt ratio and when I combine it with sovereign debt financing problems (i.e. increases in nominal long term interest rates).

The findings of this analysis (although indicative) suggest that fiscal and debt positions are going to be impacted severely and deteriorate abruptly in a single year in case of financial market crashes, with substantial part of the impact reflecting a discretionary (expansionary) fiscal policy response. However, these fiscal interventions and the weakening economic activity associated with a severe financial market collapse are going to worsen budgetary positions, leading to sharp increases in debt ratios. This is exactly what we observed following the recent financial crisis. If this occurs in a country that already faces serious fiscal challenges and imbalances, then debt deterioration could also lead to loss of confidence and lack of market access as we witnessed in the on-going sovereign debt crisis affecting several euro area member states.

Moreover, I find that a “too large” financial sector that fails in the event of a severe financial crisis increases substantially the fiscal risks that society will have to bear.

These developments call for extreme prudence and discipline on the fiscal side, in particular in good economic times. This will allow building up sound fiscal position, allowing for fiscal buffers, and reducing debt levels. In addition, it will provide room for manoeuvre in bad economic times when expansionary fiscal policy interventions might be warranted to contain the effects of a financial market collapse and to sustain economic activity. At the same time it is important to improve both the supervisory and regulatory framework of financial markets in order to contain risks stemming from the financial sector. This will reduce excessive risk taking and unsustainable patterns and behavior like the hunt for rents, the propensity to herd and create bubbles, the misalignment of incentives, and the proliferation of complex innovative financial instruments that might carry hidden risk etc.[37]

[37] See Bini-Smaghi, 2010.

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DATA Appendix

I use a yearly unbalanced data set of 20 OECD economies for the period 1990-2010: Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, UK, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Sweden, and the US.

All variables have been taken from the Economic Outlook of the OECD (OECD, 2011a). The change in the adjusted debt ratio is calculated as the change in the debt ratio net of the "snow-ball" effect. [38] The change in cyclically adjusted primary balances as a per cent of potential GDP is calculated as the difference between cyclically adjusted primary balances as a per cent of potential GDP in period t and t-1. The calculation of the change in primary balance as a per cent of GDP is done in a similar manner. The per centage change in real share prices is calculated as the per centage change in share prices minus the per centage change in GDP deflator. Trade openness is calculated as the sum of nominal exports and imports and as a per cent of nominal GDP. Details about the financial market crisis and debt deterioration indicators are provided in the main text (Section 3).

I use the ratio of credit to the private sector to GDP to proxy the size of the financial sector. I use two sets of indicators, the first one is taken from the World Development Indicators of the World Bank (2011)[39] and the second one is from the Financial Development and Structure Database of Beck et al. (2010).[40] The descriptive statistics of the variables used in the analysis are shown in Table 9.

[Table 9 about here]

[38] 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, nominal GDP and the stock flow adjustment, respectively; i and y are the average nominal interest rate on debt and nominal GDP growth, respectively.

[39] Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. See World Development Indicators of the World Bank (2011), http://data.worldbank.org/indicator/FS.AST.PRVT.GD.ZS

[40] See financial institutions and markets across countries and over time: The updated financial development and structure database, Beck et al (2010) and http://siteresources.worldbank.org/INTRES/Resources/469232-1107449512766/FinStructure_2009.xls. These are claims on private sector by deposit money banks and other financial institutions. The Beck et al (2010) database runs until 2009 so I have updated till 2010 by using the World Development Indicators database.

Table 1: The definition of financial crisis and the behavior of key macroeconomic and other variables in the 2008-2010

	Average change in								
	Real GDP		Debt ratio		Real share prices		Trade openness		Number of crisis
	Crisis	Non crisis	Crisis	Non crisis	Crisis	Non crisis	Crisis (2009)	Non crisis	
Australia	1.95	3.43	2.51	-0.18	-21.28	6.58	-4.95	0.76	2
Austria	-1.24	2.38	5.50	0.55	-33.25	7.86	-15.26	2.39	2
Belgium	-0.90	2.11	6.00	-2.09	-32.07	7.66	-26.43	2.71	2
Canada	-1.04	2.80	8.46	-0.39	-14.54	7.66	-9.53	0.99	2
Switzerland	0.11	1.52	-1.59	0.82	-21.78	10.76	-9.07	1.78	2
Germany	-2.13	1.63	5.94	2.21	-24.04	8.11	-11.04	2.61	2
Denmark	-3.17	2.17	9.05	-1.93	-26.79	10.17	-15.07	2.18	2
Spain	-1.43	2.88	10.26	-0.06	-20.92	8.43	-9.20	1.57	2
Finland	-3.62	2.66	5.08	1.72	-30.39	17.52	-17.30	2.63	2
France	-1.41	1.88	8.93	2.15	-25.14	7.12	-7.44	0.88	2
UK	-2.74	2.71	12.64	1.37	-18.33	5.42	-3.11	0.83	2
Greece	-2.31	3.84	11.34	1.08	-33.21	16.54	-12.96	1.52	3
Ireland	-3.47	6.12	23.27	-3.77	-24.05	7.95	10.53	2.59	3
Italy	-3.10	1.47	7.49	0.78	-31.85	5.67	-9.94	1.44	2
Japan	-3.72	1.50	13.50	6.06	-27.05	0.50	-9.97	1.03	2
Netherlands	-0.88	2.63	7.99	-1.82	-28.59	9.08	-13.46	2.80	2
Norway	-0.49	2.98	-4.13	1.70	-24.13	12.49	-8.41	0.27	2
Portugal	-0.38	2.21	9.39	0.72	-15.85	5.15	-11.54	0.75	3
Sweden	-2.95	2.66	1.31	0.01	-21.32	11.94	-10.23	2.31	2
US	-1.91	2.98	11.45	0.45	-19.48	8.64	-5.29	0.73	2
Un-weighted average	**-1.74**	**2.63**	**7.72**	**0.47**	**-24.70**	**8.76**	**-9.98**	**1.64**	**total: 43**

Note: All countries are considered to be in a state of financial crisis in 2008-2009, Greece, Ireland and Portugal are in a state of financial crisis also in 2010. In the context of the 2008-2009 financial crises, trade openness collapsed only in 2009.

Table 2: The impact of financial crisis episodes on the change in adjusted debt ratio

Dependent variable:	1	2	3	4	5	6	7	8	9	10	11	12
Change in debt ratio net of snow-ball effect	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM
Change in debt ratio net of snow-ball effect (t-1)	0.330 (5.47)***	0.089 (1.51)	0.224 (2.75)***	0.309 (5.08)***	0.067 (1.10)	0.196 (2.25)**	0.306 (4.90)***	0.084 (1.42)	0.247 (2.78)***	0.287 (4.57)***	0.056 (0.95)	0.223 (2.35)**
Output gap (t)	-0.481 (-3.97)***	-0.986 (-6.84)***	-0.842 (-6.08)***	-0.568 (-4.21)***	-1.113 (-6.61)***	-0.975 (-5.73)***	-0.516 (-4.23)***	-1.049 (-6.84)***	-0.752 (-4.30)***	-0.612 (-4.57)***	-1.169 (-6.68)***	-0.848 (-4.09)***
Debt ratio (t-1)	-0.018 (-2.47)**	-0.079 (-5.82)***	-0.026 (-0.86)	-0.018 (-2.52)**	-0.082 (-6.11)***	-0.026 (-0.91)	-0.020 (-2.93)***	-0.079 (-5.74)***	-0.023 (-0.72)	-0.021 (-2.97)***	-0.082 (-6.00)***	-0.017 (-0.60)
Change in real share prices							-0.017 (-1.72)*	-0.003 (-0.35)	-0.004 (-0.22)	-0.017 (-1.79)*	-0.004 (-0.38)	0.003 (0.17)
Long term interest rate							-0.175 (-1.46)	-0.077 (-0.59)	0.375 (3.05)***	-0.170 (-1.44)	-0.110 (-0.83)	0.399 (3.09)***
Trade openness							-0.012 (-1.67)*	0.015 (0.57)	0.011 (0.51)	-0.012 (-1.67)*	-0.006 (-0.22)	0.014 (0.73)
Financial Crisis	**3.366 (3.82)*** **	**2.341 (3.73)*** **	**2.702 (3.35)*** **	**2.592 (2.45)** **	**1.115 (1.35)**	**1.869 (2.13)** **	**2.689 (2.85)*** **	**1.899 (2.39)** **	**2.998 (3.22)*** **	1.804 (1.57)	0.724 (0.75)	**2.540 (2.41)** **
Financial Crisis (t+1)				**1.437 (1.79)***	**2.248 (2.76)*** **	**2.509 (3.01)*** **				**1.578 (1.97)** **	**2.409 (2.94)*** **	**2.116 (2.50)** **
Constant	1.202 (2.33)**	5.520 (5.68)***	1.772 (0.88)	1.104 (2.15)**	5.544 (5.77)***	1.493 (0.78)	3.293 (3.10)***	4.970 (2.05)**	-1.099 (-0.39)	3.173 (3.00)***	6.576 (2.71)***	-2.183 (-0.85)
Obs	361	361	361	359	359	359	361	361	361	359	359	359
F-test (p-value)	F(4, 356) : 27.58 (0.0000)	Wald chi2(4) : 190.93 (0.0000)	Wald chi2(3) : 145.19 (0.0000)	F(5, 353) : 23.12 (0.0000)	Wald chi2(5) : 188.50 (0.0000)	Wald chi2(4) : 180.76 (0.0000)	F(7, 353) : 22.21 (0.000)	Wald chi2(7) : 195.16 (0.0000)	Wald chi2(6) : 204.11 (0.0000)	F(8, 350) : 21.13 (0.0000)	Wald chi2(8) : 194.28 (0.0000)	Wald chi2(7) : 242.60 (0.0000)

Table 2: Continued

R-square	0.325	0.356 (within) 0.0024 (between) 0.2028 (overall)		0.323	0.3654 (within) 0.0005 (between) 0.1965 (overall)		0.339	0.3543 (within) 0.0000 (between) 0.1864 (overall)		0.338	0.3639 (within) 0.0023 (between) 0.2072 (overall)	
Residual's 2nd order AR (p-values)			0.101			0.055			0.085			0.062
Hansen test of overidentifying restrictions (p-values)			**0.78**			**0.124**			**0.219**			**0.307**
No of instruments			12			13			21			22

Notes: z-statistics in parenthesis, standard errors are robust (heteroskedastic and autocorrelation consistent) in the pooled OLS and one-step system GMM estimators. ***,**,* denote significance at 1%, 5%, and 10%, respectively. Estimators used: Pooled OLS, Instrumental variables fixed effects (IV-FE), and one step system GMM; see Blundell and Bond (1998) and Roodman (2009a, 2009b). In the IV-FE estimations the output gap is instrumented with its one lagged value and the lagged value of the US output gap (in the US case we use the lagged value of the EU-15 output gap), see Gali and Perotti (2003). In the GMM case a collapsed subset of the available instrument matrix was used: namely the t-2 to t-3 lags of the output gap, the lagged change in adjusted debt ratio (the change in real share prices, the long term interest rate, and trade openness were also used in columns 7-12), and the t-1 to t-3 lags of the lagged debt ratio.

Table 3: The impact of financial crisis episodes on the fiscal policy stance

	1	2	3	4	5	6	7	8	9	10	11	12
Dependent variable:	**Change in the Primary Balance as a % of GDP**						**Change in the cyclically adjusted Primary Balance as a % of potential GDP**					
Estimator	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM
Dependent variable (t-1)	0.022 (0.33)	0.034 (0.55)	-0.064 (-0.56)	0.033 (0.48)	0.046 (0.72)	-0.022 (-0.13)	-0.123 (-1.66)*	-0.208 (-3.47)***	-0.419 (-1.44)	-0.117 (-1.54)	-0.204 (-3.38)***	-0.308 (-1.02)
Output gap (t)	0.165 (2.25)**	0.049 (0.58)	0.371 (2.46)**	0.157 (2.12)**	-0.013 (-0.13)	0.351 (1.95)*	0.079 (1.12)	0.179 (2.71)***	0.367 (2.38)**	0.092 (1.34)	0.214 (2.83)***	0.346 (1.99)**
Debt ratio (t-1)	0.008 (2.03)**	0.030 (3.71)***	0.076 (1.72)*	0.008 (1.98)**	0.029 (3.55)***	0.071 (1.69)*	0.007 (2.31)**	0.027 (3.90)***	0.022 (0.89)	0.007 (2.33)**	0.026 (3.80)***	0.019 (0.71)
Financial Crisis	-3.138 (-6.88)***	-3.211 (-8.74)***	-2.557 (-5.40)***	-3.211 (-6.16)***	-3.743 (-7.57)***	-2.480 (-4.19)***	-1.029 (-2.21)**	-0.820 (-2.13)**	-0.391 (-0.71)	-0.926 (-1.76)*	-0.556 (-1.19)	-0.420 (-0.67)
Financial Crisis (t+1)				**0**.172 (0.45)	**0**.919 (1.88)*	-0.127 (-0.18)				-0.140 (-0.48)	-0.377 (-0.96)	-0.543 (-1.25)
Constant	-0.349 (-1.16)	-1.978 (-3.37)***	-5.206 (-1.73)*	-0.362 (1.20)	-1.993 (-3.35)***	-4.820 (-1.68)*	-1.006 (-1.60)	-3.092 (-2.60)***	0.887 (0.31)	-1.038 (-1.65)*	-3.214 (-2.66)***	1.586 (0.54)
Obs	363	363	363	361	361	361	362	362	362	360	360	360
F-test (p-value)	F(4, 358) : 14.76 (0.0000)	Wald chi2(4) : 119.60 (0.0000)	Wald chi2(3) : 93.35 (0.0000)	F(5, 355) : 11.85 (0.0000)	Wald chi2(5) : 121.39 (0.0000)	Wald chi2(4) : 99.42 (0.0000)	F(7, 354) : 10.29 (0.0000)	Wald chi2(7) : 94.37 (0.0000)	Wald chi2(6) : 41.68 (0.0000)	F(8, 351) : 8.92 (0.0000)	Wald chi2(8) : 93.32 (0.0000)	Wald chi2(7) : 55.34 (0.0000)

Table 3: Continued

R-square	0.2484	0.2637 (within) 0.0256 (between) 0.1752 (overall)		0.2503	0.2536 (within) 0.0380 (between) 0.1747 (overall)		0.1907	0.2166 (within) 0.0000 (between) 0.1315 (overall)		0.1899	0.2154 (within) 0.0016 (between) 0.1300 (overall)	
Residual's 2nd order AR (p-values)			0.646			0.549			0.475			0.754
Hansen test of overidentifying restrictions (p-values)			**0.292**			**0.308**			**0.666**			**0.586**
No of instruments			12			13			21			22

Notes: z-statistics in parenthesis, standard errors are robust (heteroskedastic and autocorrelation consistent) in the pooled OLS and one-step system GMM estimators. ***,**,* denote significance at 1%, 5%, and 10%, respectively. Estimators used: Pooled OLS, Instrumental variables fixed effects (IV-FE), and one step system GMM; see Blundell and Bond (1998) and Roodman (2009a, 2009b). In the IV-FE estimations the output gap is instrumented with its one lagged value and the lagged value of the US output gap (in the US case we use the lagged value of the EU-15 output gap), see Gali and Perotti (2003). In the GMM case a collapsed subset of the available instrument matrix was used: namely the t-2 to t-3 lags of the output gap, the lagged change in primary balance as a % of GDP ratio, (the lagged change in cyclically adjusted primary balance as a % of potential GDP ratio in columns 7-12), and the t-1 to t-3 lags of the lagged debt ratio.

Table 4: The impact of financial crisis episodes on the change in adjusted debt ratio when taking into account the size of the financial sector

Dependent variable: Change in debt ratio net of snow-ball effect	1	2	3	4	5	6
Estimator	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM
Size of financial sector variable	Private credit to GDP -World Bank (2011)			Private credit to GDP –Beck et al (2010)		
Change in debt ratio net of snow-ball effect (t-1)	0.351 (5.50)***	**0**.075 (1.19)	0.171 (1.68)*	0.350 (5.48)***	0.078 (1.24)	0.171 (1.69)*
Output gap (t)	-0.454 (-3.73)***	-0.981 (-6.63)***	-0.894 (-5.65)***	-0.453 (-3.73)***	-0.977 (-6.62)***	-0.883 (-5.63)***
Debt ratio (t-1)	-0.017 (-2.43)**	-0.073 (-5.53)***	-0.011 (-0.39)	-0.017 (-2.42)**	-0.073 (-5.57)***	-0.009 (-0.33)
Financial Crisis*Big financial sector	**4.519** **(4.10)***	**3.781** **(5.09)***	**4.163** **(4.10)***	**4.731** **(4.08)***	**3.928** **(5.09)***	**4.389** **(4.10)***
Financial Crisis*Small financial sector	**2.486** **(3.04)***	**1.026** **(0.98)**	**1.414** **(1.85)***	**2.443** **(3.20)***	**1.259** **(1.34)**	**1.416** **(2.26)**
Constant	1.151 (2.28)**	5.136 (5.38)***	0.676 (0.36)	1.143 (1.27)	5.148 (5.42)***	**0**.553 (0.30)
Test Financial Crisis effect (Big=Small) (p-value)	F(1, 349) : 2.46 (0.1175)	**chi2(1) : 4.96** **(0.0259)**	**chi2(1) : 4.63** **(0.0314)**	**F(1, 350) 3.07** **(0.0808)**	**chi2(1) : 5.26** **(0.0219)**	**chi2(1) : 6.51** **(0.0107)**
Obs.	**355**	**355**	**355**	**356**	**356**	**356**
F-test (p-value)	F(5, 349) : 25.35 (0.0000)	Wald chi2(5) : 210.58 (0.0000)	Wald chi2(4) : 181.33 (0.0000)	F(5, 350) : 26.78 (0.0000)	Wald chi2(5) : 218.16 (0.0000)	Wald chi2(4) : 193.20 (0.0000)

Table 4: Continued

R-square	0.3586	0.3859 (within) 0.0096 (between) 0.2317 (overall)		0.3635	0.3927 (within) 0.0081 (between) 0.2369 (overall)	
Residual's 2nd order AR (p-values)			0.174			0.160
Hansen test of overidentifying restrictions (p-values)			0.195			0.180
No of Instruments			13			13

Notes: z-statistics in parenthesis, standard errors are robust (heteroskedastic and autocorrelation consistent) in the pooled OLS and one-step system GMM estimators.. ***,**,* denote significance at 1%, 5%, and 10%, respectively. Estimators used: Pooled OLS, Instrumental variables fixed effects (IV-FE), and one step system GMM; see Blundell and Bond (1998) and Roodman (2009a, 2009b). In the IV-FE estimations the output gap is instrumented with its one lagged value and the lagged value of the US output gap (in the US case we use the lagged value of the EU-15 output gap), see Gali and Perotti (2003). In the GMM case a collapsed subset of the available instrument matrix was used: namely the t-2 to t-3 lags of the output gap and the lagged change in adjusted debt ratio, and the t-1 to t-3 lags of the lagged debt ratio.

Table 5: The impact of financial crisis episodes on the fiscal policy stance when taking into account the size of the financial sector

Dependent variable:	**Cyclically adjusted primary balance as a % of potential GDP**						**Primary balance as a % of GDP**					
	1	2	3	4	5	6	**7**	**8**	**9**	**10**	**11**	**12**
Estimator	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM	Pooled OLS	IV-FE	One step system GMM
Size of financial sector variable	Private credit to GDP -World Bank (2011)			Private credit to GDP –Beck et al (2010)			Private credit to GDP -World Bank (2011)			Private credit to GDP –Beck et al (2010)		
Dependent variable (t-1)	-0.074 (-0.97)	-0.125 (-2.09)**	-0.130 (-0.45)	-0.077 (-1.01)	-0.126 (-2.12)**	-0.126 (-0.45)	**0**.034 (0.47)	**0**.039 (0.64)	-0.031 (-0.15)	**0**.029 (0.42)	0.037 (0.60)	-0.025 (-0.13)
Output gap (t)	**0**.021 (0.31)	**0**.033 (0.53)	0.179 (1.74)*	**0**.021 (0.32)	0.033 (0.53)	**0**.175 (1.69)*	**0**.159 (2.19)**	0.039 (0.47)	**0**.343 (2.24)**	**0**.160 (2.23)**	**0**.040 (0.49)	**0**.334 (2.18)**
Debt ratio (t-1)	0.005 (1.61)	**0**.026 (3.72)***	**0**.058 (1.57)	**0**.005 (1.59)	**0**.026 (3.78)***	**0**.058 (1.55)	**0**.007 (1.78)*	**0**.032 (3.89)***	**0**.077 (1.68)*	**0**.007 (1.76)*	**0**.032 (3.95)***	**0**.076 (1.67)*
Financial Crisis*Big financial sector	**-2.625 (-4.74)*** **	**-2.496 (-6.49)*** **	**-1.797 (-3.13)*** **	**-2.788 (-4.73)*** ***	**-2.647 (-6.64)*** **	**-1.940 (-3.32)*** **	**-3.628 (-6.07)*** **	**-3.603 (-8.07)*** **	**-2.691 (-3.78)*** **	**-3.802 (-6.03)*** **	**-3.779 (-8.18)*** **	**-2.855 (-4.00)*** **
Financial Crisis*Small financial sector	**-0.959 (-1.48)**	**-0.762 (-1.42)**	**-1.191 (-2.63)*** **	**-0.992 (-1.86)***	**-0.831 (-1.72)***	**-1.078 (-2.78)*** **	**-2.151 (-2.74)*** **	**-2.191 (-3.49)*** **	**-2.506 (-4.37)*** **	**-2.123 (-3.28)*** **	**-2.168 (-3.84)*** **	**-2.296 (-4.21)*** **
Constant	-0.281 (-1.21)	-1.797 (-3.56)***	-4.072 (-1.61)	-0.279 (-1.19)	-1.814 (-3.61)***	-4.044 (-1.59)	-0.265 (-0.89)	-2.101 (-3.55)***	-5.245 (-1.68)*	-0.260 (-0.87)	-2.121 (-3.60)***	-5.191 (-1.67)*
Test Financial Crisis effect (Big=Small) (p-value)	**F(1, 350) : 3.40 (0.0662)**	**chi2(1) : 7.29 (0.0069)**	chi2(1): 0.52 (0.4698)	**F(1, 351) : 4.56 (0.0334)**	**chi2(1) : 9.03 (0.0027)**	chi2(1): 1.24 (0.2658)	F(1, 351) : 2.07 (0.1508)	**chi2(1) : 3.61 (0.0574)**	chi2(1) : 0.04 (0.8448)	**F(1, 352) : 3.19 (0.0748)**	**chi2(1) : 5.30 (0.0214)**	chi2(1) : 0.40 (0.5266)
Obs.	**356**	**356**	**356**	**357**	**357**	**357**	**357**	**357**	**357**	**358**	**358**	**358**

Table 5: Continued

F-test (p-value)	F(5, 350) : 6.93 (0.0000)	Wald chi2(5) : 68.01 (0.0000)	Wald chi2(4) : 38.19 (0.0000)	F(5, 351) : 7.35 (0.0000)	Wald chi2(5) : 71.79 (0.0000)	Wald chi2(4) : 40.20 (0.0000)	F(5, 351) : 11.72 (0.0000)	Wald chi2(5) : 116.91 (0.0000)	Wald chi2(4) : 135.15 (0.0000)	F(5, 352) : 12.58 (0.0000)	Wald chi2(5) : 123.20 (0.0000)	Wald chi2(4) : 127.71 (0.0000)
R-square	0.1427	0.1688 (within) 0.0261 (between) 0.0904 (overall)		0.1502	0.1757 (within) 0.0281 (between) 0.0956 (overall)		0.2524	0.2634 (within) 0.0248 (between) 0.1643 (overall)		0.2607	0.2726 (within) 0.0232 (between) 0.1705 (overall)	
Residual's 2nd order AR (p-values)			0.776			0.757			0.782			0.771
Hansen test of overidentifying restrictions (p-values)			**0.684**			**0.693**			**0.313**			**0.322**
No of Instruments			**13**			**13**			**13**			**13**

Notes: z-statistics in parenthesis, standard errors are robust (heteroskedastic and autocorrelation consistent) in the pooled OLS and one-step system GMM estimators.. ***,**,* denote significance at 1%, 5%, and 10%, respectively. Estimators used: Pooled OLS, Instrumental variables fixed effects (IV-FE), and one step system GMM; see Blundell and Bond (1998) and Roodman (2009a, 2009b). In the IV-FE estimations the output gap is instrumented with its one lagged value and the lagged value of the US output gap (in the US case we use the lagged value of the EU-15 output gap), see Gali and Perotti (2003). In the GMM case a collapsed subset of the available instrument matrix was used: namely the t-2 to t-3 lags of the output gap and the lagged change in cyclically adjusted primary balance to potential GDP ratio (the primary balance to GDP ratio was used in columns 7-12) debt ratio, and the t-1 to t-3 lags of the lagged debt ratio.

Table 6: 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	1994	-	1994
Austria	-	-	2008
Belgium	1992	-	-
Canada	2009	2009	-
Switzerland	-	-	1992
Germany	1995, 2010	-	-
Denmark	1993, 2008, 2009	1993	-
Spain	1993, 2009	1993, 2009	2008
Finland	1991, 1992, 1993, 2009	1992, 1993, 2009	1992
France	1994, 2009	2009	1994
UK	1993, 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	1993, 2009	2009	-
Japan	1998, 1999, 2000, 2001, 2002, 2005, 2009	1998, 1999, 2009	1994, 1999, 2004
Netherlands	2008	2008	-
Norway	2003, 2006	2006	2002, 2006
Portugal	2009, 2010	2009, 2010	2008, 2010
Sweden	1991, 1992	1992	-
US	2008, 2009, 2010	2009	-
Total country-year episodes	**45**	**26**	**18**

Table 7: Probability of debt deterioration

	1	2	3	4	5	6	7	8	**9**	**10**	**11**	**12**
Estimation	Logit		Logit -FE		Logit		Logit -FE		Logit		Logit -FE	
Dependent variable:	**Sharp debt deterioration**				**Dramatic debt deterioration**				**Debt deterioration with sovereign debt financing problems**			
Change in cyclically adjusted primary balance as a % of potential GDP (t-1)	-0.246 (-2.27)**	-0.218 (-1.99)**	-0.111 (-0.98)	-0.117 (-1.09)	-0.388 (-3.02)***	-0.344 (-2.71)***	-0.229 (-1.45)	-0.218 (-1.53)	-0.404 (-3.11)***	-0.459 (-3.78)***	-0.323 (-1.71)*	-0.489 (-2.76)***
Output gap (t-1)	-0.279 (-3.32)***	**0**.030 (0.32)	-0.382 (-3.36)***	**0**.0009 (0.01)	-0.220 (-2.02)**	**0**.187 (1.33)	-0.285 (-2.00)**	**0**.136 (1.37)	-0.152 (-1.66)*	-0.004 (-0.03)	-0.242 (-1.52)	-0.097 (-0.78)
Debt ratio (t-1)	**0**.007 (1.02)	**0**.007 (1.14)	-0.015 (-1.36)	-0.007 (-0.68)	**0**.004 (0.52)	**0**.006 (0.80)	-0.019 (-1.35)	-0.012 (-0.89)	-0.004 (-0.43)	-0.003 (-0.28)	-0.031 (-1.80)*	-0.016 (-0.99)
Financial Crisis (t)	2.997 (7.00)***		3.259 (5.84)***		3.537 (6.07)***		3.598 (5.11)***		2.248 (4.15)***		2.383 (3.24)***	
Financial Crisis (t-1)		1.921 (4.33)***		2.133 (4.58)***		2.387 (4.32)***		2.694 (4.60)***		0.364 (0.61)		**0**.128 (0.15)
Constant	-3.444 (-6.50)***	-3.048 (-5.77)***			-4.332 (-6.00)***	-3.841 (-5.45)***			-3.684 (-4.42)***	-3.243 (-4.20)***		
Average Marginal effect of financial crisis (t)	0.451 (6.02)***		**0**.586 (7.93)***		**0**.374 (4.97)***		**0**.641 (7.79)***		**0**.161 (2.90)***		**0**.423 (3.09)***	

Table 7: Continued

Average Marginal effect of financial crisis (t-1)		**0**.282 (3.25)***		**0**.451 (4.66)***		0.241 (3.02)***		**0**.529 (5.12)***		**0**.017 (0.56)		**0**.024 (0.15)
Obs.	**362**	**362**	**324**	**324**	**362**	**362**	**269**	**269**	**362**	**362**	**193**	**193**
Wald Chi2 (p-value)	Wald chi2(4) : 57.05 (0.0000)	Wald chi2(4) : 37.60 (0.0000)	LR chi2(4) : 56.89 (0.0000)	LR chi2(4) : 34.79 (0.0000)	Wald chi2(4) :40.89 (0.0000)	Wald chi2(4) : 39.67 (0.0000)	LR chi2(4) : 54.13 (0.0000)	LR chi2(4) : 37.23 (0.0000)	Wald chi2(4) : 31.94 (0.0000)	Wald chi2(4) : 18.28 (0.0011)	LR chi2(4) : 27.02 (0.0000)	LR chi2(4) : 15.33 (0.0000)
Pseudo R-square	0.236	**0.148**			**0.344**	0.2245			**0.2146**	**0.116**		
Log pseudolikelihood	-100.794	-112.416	-67.421	-78.471	-61.321	-72.522	-36.472	-44.921	-56.211	-63.265	-30.731	-36.577

Notes: Logit model estimates in columns 1, 2 and 5, 6. Fixed effects logit models in columns 3, 4 and 7,8. Dependent variable: probability of severe/dramatic debt deterioration or debt deterioration with sovereign financing problems. Logit models have robust variance covariance matrix (i.e., the Huber and White or sandwich estimator was used in order to get heteroskedastic-consistent standard errors). In the fixed effect logit regressions the observed information matrix was used to estimate the variance covariance matrix. The average marginal effect of the financial crisis indicator reports the marginal effect (dy/dx) on the debt deterioration from a discrete change from 0 to 1 of the financial crisis dummy variable. In the fixed effect logit regressions (columns 3, 4, 7 and 8) the average marginal effect corresponds to the probability of a positive outcome (debt deterioration) assuming that the fixed effect is zero. ***,**,* denote significance at 1%, 5%, and 10%, respectively

Table 8: Probability of debt deterioration with additional control variables

	1	2	3	4	5	6	7	8	**9**	**10**	**11**	**12**
Estimation	Logit		Logit -FE		Logit		Logit -FE		Logit		Logit -FE	
Dependent variable:	**Sharp debt deterioration**				**Dramatic debt deterioration**				**Debt deterioration with sovereign debt financing problems**			
Change in cyclically adjusted primary balance as a % of potential GDP (t-1)	-0.217 (-1.57)	-0.223 (-1.78)*	-0.030 (-0.26)	-0.103 (-0.93)	-0.395 (-2.37)**	-0.381 (-2.77)***	-0.039 (-0.23)	-0.185 (-1.18)	-0.449 (-3.33)***	-0.456 (-3.81)***	-0.355 (-1.69)*	-0.483 (-2.67)***
Output gap (t-1)	-0.233 (-2.34)**	**0**.103 (0.94)	-0.332 (-2.59)***	**0**.143 (1.50)	-0.122 (-0.96)	**0**.288 (1.73)*	-0.177 (-1.01)	**0**.333 (2.66)**	-0.187 (-1.92)*	-0.024 (-0.17)	-0.217 (-1.29)	-0.089 (-0.62)
Debt ratio (t-1)	**0**.006 (0.90)	**0**.008 (1.39)	-0.012 (-1.04)	**0**.001 (0.13)	**0**.007 (1.11)	**0**.009 (1.44)	-0.019 (-1.21)	-0.0004 (-0.03)	-0.006 (-0.71)	-0.005 (-0.51)	-0.029 (-1.37)	-0.015 (-0.83)
Change in real share prices (t-1)	-0.014 (-0.99)	-0.005 (-0.33)	-0.017 (-1.52)	**0**.0008 (0.07)	-0.017 (-0.73)	-0.002 (-0.06)	-0.025 (-1.67)*	**0**.001 (0.07)	**0**.011 (0.99)	-0.003 (-0.27)	**0**.012 (0.89)	-0.002 (-0.12)
Long term interest rate (t-1)	**0**.104 (1.01)	0.150 (1.50)	0.036 (0.30)	**0**.211 (1.89)*	**0**.281 (2.13)**	**0**.308 (2.47)***	-0.038 (-0.20)	**0**.241 (1.59)	-0.045 (-0.29)	-0.086 (-0.61)	-0.098 (-0.44)	-0.062 (-0.34)
Trade openness (t-1)	-0.018 (-2.23)**	-0.013 (-1.79)*	-0.079 (-2.48)**	-0.047 (-1.67)*	-0.012 (-1.46)	-0.007 (-0.75)	-0.147 (-2.56)**	-0.076 (-1.88)*	-0.005 (-0.71)	-0.0009 (-0.12)	-0.068 (-1.43)	-0.025 (-0.67)
Severe Financial Crisis (t)	3.314 (6.97)***		4.261 (5.61)***		4.006 (5.65)***		5.252 (4.64)***		2.510 (4.12)***		3.097 (3.42)***	
Severe Financial Crisis (t-1)		2.370 (3.88)***		3.328 (4.44)***		3.139 (3.18)***		4.301 (4.27)***		0.111 (0.16)		**0**.106 (0.10)
Constant	-2.889 (-2.55)***	-3.184 (-3.17)***			-5.609 (-5.90)***	-5.582 (-4.60)***			-3.113 (-2.40)**	-2.553 (-2.01)**		

Table 8: Continued

Average Marginal effect of severe financial crisis (t)	**0**.473 (6.13)***		**0**.297 (1.17)		**0**.399 (4.49)***		**0**.081 (0.73)		**0**.190 (2.73)***		**0**.083 (0.46)	
Average Marginal effect of severe financial crisis (t-1)		**0**.356 (2.87)***		**0**.523 (6.35)***		**0**.346 (1.90)*		**0**.524 (1.73)*		**0**.005 (0.15)		**0**.008 (0.10)
Obs.	**362**	**362**	**324**	**324**	**362**	**362**	**269**	**269**	**362**	**362**	**193**	**193**
Wald Chi2 (p-value)	Wald chi2(7) : 64.13 (0.0000)	Wald chi2(7) : 44.98 (0.0000)	LR chi2(7) : 68.89 (0.0000)	LR chi2(7) : 46.15 (0.0000)	Wald chi2(7) : 41.33 (0.0000)	Wald chi2(7) : 47.27 (0.0000)	LR chi2(7) : 68.77 (0.0000)	LR chi2(7) : 50.19 (0.0000)	Wald chi2(7) : 37.52 (0.0000)	Wald chi2(7) : 25.59 (0.0000)	LR chi2(7) : 30.21 (0.0000)	LR chi2(7) : 15.81 (0.0000)
Pseudo R-square	**0.2778**	**0.1839**			**0.3943**	**0.2724**			**0.2230**	**0.1188**		
Log pseudolikelihood	-95.296	-107.686	-61.421	-72.788	-56.647	-68.045	-29.149	-38.441	-55.606	-63.063	-29.138	-36.337

Notes: Logit model estimates in columns 1, 2 and 5,6. Fixed effects logit models in columns 3,4 and 7,8. Dependent variable: probability of severe/dramatic debt deterioration or debt deterioration with sovereign debt financing problems. Logit models have robust variance covariance matrix (i.e., the Huber and White or sandwich estimator was used in order to get heteroskedastic-consistent standard errors). In the fixed effect logit regressions the observed information matrix was used to estimate the variance covariance matrix. The average marginal effect of the financial crisis indicator reports the marginal effect (dy/dx) on the debt deterioration from a discrete change from 0 to 1 of the financial crisis dummy variable. In the fixed effect logit regressions (columns 3, 4, 7 and 8) the average marginal effect corresponds to the probability of a positive outcome (debt deterioration) assuming that the fixed effect is zero. ***,**,* denote significance at 1%, 5%, and 10%, respectively

Table 9: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Severe financial crisis	0.104	0.305	0	1
Change in the adjusted debt ratio	0.624	4.586	-12.027	21.054
Change in the cyclically adjusted primary balance as a % of potential GDP	-0.170	1.881	-13.737	7.345
Change in the primary balance as a % of GDP	-0.280	2.376	-15.896	9.134
Output gap	-0.268	2.339	-8.857	6.139
Debt ratio	70.688	31.586	13.743	199.969
Change in debt ratio	1.424	5.603	-11.727	27.353
Sharp debt deterioration	0.118	0.323	0	1
Dramatic debt deterioration	0.068	0.252	0	1
Debt deterioration with financing problems	0.047	0.212	0	1
Per centage change in real share prices	5.007	21.878	-45.523	95.432
Nominal long term interest rate	5.817	2.917	0.811	21.283
Change in nominal long term interest rate	-0.394	0.922	-6.382	3.918
Trade openness	71.696	34.991	16.012	183.102
Inflation rate (based on GDP deflator)	2.270	2.105	-5.554	15.651
Domestic credit to private sector as a % of GDP (World Bank)	111.940	48.546	27.938	235.932
Domestic credit to private sector as a % of GDP (Beck et al, 2010)	111.292	46.877	27.145	231.892

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