IMPLICATIONS FOR FISCAL POLICY
OF SUSTAINING A LARGE BANKING SECTOR

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"The sheer size of an object, institution or animal determined their structure[...] as their size rose, their structure needed to strengthen more than proportionately if they were to remain robust and resilient"

Andrew G Haldane, Executive Director, Financial Stability, Bank of England

This paper investigates common determinants of fiscal crises using a standard Early Warning System (EWS) approach, with a particular focus on the role of the financial sector. We find that the probability of a fiscal crisis decreases with the level of domestic credit (as a share of GDP), but that at very high levels of credit it starts to increase. The critical threshold above which an increase in the level of credit signals an increase in the likelihood of a fiscal crisis, appears to be country (or group) specific, rather than an absolute level valid across all countries as previous research on this issue seemed to suggest. The paper also presents some preliminary results suggesting that, to determine a country's vulnerability to fiscal crises, it might play a role whether the credit is provided to the real economy (e.g., households, non-financial corporations) as opposed to the financial sector. In fact, after controlling for the stage of financial development of a country, the likelihood of a fiscal crisis decreases with the ratio of credit to the real economy (as a share of GDP) and increases with the ratio of credit to the financial sector (as a share of GDP). Consistent with previous findings in this literature, we find that higher levels of gross government debt, larger budget deficits, lower GDP growth and a loss of competitiveness (at least for more advanced economies) increase the likelihood of a fiscal crisis. We also find that countries with larger negative Net International Investment Positions (NIIPs) are more vulnerable to fiscal crises, especially if the level of debt liabilities (as opposed to FDIs) is large. This paper does not, however, account for other important factors that are likely to have an impact on a country's vulnerability to a fiscal crisis. These include the strength and credibility of domestic institutions, the potentially stabilising role of an independent monetary policy, progress made on structural reforms; and other political economy factors. These limitations inevitably call for some care in assessing the key policy implications of this paper.

Introduction

The recent financial crisis has shown the limits of traditional debt sustainability analysis (DSA). First, focusing on a central case scenario and with a limited range of sensitivity tests that can be applied to the key variables, it cannot capture the impact of relatively unlikely, but large,

tail-risk events, such as bank recapitalisations or other large stock-flow adjustments.[1] Second, its focus of analysis (the debt-to-GDP ratio) is too narrow to assess the risk that countries might not be able to rollover their existing debt, which is a key source of vulnerability. There have been several attempts to overcome these limitations. For example, Early Warning Systems (EWS) for fiscal crises complement the evaluation of debt ratios with other macro-economic variables. Other research has focussed on the implications for fiscal policy of large contingent liabilities, in particular from the financial sector.

The purpose of this paper is twofold. First, it provides a review of the existing literature on contingent liabilities from the financial sector and their impact on the sustainability of public finances, including key stylised facts characterising the relationship between banking and fiscal crises. Second, it aims to contribute to the literature on early-warning indicators, assessing common determinants of fiscal crises, focusing in particular on the relationship between financial depth and fiscal crises. Importantly, this paper does not attempt to estimate the exact likelihood that a fiscal crisis will occur given a set of macroeconomic and financial variables, this would require controlling for other factors including the political economy factors, the strength and credibility of domestic institutions, the potentially stabilising role of an independent monetary policy and progress made on planned structural reforms; rather, its main objective is to explore what economic and financial variables are associated with fiscal crises and might be seen as a warning signal for possible future crises. Furthermore, this paper does not reach any definite conclusion on the direction of causality between the likelihood of a crises and the set of key variables investigated.

The main findings of this paper are as follows. First, the likelihood of a fiscal crisis declines with the level of domestic credit (as a share of GDP), a measure of financial depth. However, there is evidence of non-linear effects in the relationship between domestic credit and the occurrence of fiscal crises: at very high levels of credit, the probability that a crisis will occur starts to increase. The critical threshold of credit, above which it starts to signal an increase in the likelihood of a crisis, appears to be country (or group) specific, rather than an absolute level valid for all countries. We also find some preliminary evidence that the likelihood of a fiscal crisis increases with the level of credit to the financial sector and decreases with the level of credit to the real economy. Consistent with previous findings from the Early Warning Systems (EWS) literature, we find that higher levels of gross government debt, larger budget deficits, lower GDP growth and a loss of competitiveness (at least for more advanced economies) all increase the likelihood of fiscal crises. Finally, we find that large negative Net International Investment Positions (NIIPs) increase the likelihood of a crisis; and the composition of the external balance sheet is also important.

This paper does not, however, account for other important factors that are likely to have an impact on a country's vulnerability to a fiscal crisis. These include the strength and credibility of domestic institutions, the potentially stabilising role of an independent monetary policy, progress made on structural reforms; and other political economy factors. These limitations inevitably call for some care in assessing the key policy implications of this paper.

The paper is structured as follows. The first part presents the literature review. The second looks at some stylised facts regarding possible links between banking and fiscal crises. The third section investigates common determinants of fiscal crises using a probabilistic approach in a subset of advanced and emerging market economies. Finally, the last section draws together the key conclusions and policy implications of the paper, and suggests avenues for further work.

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[1]   The Irish sovereign debt crisis is an example of how a large banking sector can put at risk the sustainability of the public finances: Ireland's public debt ballooned from 25 per cent of GDP in 2007 to over 100 per cent in 2011, which caused the country to lose access to the markets and having to resort to an international package of financial assistance. Around thirty percentage points of this increase was due to more than €60 billion banking support measures provided by the government.

1 Literature review

There are two main strands in the literature on the fiscal implications of banking crises: a number of papers have investigated the transmission channels between banking and fiscal crises while more recent work has focused on the size of the financial sector and its role in the build-up of fiscal crises. This work considers how the ex-ante fiscal policy can reduce the impact of contingent liabilities from the financial sector and the likelihood that these might lead to a fiscal crisis. The following sections give an overview of the main findings from both strands.

1.1 From banking to sovereign crises

The literature on the relationship between the state and the banking system dates back at least to the time of the Italian banking houses in the 13th century when banks were financiers of the sovereign. As shown by Alessandri and Haldane (2009), this relationship has evolved over time, with "the Great Depression marking a regime-shift in state support to the banking system". Before it was the banks supporting the state, after it has become common for the state to act as a lender of last resort for the banks. If large, systemically important financial institutions face the risk of bankruptcy, governments have little option other than to provide the required financial support if they want to preserve the stability of the financial system. But there are other channels through which weaknesses in the banking sector can be transmitted to the sovereign: for example, a deterioration of bank balance sheets could constrain their ability to lend to the real the economy or reduce the investor base for government bonds. Furthermore, a rapid expansion of the financial sector could boost government revenues over and above normal cyclical fluctuations, with the apparent strength of public finances allowing governments to justify permanent increases in spending, which may lead to unsustainable fiscal positions once such revenues suddenly disappear.

In several cases, the economic effects of banking crises have been so large as to lead to state default.[2] De Paoli *et al.* (2009) found a strong correlation between banking and sovereign crises, finding that two thirds of sovereign defaults in their sample overlap with banking crises, and almost half of these episodes overlap with both banking and currency crises.[3] Reinhart and Rogoff (2009) found that government debt grew on average by 86 per cent in the major post-World War II banking crisis episodes. Such increases are, however, only partly justified by the direct costs of "bailing-out" the banks, the main cause being indirect costs such as a sharp decline in tax revenues and/or increase in government spending.[4] Bénassy-Quéré and Roussellet (2012) have estimated the gross fiscal costs of a set of 60 systemic banking crises involving 51 different countries from 1977 to 2007, finding an average cost of 14.3 per cent of GDP. Laeven and Valencia (2012) find that, of the banking crises included in their sample, 5 per cent are followed by a sovereign debt crisis within three years, whereas only 1 per cent are preceded by a sovereign debt crisis in the previous three years.

Recent experience has also emphasised that there are important feedback loops between the sovereign and the banking sector. There are several channels through which the sovereign and the

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[2] As noted by Reinhart (2009), "Sharp economic downturns follow banking crises; with government revenues dragged down, fiscal deficits worsen; deficits lead to debt; as debt piles up rating downgrades follow. For the most fortunate, the crisis does not lead to the deadliest D: default, but for many it has".

[3] The probability of a banking crisis occurring in the same year or after a default is 0.46 in their sample of crises. Output losses after a default last about 10 years, and are larger in the event of a triple crisis.

[4] Indeed, they note that "the main cause of debt explosions is not the widely cited costs of bailing-out and recapitalising the banking system, [but] 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".

banking sector could influence each other.[5] For example, an increase in sovereign risk could push up bank funding costs because of a deterioration of the perceived ability (or willingness) of the sovereign to support the banks, or because banks are forced to record a loss in the domestic and foreign sovereign portfolio. Studying a sample of 534 unsecured fixed-rate senior banks bonds from 116 banks in 14 advanced countries in 2010, BIS (2011) concluded that about 30 per cent of the spread at the launch of the bonds depended on the conditions of the sovereign, reaching 50 per cent for countries under severe fiscal strain. In more "normal" times, they find that bank-specific factors have a more prominent role in determining bank funding costs.

1.2   Fiscal risks from a large financial sector

Systemic banking crises have been frequent around the world, carrying fiscal costs which ultimately lead to large increases in public debt.[6] According to recent research by Laeven and Valencia (2012) on over 147 banking crisis episodes globally, the median increase in public debt associated with banking crisis episodes – which reflects both direct (e.g., recapitalization, liquidity) and indirect *(i.e.*, subsequent falls in GDP and government revenues) costs – is close to 20 per cent of GDP, although there is a large variation across countries. Further evidence (Tagkalakis, 2012) suggests that the increase in public debt tends to be related to the size of the financial sectors: countries with large financial sectors saw their debt increase on average between 4.2 and 5.3 per cent of GDP, compared to between 1.4 and 1.7 per cent for those with smaller financial sectors.[7]

The financial sector has recently become more important in determining the markets' perception of a country's vulnerability to fiscal crises. Mody (2009) showed that US intervention in support of Bear Stearns in 2008 strengthened the link between financial sector variables and sovereign spreads. Gerlash *et al.* (2010) found that the size and structure of the banking system are important determinants of sovereign risk premia during periods of financial crisis; and that countries with large banking systems, especially those with low equity ratios, tend to experience higher yield spreads when aggregate risk increases. Mody and Sandri (2011) found that the vulnerability of domestic banks is an important driver of sovereign spreads and that this relationship tends to be stronger for countries with high debt-to-GDP ratios.

The traditional literature on financial deepening suggests that more credit in the economy should lead to better economic performance. For example, in a cross-country study, Beck and Levine (2004) found that financial deepening has a positive effect on medium-term growth. However, this conventional wisdom has recently been called into question. Recent IMF research (Arcand, Berkes and Panizza, 2012) suggests that, whilst financial deepening is positive for growth, at high levels of private credit-to-GDP, it could start to have a negative impact. The threshold appears to be at levels of private credit of 80-100 per cent of GDP. This finding is consistent with earlier cross-country studies (Easterly, Islam and Stiglitz, 2000) which suggested that output volatility tends to increase at credit-to-GDP ratios above unity. Since this threshold is well below the levels of financial depth in most advanced economies, this finding would suggest that the banking sector could be acting as a drag on medium-term growth in these countries.

Finally, Taylor and Schularick (2012) found that financial crises, recessions and recoveries are more painful than normal recessions and that there is a close correlation between the build up of credit in the expansion and the severity of the subsequent recession: the more excess-credit in the

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[5]   For an in-depth discussion of these channels, see BIS (2011).

[6]   On the costs of banking crises see also OECD (2009) and the Independent Banking Commission (2011).

[7]   Large is defined as private sector domestic credit relative to GDP above 120 per cent (small is below 120 per cent).

expansion, the worse the recession and subsequent recovery seems to be. This result is robust to the inclusion of several macro control variables such as current account and real investment per capita.

Recent research has also focussed on the role of fiscal buffers in mitigating the fiscal consequences of bankruptcies and banking sector crises. In a review of the experience of five economies with large financial sectors relative to GDP during the recent financial crises (Hong Kong SAR, Iceland, Ireland, Singapore and Switzerland), the IMF (2010) concluded that one of the reasons why Hong Kong SAR and Singapore managed to escape from the crisis relatively unaffected was that they had developed prudent fiscal buffers. By contrast, bubble-related revenues in Iceland and Ireland in the pre-crisis period obscured weaknesses in the underlying fiscal position. Switzerland, which was running a significant structural budget surplus, also experienced limited negative consequences from the crisis. In their analysis of tax gaps, Bénassy-Quéré and Roussellet (2012) also found that these increase with the level of contingent liabilities, suggesting that more prudent fiscal policy could reduce the likelihood of debt becoming unsustainable following a banking crisis. Without diminishing the role of fiscal buffers in mitigating these countries' vulnerability to the financial crisis, the IMF (2010) also recognises that there were several other important factors that might have contributed to insulating Asian economies from the risk of a fiscal crisis, including a large positive net international investment position, a large stock of international reserves (as a share of GDP), a banking sector with a relatively well diversified funding structure and more effective financial market regulation and supervision.[8]

2 From banking to fiscal crises: stylised facts

This section provides some stylised facts about the relationship between banking and fiscal crises. The aim is twofold. First, to identify how often a banking crisis is associated with a fiscal crisis and whether fiscal crises tend to occur before, at the same time, or after the banking crises. Second, to provide a preliminary assessment of whether key macroeconomic and financial variables behave differently in cases where a banking crisis eventually leads to a fiscal crisis compared to when it does not. In fact, as it will become evident later on in the paper, traditionally in the Early Warning System (EWS) literature the whole duration is used between in the estimation phase, to increase the sample size. This makes it very difficult to determine whether the fiscal crisis had started before, in the same year, or after the banking crisis occurred. On the contrary, in the descriptive analysis presented, each crisis episode counts as one data point, which allows us to shed some light on the direction of causality between banking and fiscal crises.

2.1 Defining banking and fiscal crisis

There are several approaches used to identify banking crisis episodes. We follow the approach used by Laeven and Valencia (2012), which identifies a systemic banking crisis when the following two conditions occur simultaneously: (i) significant signs of financial stress in the banking system (e.g., bank runs, liquidations, etc.); and (ii) significant policy intervention in response to losses in the banking system (*i.e.*, when there have been at least three out of six possible interventions identified by the authors, which include restructuring of banks, injections of

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[8] Other factors that could make an economy (especially with a large banking sector) particularly vulnerable to episodes of crises are large cross-border banking systems, issuing a (non-reserve) currency or adopting a reserve currency as its legal tender.

liquidity). With this definition, the authors found 147 banking sector crises in over 100 countries over the period 1970-2011.[9]

For these countries, we constructed a binary indicator of fiscal crises following the definition by Baldacci *et al.* (2011) and European Commission (2012). We identify a fiscal crisis when at least one of the following conditions is satisfied: (i) IMF programme (not precautionary) of more than 100 per cent of quota; (ii) public debt default is reported based on Standard & Poor's definition, or a restructuring/rescheduling is reported; (iii) sovereign spreads relative to US comparable bonds more than two standard deviations above long-term average, highlighting significant market financing pressure; and (iv) inflation above 35 per cent for advanced economies (AE) and 500 per cent for emerging markets (EME), capturing an implicit default event. Our indicator covers a larger number of countries than Baldacci (2011) or European Commission (2012). However, for available countries, we obtain results in line with previous estimates (full list of fiscal crises in Annex 2).

We found that, of the 147 episodes of banking crises, 79 were associated to the occurrence of a fiscal crisis.[10] In 28 cases the fiscal crisis preceded the banking crisis; in 20 they started in the same year. Using data from Laeven and Valencia (2012) and IMF WEO (2012), we then assessed the performance of a number of key macro variables across the different banking crisis episodes, investigating whether their behaviour changes when these are also associated with a fiscal crisis.[11] As is evident from Figure 1a, output loss, direct fiscal costs (e.g., to recapitalise the banks), liquidity support, Non-performing Loans (NPLs) and Increase in public debt, were all higher when there is a banking and a fiscal crisis. To account for the risk of endogeneity (*i.e.*, that the fiscal crisis preceded the banking one), we also ran the analysis excluding the cases in which there was already a fiscal crisis in place, and in fact found that in this case (Figure 1b) the differences in the other macroeconomic variables are even more accentuated.[12]

We then considered a different sets of macroeconomic and financial variables, from the IMF World Economic Outlook (WEO) and found that (see Figures 2a and 2b) countries that experienced a fiscal crisis following a banking crisis had a more negative Net Investment International Position (NIIP) than those that did not, and higher level of public debt (even if the difference is less evident than in the case of the NIIP).[13] Finally, we found that, among the countries that experienced a banking crisis, those that also experienced a fiscal crisis tended to have lower levels of domestic credit (as a share of GDP), particularly in these countries where the fiscal crisis preceded the banking one (see Figure 2b on the right). This seems to confirm some of the early findings in the literature on the stabilising role of greater financial deepening.

However, we also found that higher levels of domestic credit also tend to be associated with higher direct fiscal costs of a banking crisis (Figure 3a, left), which in turn lead to larger contractions in output (Figure 3b, right). This relationship seems to be even more evident when the banking crisis is associated with a fiscal one (dotted line). This suggests that the relationship

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[9]   Another possible definition is the one by Reinhart and Rogoff (2011), who mark a banking crises as two types of events: (i) bank runs that lead to the closure, merging or takeover by the public sector of one or more financial institutions; or (ii) closure, merging, takeover, or large-scale government assistance of an important financial institution that marks the start of a string of similar outcomes for others. With these criteria, they identify 66 cases between 1945 and 2007.

[10]   Our definition of fiscal crises is different than the one used by Laeven and Valencia (2012), which is one reason why their conditional probability of fiscal crises given a banking crisis is lower.

[11]   To eliminate the impact of possible outliers, for each of the regressors we have excluded observations higher or smaller than the average by three standard deviations.

[12]   One caveat in our analysis is related to the use of annual data. This allows us to control for whether the crises took place in the same or in different years, but within the same year we are not able to do so. Therefore, among the "same year" category, it is still possible that the fiscal crisis would have preceded the fiscal one. But with annual data this is a difficult limit to overcome.

[13]   While we do not show this in the figure for scale reasons, also the current account balances tend to me more negative when a banking crisis is accompanied by a fiscal crisis (–5 per cent of GDP) than when it is not (–2 per cent of GDP)

Figure 1
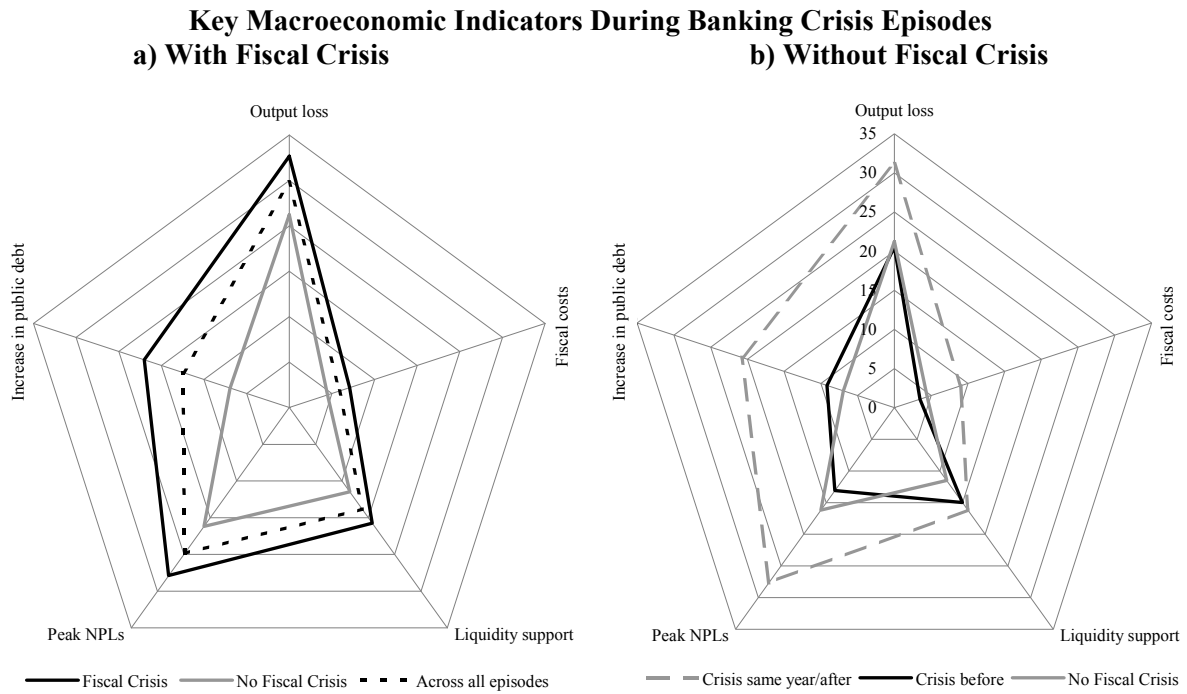
Key Macroeconomic Indicators During Banking Crisis Episodes
a) With Fiscal Crisis   **b) Without Fiscal Crisis**

Source: Authors' calculations from Laeven and Valencia (2012).

Figure 2

Other Macroeconomic Indicators During Banking Crisis Episodes
a) With Fiscal Crisis   **b) Without Fiscal Crisis**
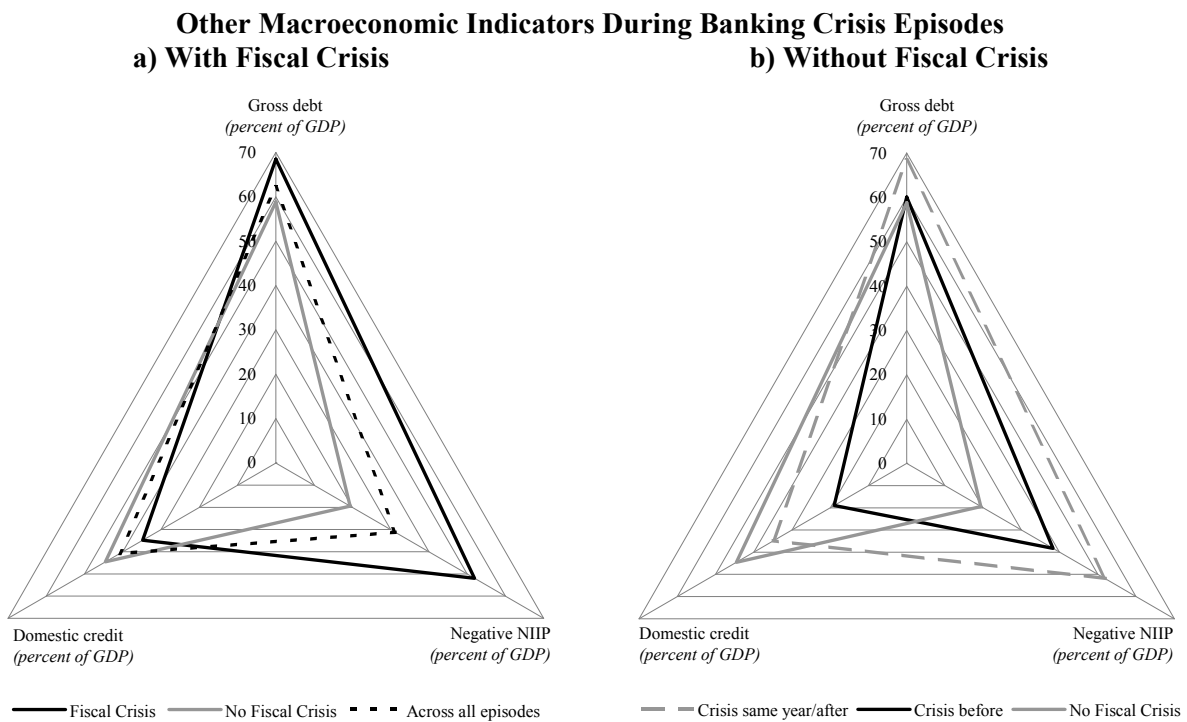
Source: Authors' calculation from IFS (Datastream) and WEO.

Domestic Credit, Direct Fiscal Costs and GDP During Banking Crises
(percent of GDP)
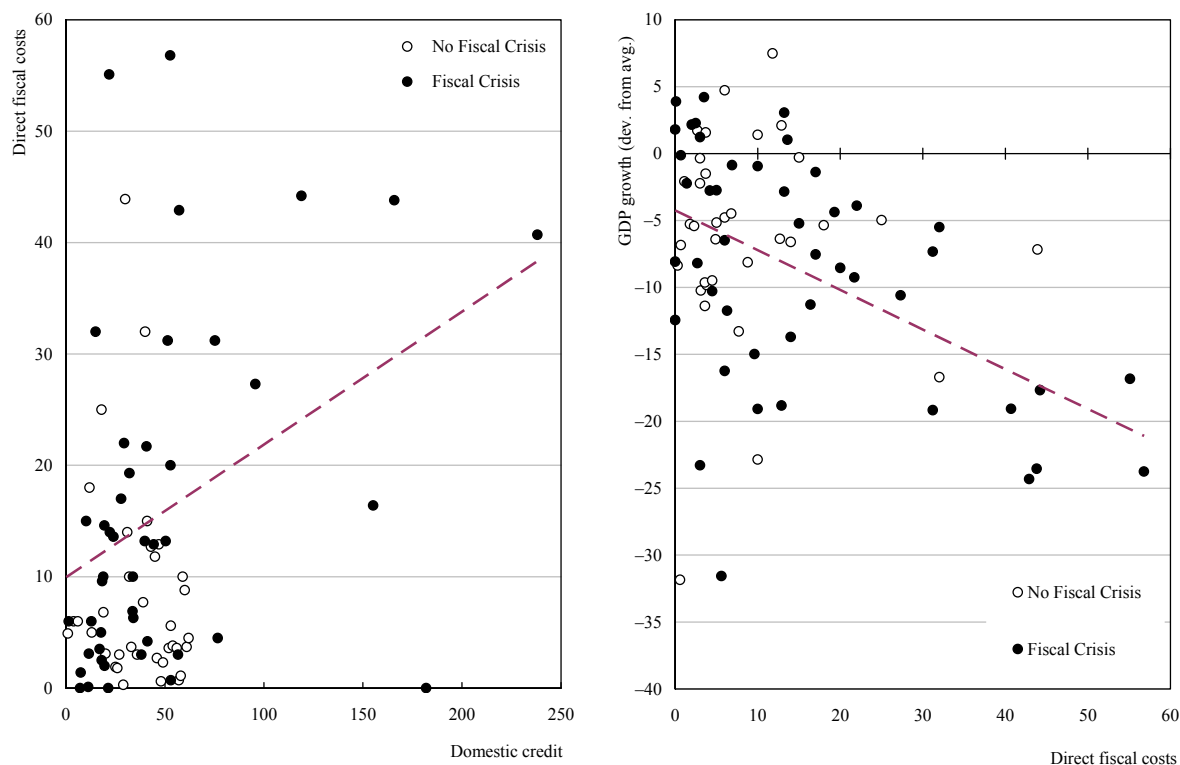
Source: Authors' calculations from Laeven and Valencia (2012), IFS (Datastream) and WEO.

between the level of domestic credit and the likelihood being affected by a fiscal crisis might be more complex, which will be explored later on.

Finally, we investigated whether the likelihood of a fiscal crisis is influenced by whether credit is provided to the real or financial sector of the economy. Theory predicts that credit should be a stabilising influence if it is provided to the productive sectors of the economy, but that when it is provided to the financial sector it could become destabilising. Using data from the McKinsey Global Institute (MGI), we distinguish between credit provided to the "real" economy and to financial institutions.[14] As shown in the Figure 4, countries that have experienced banking and fiscal crises (Ireland and Greece) had previously experienced an impressive growth in financial assets. Conversely, a country such as Switzerland, which also has a very high level of overall credit but experienced much less significant growth in the exposure of financial institutions to financial sector bonds, managed to escape the worst consequences of the crisis.

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[14]   According to definition provided by MGI, credit to households and non-financial companies, intermediated through banks and capital markets, include: for households, mortgages and other loans from banks and other financial institutions (auto loans, student loans, credit card debt and home equity lines of credit); for non-financial corporations, loans from banks and non-bank financial institutions (lines of credit, commercial paper, and all corporate bonds). Equity market capitalisation of listed non-financial corporations is also included. Credit to financial institutions includes tradable securities issued by banks and other financial institutions to fund their own operations (commercial paper, bonds and asset-backed securities issued by financial institutions). Stock-market capitalization of financial institutions listed on stock exchanges is also included whereas interbank loans are excluded.

Figure 4

Bank Assets Split into Credit to the Real Economy and Financial Assets: Selected Countries

Greece

Ireland

Switzerland
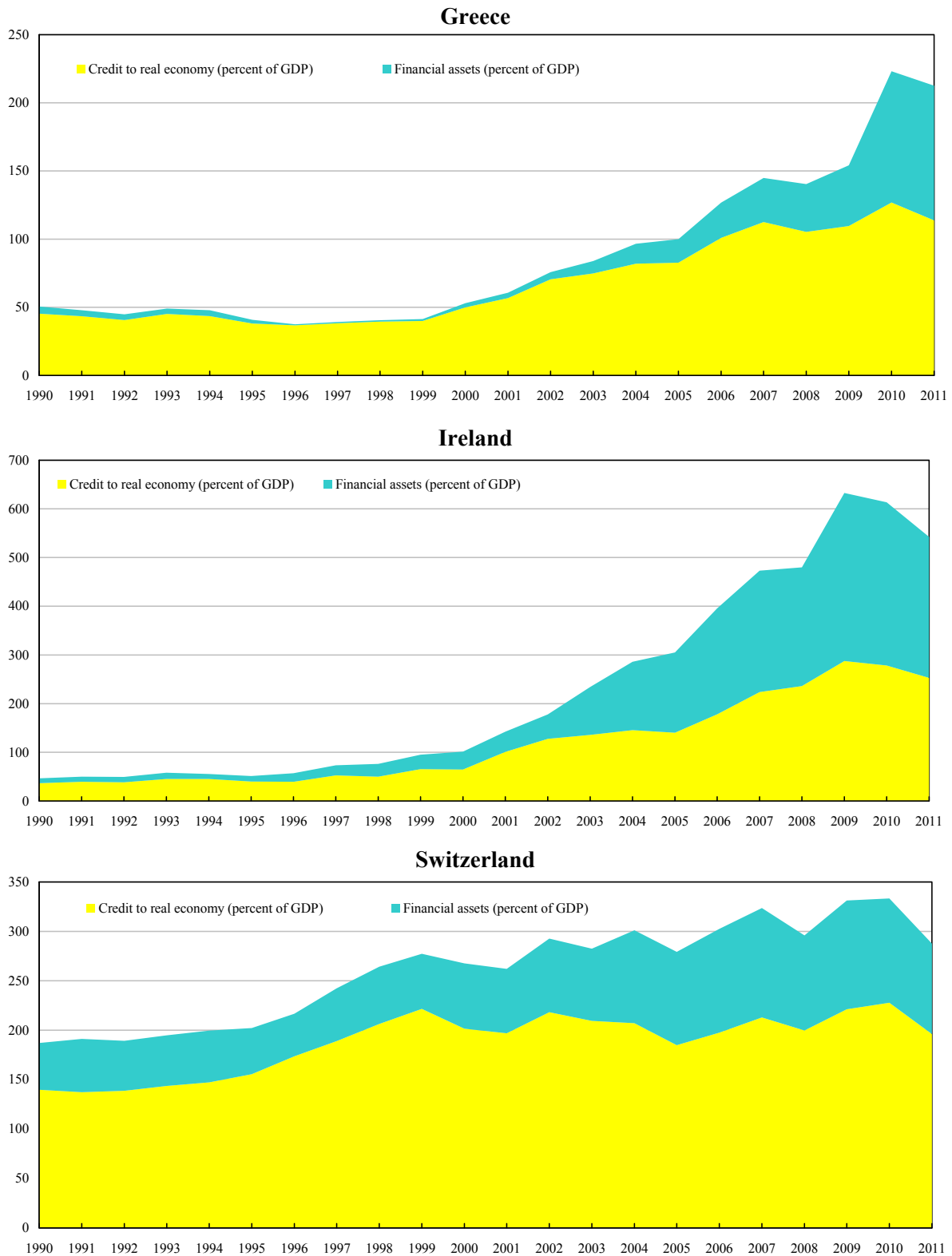
Source: authors' reelaboration from McKinsley Global Institute (MGI).

3   Econometric analysis

In this section, in line with traditional EWS literature, we assess the common determinants of fiscal crises conditional on a set of macroeconomic and financial variables. Our dataset comprises annual data for a sample of 60 emerging and advanced economies over the period 1980-2012 (due to data constraints, we have considered a subset of the countries in the previous section).[15] The majority of the data are taken from the IMF's *World Economic Outlook* (WEO) and the IMF's *International Financial Statistics* (IFS).[16]

The estimation technique used is a standard probabilistic framework, following Verbeek (2004). We used a pooled logit model to estimate the probability of a fiscal crisis conditional on a set of explanatory variables (full details of the estimation technique are presented in Annex 1). The endogenous variable (Y) is a binary variable that takes the value of 1 in periods when a fiscal crisis occurs and 0 otherwise. Consistent with the earlier EWS literature (and differently than what we did previously when assessing some of the stylised facts) the fiscal crisis dummy equals 1 for the whole duration of the crisis. The vector of explanatory variables consists of quantitative (e.g., macroeconomic and financial) as well as qualitative (e.g., a dummy variable for emerging vs. advanced economies) indicators. Overall, we identified 84 episodes of fiscal crisis in the 60 countries, of different duration (full list of fiscal crisis presented in Annex 2).

This probabilistic approach allows us to fully exploit the cross-sectional and time-series information contained in the panel data set, to test the statistical significance of individual variables and also take into account the correlation between variables, which would not be possible if each control was introduced separately as is the case with the so-called "signalling" approach to fiscal crisis.[17] Binary choice models do, however, also present drawbacks, which will be discussed later in the paper.[18]

3.1   *Results*

The estimation procedure consists of two steps. First, we assess the ability of each variable individually to explain fiscal crises. Table 1 presents the full list of variables, reporting expected and actual signs. The expected signs are based on previous findings from the EWS literature on fiscal crises, as well as the stylised facts presented above. As shown in the table, the results are in line with the *a priori*.

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[15]   Our sample includes 60 countries, 32 advanced economies in the OECD (Australia, Austria, Belgium, Bulgaria, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, Great Britain, Greece, Hungary, Ireland, Iceland, Italy, Japan, Latvia, Lithuania, Netherland, Norway, New Zealand, Poland**,** Portugal, Romania, Slovenia, Slovak Republic, Sweden, USA) and 28 Emerging Economies from the JP Morgan *EMbig* Index (Argentina, Brazil, Chile, China, Colombia, Ecuador, Egypt, Hong Kong, Indonesia, India, Israel, Korea, Morocco, Malaysia, Mexico, Nigeria, Pakistan, Panama, Peru, Philippines, Russia, Singapore, El Salvador, South Africa, Thailand, Turkey, Uruguay and Venezuela). To eliminate the impact of possible outliers, for each of the regressors we have excluded observations higher or smaller than the average by three standard deviations.

[16]   Data for the external balance sheet variables are from Lane and Milesi-Ferretti (2010) while data on domestic credit are from the financial structure database developed by Beck *et al*. (2012) and from the World Development Indicators (WDI) of the World Bank. Finally, the split of banks' assets between credit to the real economy and financial assets is courtesy of MGI.

[17]   This non-parametric approach is followed, among others, by the European Commission (2012).

[18]   One drawback worth mentioning here is the incidental parameter, which arises in every fixed-effects model. This type of model accounts for heterogeneity $(\varepsilon \neq 0)$ treating the constant heterogeneous term ε as a fixed unknown parameter, by including N dummy variables in the model. However, the process of estimation of β and ε provide consistent results only under the assumption that the number of periods T goes to infinity. Therefore, the incidental parameter problem arises because for fixed T, the number of parameters grows with the sample size N. This problem is extensively discussed in Greene (2002).

Table 1

Single Variables Regressions

Indicator	Expected Sign	Actual Sign
International reserves *(percent of GDP)*	–	– (***)
REER annual change	+	– (*) + for AEs only (***)
REER two year change	+	– () + for AE only (***)
Real GDP annual change	–	– (***)
Real GDP two year average (before crisis)	–	– (***)
Real GDP Dev. from trend (after crisis)	–	– (**)
Change in revenue *(percent of GDP)* (t+1, t–1)	+	+() Significant at 15%
Gross Debt *(percent of GDP)*	+	+ (***)
Budget Balance *(percent of GDP)*	–	–(***)
Current account *(percent of GDP)*	–	– (***)
Avg. 2 year change CA before event	–	– ()
Net International Investment Position *(percent of GDP)*	–	– (***)
Bank deposit *(percent of GDP)*	–	– (***)
Domestic Credit *(percent of GDP)*[19]	–	– (***)
Change in Domestic Credit *(percent of GDP)*	–	– (***)
Financial liberalisation (A+L, *percent of GDP*)	–	– (**) >150% + (***)
FDI *(percent of total liabilities)*	–	– (***)
Debt liabilities *(percent of total liabilities)*	+	+ (***)

We then estimated the likelihood of a fiscal crisis conditional on a set of explanatory variables. We started from a wide selection of possible variables, deleting stepwise the ones that were not statistically and economically significant until we reached a satisfactory model specification. Table 2 below reports the most parsimonious model specifications (the actual STATA output with the value of the parameters is reported in Annex 3).

The most notable results are as follows. First, in all model specifications (1-6), domestic credit (as a share of GDP) is highly significant and reduces the likelihood of a fiscal crisis. This provides support for the idea, presented in the literature review, that a high degree of financial depth has a stabilising effect. However, our results also show that at very high levels of domestic credit, the probability of a fiscal crisis increases. This is shown by the highly positive and statistically significant quadratic term (specifications 3-6). We also found that the deviation from the country-specific average is positive and significant. This suggests that the critical level of

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[19] Refers to financial resources provided to the private sector (e.g., loans, purchases of non equity securities, and trade credits and other accounts receivable), that establish a claim for repayment. For some countries includes credit to public enterprises.

Summary of Econometric Results for Different Model Specifications (1-6)

Y = Probability of Fiscal Crisis	1	2	3	4	5	6
GDP Growth	_ ***	_ **	_ *	_ *	_	_ *
Net International Investment Position *(percent of GDP)*	_ ***	_ ***	_ ***	_ ***	_ **	_
Domestic Credit *(percent of GDP)*	_ ***	_ ***	_ ***	_ ***	_ ***	_ ***
Gross Government Debt *(percent of GDP)*	+ **					
Debt liabilities *(percent of total external liabilities)*		+ ***	+ ***	+ ***	+ ***	+ ***
Domestic Credit *(percent of GDP)*, squared			+ ***	+ ***	+ **	+ **
DC deviation from country-specific average				+ ***	+ **	+
Banking crisis (LV) dummy					+ ***	+ ***
EME dummy						+ ***
Pseudo R^2 [20]	0.16	0.19	0.20	0.21	0.25	0.28
Observations	1017	1435	1435	1428	1428	1435

domestic credit, above which the likelihood of a fiscal crisis starts to increase, may be specific to each country, as suggested in some of the earlier literature.

Second, there is evidence that the probability of a fiscal crisis increases as a country's NIIP (as a share of GDP) becomes more negative. This confirms one of the stylised facts identified in the previous sections, and suggests that external imbalances are a very important source of fiscal vulnerability. We also find that (specifications 2-6) the probability of fiscal crisis increases with the share of debt in total external liabilities and decreases with the share of Foreign Direct Investments (FDIs) in Total External Liabilities. A possible reason could be that FDI provides a more stable source of financing for a country's external liabilities. Third, the probability of a fiscal crisis increases with the level of government gross debt (as a share of GDP), suggesting that fiscal variables matter for a country's vulnerability to fiscal crisis. Unfortunately, we could not include this variable in all model specifications because it reduces the sample size significantly. Real economy variables also play a key role: high real GDP growth reduces the probability that a country will be affected by a fiscal crisis. Fourth, the banking crisis dummy is positive and significant (specification 5). However, as previously mentioned, in this approach it is not possible to identify the direction of causality. The emerging economies dummy is also positive and significant (specification 6), suggesting that these economies are, in general, more vulnerable to fiscal crises.

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[20] The joint hypothesis that all the coefficients are zero is examined using a chi-squared test. In order to approximate the explanatory power of the model, the value of the likelihood function for the full model as well as for the model with the constant only are considered and pseudo R-squared is computed.

Table 3

Regression Results with the Inclusion of Credit to the Real Economy vs. Financial Sector

Y = Probability of a Fiscal Crises	Coefficient[21]	*Z*-test
Net International Investment Position *(percent of GDP)*	–0.22	–5.11 (***)
GDP growth	–0.13	–3.93 (***)
Credit to the "real" economy *(percent of GDP)*	–0.32	–6.34 (***)
Financial sector bonds *(percent of GDP)*	0.23	3.83 (***)
Share of financial sector bonds over total assets	–4.39	–3.65 (***)
	Pseudo R^2	0.21

Finally, using the dataset provided by MGI, we also tested whether the split between credit to the real economy and the financial sector plays a role in determining the likelihood of a fiscal crisis. As we only have data from 1990 to 2011, adding this variable to the previous model specification reduces the sample size significantly. We have therefore run this regression separately, looking for the most parsimonious model specification; and not included it in the set of model specification presented in Table 3.

Similarly to the previous model specifications, large negative NIIPs increase the likelihood of a fiscal crisis, as does GDP growth. The level of credit to the "real" economy reduces the likelihood of a fiscal crisis. However, the level of credit to the financial sector (as a share of GDP) increases the likelihood of a crisis, while the share of credit to the financial sector over total credit reduces the likelihood. Interpreting these results is not straightforward. One plausible interpretation is that, after controlling for the "stage" of financial development of each country (for which the share of credit to the financial sector over total credit seems to be a good proxy) higher levels of credit to the financial sector increase the likelihood of a fiscal crisis. Controlling for the stage of financial development seems justified, since we have observed previously that emerging economies, that tend to have much lower ratios of credit to the financial sector, also exhibit a higher unconditional probability of a fiscal crisis to occur. Whilst still preliminary, these results appear to be very interesting and merit further work.

3.2 *Robustness results and limits*

We have undertaken a number of robustness tests and our results are robust to all the tests performed. First, we re-estimated the most parsimonious pooled logit model with a pooled probit; and with/without Huber-White robust standard errors to account for possible heteroskedasticity in the estimated residual. Second, the most parsimonious model was also re-estimated using a random

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[21] The estimated coefficients in a binary regression are related to the effect of the independent variables on the estimated probability but they cannot be directly interpreted as changes in the dependent variable as a result of a change in the explanatory variable. The marginal impact of a change in one explanatory variable depends on the values of other variables as well as the value of this variable. To study the magnitude of the impact of a marginal change in an independent variable, marginal impacts can be derived at different levels of the explanatory variables (e.g., mean, median and given percentile, etc).

effect probit estimator to fully exploit the cross-sectional and time-series information contained in the panel data set. This approach is also free from the incidental parameters problem and provides unbiased estimates in the presence of heterogeneity of the country-specific term.[22] In particular, it specifies this term as randomly distributed across cross-sectional units. However, it relies on the very strong assumption that the country-specific term (εi) is uncorrelated with the regressors (X).

Third, we estimated the most parsimonious model in the advanced economies and emerging market sub-sample, using an alternative fiscal crises index obtained using a different definition of fiscal crises including Baldacci *et al.* (2011a); and using a different definition of domestic credit as a share of GDP.

However, of course some weaknesses remain. First, our approach does not account for other important dimensions that could reduce a country's vulnerability to a fiscal crisis. These include political economy factors, the strength and credibility of domestic institutions, the potentially stabilising role of an independent monetary policy and progress made on planned structural reforms.

Furthermore (and as mentioned previously this is a limit of all traditional EWS literature), our results have been obtained assuming that the fiscal crisis dummy maintains a value of 1 for the whole duration of the crisis. However, this leads to some problems. One, identified by Ciarlone and Trebeschi (2006), is the so-called "post-crisis bias." This is the risk of confusing the behaviour of explanatory (macroeconomic and financial) variables which are meant to predict a fiscal crisis, with the behaviour associated with the adjustment process after the crisis.[23] Another is the possible exacerbation of the endogeneity problem. In the years following the start of a crisis, the explanatory variables (Xs) are likely to be correlated with the Ys (fiscal crises). In order to mitigate these problems, we ran regressions where the dependent variable Y was set equal to 1, rather than in the years of the crisis itself, in the year before the crisis, in the two years before the crisis and in the three years before the crisis; and the results remained broadly unchanged.[24]

It is also worth referring back to the evidence from the stylised facts presented earlier in the paper, where, using one single data point for each crisis episodes, we could distinguish whether a fiscal crisis started before, in the same year or after the banking crisis. The findings on the behaviour of key macroeconomic and financial variables were broadly consistent with the results of the econometric analysis in the last section, which provides some reassurance on the robustness of these results to the endogeneity problem.

4   Conclusions, main policy implications and next steps

This paper investigates common determinants of fiscal crises using a standard Early Warning System approach; and especially the role of the financial sector. The main finding of the paper is that a high level of domestic credit (as a share of GDP) is associated with a lower likelihood of a

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[22]   The incidental parameter arises in every fixed-effects model. This type of model accounts for heterogeneity *(ε ≠ 0)* treating the constant heterogeneous term *ε* as a fixed unknown parameter, by including *N* dummy variables in the model. However, the process of estimation of *β* and *ε* provide consistent results only under the assumption that the number of periods *T* goes to infinity. Therefore, the incidental parameter problem arises because for fixed *T*, the number of parameters grows with the sample size *N*. This problem is extensively discussed in Greene (2002).

[23]   The logit approach to the EWS literature cannot distinguish between the behaviour of the regressors in the run up to a crisis and during the post-crisis adjustment period. An alternative approach is the one followed by the Commission (2012), *i.e.*, to use a non-parametric approach based on the so called "signalling" approach, taking each single regressor individually. But this has other drawbacks, such as for example not being able to take into account the interaction between different regressors.

[24]   This is *de facto* equivalent to using lagged regressors as instruments for the regressors. Another possible way to account for the "post-crisis bias" is the approach followed by Ciarlone and Trebeschi (2006) who used a multinomial approach to distinguish between periods building up to a fiscal crisis, and periods of adjustment after the crisis hit.

fiscal crisis. However, there is preliminary evidence of non-linear effects in the relationship between domestic credit and fiscal crises. At very high levels of credit, the probability of a fiscal crisis starts to increase. The critical threshold of credit, above which it starts to signal an increase in the likelihood of a crisis, appears to be country (or group) specific, rather than an absolute level valid for all countries as some of the previous evidence from the literature seemed to suggest.

We also found some preliminary evidence that whether the credit is provided to the real economy (e.g., households, non-financial corporations) as opposed to the financial sector might play a role in determining a country's vulnerability to fiscal crises: after controlling for the stage of financial development of a country (measured by the share of financial sector bonds over total assets), a higher level of credit to the real economy is associated with a lower likelihood of a fiscal crisis. By contrast, the likelihood of a fiscal crisis increases with the ratio of credit to the financial sector.

Furthermore, we found that large negative Net International Investment Positions increase the likelihood of a fiscal crisis and that the composition of the external balance sheet is important: financing large external liabilities through debt leaves a country more vulnerable than FDIs. Finally, consistent with previous findings from the Early Warning Systems (EWS) literature, we also found that higher levels of gross government debt, larger budget deficits, lower GDP growth and a loss of competitiveness (at least for more advanced economies) increase the likelihood of fiscal crises.

This paper does not, however, account for other important factors that are likely to have an impact on a country's vulnerability to a fiscal crisis. These include the strength and credibility of domestic institutions, the potentially stabilising role of an independent monetary policy, progress made on structural reforms; and other political economy factors. These limitations inevitably call for some care in assessing the key policy implications of this paper.

From a policy point of view – notwithstanding the caveats mentioned above – our results support previous findings from the literature on fiscal crisis, that large fiscal buffers are important in reducing the risk of a fiscal crisis. However, they are not sufficient. The occurrence of a large banking sector crisis might put at risk the sustainability of public finances, regardless of the initial position. Therefore, the findings of this paper emphasise the importance of macro-prudential policy in reducing the likelihood of banking crises and the risk they pose to the sovereign by breaking possible feedback loops. Governments should also be realistic in assessing the impact of financial sector cycles on the economy (and on the Government's revenues); and consider policies to avoid the build up of excessive external imbalances.

There are several directions for future work. First, we could further investigate the relationship between financial depth and the likelihood of a crisis, especially focusing on the role played by the funding strategy (e.g., wholesale vs. deposits). Second, one focus of the literature on contingent liabilities from the financial sector to date (Bénassy and Roussellet, 2012) has been to investigate the relationship between the size of these liabilities and the fiscal surpluses that a country should run to create the adequate fiscal buffer. While these are certainly useful steps forward in assessing the sustainability of current fiscal policies, one of the limits of this approach is that it disregards likely non-linearities in the transmission mechanism between the materialisation of the contingent liabilities from the financial sector and the occurrence of a fiscal crisis. One interesting development of this literature would be to integrate this analysis with the one on the fiscal space literature (IMF, 2011a), for example using a probabilistic approach to analyse the likelihood that, if these liabilities materialise, a country might hit their debt ceiling.

ANNEX 1
PROBABILISTIC APPROACH

For the general case of an unbalanced panel with *N* countries that are observed over *T* periods, a general binary dependent variable model can be formulated in terms of an underlying latent variable *(Y*it)* defined as follows:[25]

$$Y^*it = \beta\, Xit + \varepsilon i + \mu it \quad i = 1....N \;;\; t = 1...T \tag{1}$$

where *Xit* is the vector of explanatory variables, *β* is a vector of corresponding parameters estimated for *m* explanatory variables, *εi* is the unobserved individual country-specific heterogeneity, which explains the specific features of the group (e.g., country) that are constant over time and, finally, *μit* is the disturbance term.

The latent *(Y*it)* and observed binary variable *(Yit)* are related through the following measurement equation:

$$Yit = 1 \text{ if } Y^*it > 0 \text{ and } = 0 \text{ otherwise} \tag{2}$$

Then, *Yit* = 1 when *Y*it* is above a certain threshold (assumed equal to 0 for simplicity). It follows that:

$$P(Yit = 1|\, Xit) = P(Y^* > 0 \mid Xit) = P(\beta Xit + \varepsilon it + \mu it > 0 \mid Xit) = P(\varepsilon i \leq \beta Xit + \mu it \mid Xit) \tag{3}$$

which represents the cumulative distribution function of the error distribution evaluated at *(βXit + μit)*. The latter can also be written as follows:

$$P(Y=1|\, Xit) = \Phi\, (\beta\, Xit) \tag{4}$$

where *Φ* is the logistic cumulative distribution.

Equation (4) summarises the relationship between the crisis probability and the explanatory variables.

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[25] See, for instance, Verbeek (2004).

ANNEX 2
BANKING AND FISCAL CRISES

Table 4

Fiscal Crises Events Identified in the Period 1980-2012

Country	Fiscal Crisis Events	Baldacci *et al.* (2011)
Albania	1993-96; 1998-2001	1991-96; 1998
Algeria	1995-98	1991-97
Angola	1993-96; 2009-12	N/A
Antigua and Barbuda	2010-12	N/A
Argentina	1983-86; 1989-90; 1992-19; 1998-06	1982-93; 1998; 2000-05
Armenia	1993-1994; 1996-99; 2009-10	1993-94; 1996; 2000-03; 2009-10
Australia	1986-87; 1989	1986-87; 1989; 2008-10
Azerbaijan	1993-94	N/A
Bangladesh	1980-82; 1990-93;	N/A
Barbados	1982-84	N/A
Belarus	1993-95; 2009-10	N/A
Belize	2006-07; 2012	N/A
Benin	1993-96; 2010-12	N/A
Bolivia	1980-81; 1984-85; 1988-91	N/A
Bosnia and Herzegovina	2009-12	1992-97; 2009
Botswana		N/A
Brazil	1983-86; 1988-90; 1992-94; 1998-2001	1983-1994; 1998; 2001-02
Bulgaria	1980; 1994-95; 1997-2001	1990-95; 1997-98; 2009
Burkina Faso	1993-96	N/A
Burundi	1991-94	N/A
Cambodia	1994-97	N/A
Cameroon	1997-2000	N/A
Canada	1990	N/A
Central African Republic	1998-2001; 2006-10	
Chad	1995-99	
Chile	1983-89	1972; 1974-75; 1983-90
Colombia	1999-2002	1999; 2003; 2009
Comoros	2009-12	
Dem. Rep. of the Congo	1981-85; 1992-96; 2000; 2002-06	
Republic of Congo	1996-99	
Costa Rica	1980-85; 2009	1980-90; 2009
Côte d'Ivoire	1981-84; 1994-2004; 2009-12	
Croatia	1993; 1997-2000	1992-97
Cyprus	2012	N/A
Czech Republic	1991-1992	1991
Denmark	1982	1982
Djibouti	1999-2003	N/A
Dominica	1981-84	N/A
Dominican Republic	1983-85; 2003-07; 2009-12	1980-94; 2003; 2005; 2009
Ecuador	1983-84; 1999-2000; 2008-09	1982-1995; 1999-2000; 2005
Egypt	1980-81	N/A
El Salvador	2009	1981-96; 2009-10
Equatorial Guinea	1980	N/A

Country	Fiscal Crisis Events	Baldacci *et al.* (2011)
Ethiopia	1981-82; 2009-10	N/A
Fiji	2009	N/A
Finland	1990; 1992	1990; 1992
Gabon	1980-82; 1986-88; 1995-99	N/A
The Gambia	1982-83; 1988-91	N/A
Georgia	1996-99; 2008-10; 2012	1996; 2008
Ghana	1983-84; 1987-1991; 2009-12	N/A
Greece	1993; 2010-12	1993; 2008-12
Grenada	1983-84; 2004-09; 2012	N/A
Guatemala	1983-84; 1989;	1983; 1986; 1989. 2009
Guinea	1991-96; 2012	N/A
Guinea-Bissau	1995-98; 2000-01	N/A
Guyana	1980-82; 1990-93	N/A
Haiti	1980-85; 1996-99; 2006-10	N/A
Honduras	1980-83; 1996; 1999-2002	N/A
Hungary	1982-84; 1991-93; 2008-10	1982; 1991; 2008-10
Iceland	2008-11	2008-11
India	1981-84;	1981; 1989-90
Indonesia	1997-2003	1997-2000; 2002
Iraq	2010-12	
Ireland	2010-12	2008-12
Israel		1982-86
Italy		2008-10
Jamaica	1980-1984; 2010-12	1981-97; 2010
Japan		2009-10
Jordan	1994-99	1989-94; 1996
Kazakhstan	1993-94; 1996-1999	1993-94; 1996
Kenya	1980-84; 1989-1992	1980; 1982-83; 1988-89; 1994-98; 2000
Korea	1980-85; 1997-2000	1983-1984; 1997-2000
Kosovo	2010-12	N/A
Kyrgyz Republic	1993-2001; 2011-12	N/A
Latvia	2008-11	2008-10
Lesotho	1991-94; 2010-12	N/A
Liberia	1980-84; 2008-12	N/A
Libya	1984	N/A
Lithuania	1994-97; 2009	1994; 2009
FYR Macedonia	1997-2000	1992-97
Madagascar	1980-83; 1988-92; 1996-99	N/A
Malawi	1980-86; 1988-99	N/A
Malaysia	1998	1998; 2009-10
Maldives	2009-12	N/A
Mali	1983-85; 1992-95	N/A
Mauritania	1980-82; 1989-92; 2010-12	N/A
Mauritius	1980-81; 1983-84	N/A
Mexico	1980-93; 1995-97; 1999-2000	1982-90; 1995-97; 1999; 2009-10
Moldova	1993; 1996-2000; 2002; 2010-12	N/A
Mongolia	1993-96; 2009-10	N/A
Morocco	1980-85	1980-83; 1986-90
Mozambique	1990-95; 2009-10	N/A

Country	Fiscal Crisis Events	Baldacci *et al.* (2011)
New Zealand	1985-87	1985-87; 2008
Nicaragua	1985-90; 1994-02	N/A
Niger	1988-91; 1996-99	N/A
Nigeria	1986-88; 1992; 2002	1982-92; 2001; 2004-05
Norway	1986-88	1986-88
Pakistan	1980-83; 1999; 2001-04; 2008-11	1980-81; 1988; 1994; 1997-99; 2001; 2008-10
Panama	1980; 1982-83; 1987-94	1980; 1983-96
Paraguay	2003-04	
Peru	1980; 1982-84; 1988-90; 1993-96	1980; 1982-97
Philippines	1980-81; 1983-86; 1989-91; 1994-2001	1980; 1983-92; 1998
Poland	1990-93; 2001	1981-94; 2001; 2009-10
Portugal	1983-85; 2011-12	1983-85; 2008; 2010
Qatar		
Romania	1981-84; 2009-12	1981-83; 1986; 2008-10
Russia	1993; 1995-2000	1991-99; 2009
Rwanda	1998-2002	N/A
Senegal	1980-84; 1988-98	N/A
Serbia	2002-06	1983-2004
Seychelles	2008-12	N/A
Sierra Leone	1981-82; 1994-98; 2001-05	N/A
Slovenia	1992	N/A
Solomon Islands	2010-11	N/A
South Africa		1985-87; 1989; 1993
Spain		2010
Sri Lanka	1980-81; 1991-95; 2009-12	1991; 1993; 2003; 2009
St. Kitts and Nevis	2011-12	N/A
Sudan	1981-84	N/A
Sweden	1990	1990
Switzerland		2008
Tajikistan	1993; 1995; 1998-2001	N/A
Tanzania	1980-82; 1991-94; 1996-2000; 2009-10	N/A
Thailand	1981-83; 1985-87; 1997-2000	1981-82; 1985; 1997-98
Dem. Rep. Timor-Leste		N/A
Togo	1981-83; 1989-98; 2008-11	N/A
Tonga		N/A
Trinidad and Tobago	1992	N/A
Tunisia	1988-92	1988
Turkey	1980-83; 1999-08	1980; 1982; 1999; 2002; 2005
Uganda	1981-83; 1989-94	
Ukraine	1993-96; 1998-2002; 2008-12	1992-95; 1998-2000; 2008; 2010
Uruguay	1993-94;	1983-85; 1987; 1990-91; 2002-03; 2005
Venezuela	1989-94; 2005	1983-2005; 2008; 2010
Vietnam	1994-97	1985-1998
Yemen	1997-2000; 2010-12	N/A
Zambia	1980-84; 1995-98	N/A
Zimbabwe	1980; 1983-84; 1991-95	N/A

Banking Crisis (Valencia-Laeven, 2012) and Fiscal Crisis Events

Country	Group	Banking Crisis		Fiscal Crisis	
		Start	End	Start	Relative to Banking Crisis
Albania	Developing	1994	1994	Already	Before
Algeria	Developing	1990	1994	1996	After
Argentina	EMBig	1995	1995	Already	Before
Argentina	EMBig	1980	1982	1984	After
Argentina	EMBig	1989	1991	1993	After
Argentina	EMBig	2001	2003	2002	After
Armenia	Developing	1994	1994	Already	Before
Austria	Advanced	2008	2012		After
Azerbaijan	Developing	1995	1995		After
Bangladesh	Developing	1987	1987		After
Belarus	Developing	1995	1995	Already	Before
Belgium	Advanced	2008	2012		After
Benin	Developing	1988	1992	1994	After
Bolivia	Developing	1986	1986		After
Bolivia	Developing	1994	1994		After
Bosnia and Herzegovina	EMBig	1992	1996		After
Brazil	EMBig	1990	1994	Already	Before
Brazil	EMBig	1994	1998	Already	Before
Bulgaria	Advanced	1996	1997	1998	After
Burkina Faso	Developing	1990	1994	1994	After
Burundi	Fragile	1994	1998	Already	Before
Cameroon	Developing	1987	1991		After
Cameroon	Developing	1995	1997	1998	After
Cape Verde	Developing	1993	1993		After
Central African Rep.	Fragile	1976	1976	N/A	N/A
Central African Rep.	Fragile	1995	1996		After
Chad	Fragile	1983	1983		After
Chad	Fragile	1992	1996	1996	After
Chile	EMBig	1976	1976	N/A	N/A
Chile	EMBig	1981	1985	1984	After
China	EMBig	1998	1998		After
Colombia	EMBig	1982	1982		After
Colombia	EMBig	1998	2000	2000	After

Country	Group	Banking Crisis		Fiscal Crisis	
		Start	**End**	**Start**	**Relative to Banking Crisis**
Congo, Democratic Rep.	Fragile	1983	1983		After
Congo, Democratic Rep.	Fragile	1991	1994		After
Congo, Democratic Rep.	Fragile	1994	1998	1997	After
Congo, Republic	Fragile	1992	1994	Already	Before
Costa Rica	EMBig	1994	1995		After
Costa Rica	EMBig	1987	1991		After
Cote d'Ivoire	Fragile	1988	1992		After
Croatia	EMBig	1998	1999	Already	Before
Czech Republic	Advanced	1996	2000		After
Denmark	Advanced	2008	2012		After
Djibouti	Fragile	1991	1995		After
Dominican Republic	Developing	2003	2004	2004	After
Ecuador	EMBig	1982	1986	1984	After
Ecuador	EMBig	1998	2002	2000	After
Egypt	EMBig	1980	1980	Already	Before
El Salvador	EMBig	1989	1990		After
Equatorial Guinea	Fragile	1983	1983		After
Eritrea	Fragile	1993	1993		After
Estonia	Advanced	1992	1994		After
Germany	Advanced	2008	2012		After
Ghana	Developing	1982	1983	1984	After
Greece	Advanced	2008	2012	2011	After
Guinea	Fragile	1985	1985		After
Guinea	Fragile	1993	1993	Already	Before
Guinea-Bissau	Fragile	1995	1998	1996	After
Guyana	Developing	1993	1993	Already	Before
Haiti	Fragile	1994	1998	1997	After
Hungary	Advanced	1991	1995	1992	After
Hungary	Advanced	2008	2012	2009	After
Iceland	Advanced	2008	2012		After
India	EMBig	1993	1993		After
Indonesia	EMBig	1997	2001	1998	After
Ireland	Advanced	2008	2012	2011	After
Israel	Developing	1977	1977	N/A	N/A
Italy	Advanced	2008	2012		After
Jamaica	Developing	1996	1998		After
Japan	Advanced	1997	2001		After

Country	Group	Banking Crisis		Fiscal Crisis	
		Start	End	Start	Relative to Banking Crisis
Jordan	Developing	1989	1991		After
Kazakhstan	Developing	2008	2012		After
Kenya	Fragile	1985	1985		After
Kenya	Fragile	1992	1994	Already	Before
Korea	EMBig	1997	1998	1998	After
Kuwait	Developing	1982	1985		After
Kyrgyz Republic	Developing	1995	1999	Already	Before
Latvia	EMBig	1995	1996		After
Latvia	Advanced	2008	2012	2009	After
Lebanon	Developing	1990	1993		After
Liberia	Fragile	1991	1995		After
Lithuania	Advanced	1995	1996	Already	Before
Luxembourg	Advanced	2008	2012		After
Macedonia, FYR	Developing	1993	1995		After
Madagascar	Developing	1988	1988	1990	After
Malaysia	EMBig	1997	1999	1999	After
Mali	Developing	1987	1991	1993	After
Mauritania	Developing	1984	1984		After
Mexico	EMBig	1981	1985	Already	Before
Mexico	EMBig	1994	1996		After
Mongolia	Developing	2008	2012	2010	After
Morocco	EMBig	1980	1984	1981	After
Mozambique	Developing	1987	1991	1991	After
Nepal	Fragile	1988	1988		After
Netherlands	Advanced	2008	2012		After
Nicaragua	Developing	1990	1993	Already	Before
Nicaragua	Developing	2000	2001	Already	Before
Niger	Fragile	1983	1985		After
Nigeria	Fragile	1991	1995	1993	After
Nigeria	EMBig	2009	2012		After
Norway	Advanced	1991	1993		After
Panama	EMBig	1988	1989	Already	Before
Paraguay	Developing	1995	1995		After
Peru	EMBig	1983	1983	Already	Before
Philippines	EMBig	1983	1986	1984	After
Philippines	EMBig	1997	2001	Already	Before
Poland	Advanced	1992	1994	Already	Before

Country	Group	Banking Crisis		Fiscal Crisis	
		Start	**End**	**Start**	**Relative to Banking Crisis**
Portugal	Advanced	2008	2012	2012	After
Romania	Advanced	1990	1992		After
Russia	EMBig	1998	1998	1999	After
Russia	EMBig	2008	2012		After
São Tomé & Príncipe	Fragile	1992	1992		After
Senegal	Fragile	1988	1991	1989	After
Sierra Leone	Fragile	1990	1994	1995	After
Slovak Republic	Advanced	1998	2002		After
Slovenia	Advanced	2008	2012		After
Slovenia	Advanced	1992	1992	1993	After
Spain	Advanced	1977	1981	N/A	N/A
Spain	Advanced	2008	2012		After
Sri Lanka	Developing	1989	1991	1992	After
Swaziland	Developing	1995	1999		After
Sweden	Advanced	1991	1995		After
Sweden	Advanced	2008	2012		After
Switzerland	Advanced	2008	2012		After
Tanzania	Developing	1987	1988		After
Thailand	EMBig	1983	1983	Already	Before
Thailand	EMBig	1997	2000	1998	After
Togo	Fragile	1993	1994	Already	Before
Tunisia	Developing	1991	1991	Already	Before
Turkey	EMBig	1982	1984	Already	Before
Turkey	EMBig	2000	2001	Already	Before
Uganda	Fragile	1994	1994	Already	Before
Ukraine	Developing	1998	1999		After
Ukraine	Developing	2008	2012	2009	After
United Kingdom	Advanced	2007	2012		After
United States	Advanced	1988	1988		After
United States	Advanced	2007	2012		After
Uruguay	EMBig	1981	1985		After
Uruguay	EMBig	2002	2005	2004	After
Venezuela	EMBig	1994	1998	1995	After
Vietnam	Developing	1997	1997	Already	Before
Yemen	Fragile	1996	1996	1998	After
Zambia	Developing	1995	1998	1996	After
Zimbabwe	Fragile	1995	1999	Already	Before

ANNEX 3
STATA RESULTS FOR THE MODEL SPECIFICATIONS PRESENTED IN THE PAPER

Model specification 1

```
Logistic regression                          Number of obs   =       1017
                                             LR chi2(4)      =      95.83
                                             Prob > chi2     =     0.0000
Log likelihood = -253.87284                  Pseudo R2       =     0.1588
```

blcrisis	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
gdp	-.0945637	.0352253	-2.68	0.007	-.1636041	-.0255233
niip	-.0213836	.0048136	-4.44	0.000	-.0308181	-.0119491
dc	-.0314568	.0046814	-6.72	0.000	-.0406323	-.0222814
debt	.0099532	.0041536	2.40	0.017	.0018122	.0180941
_cons	-1.440152	.3707475	-3.88	0.000	-2.166804	-.7135002

Model specification 2

```
Logistic regression                          Number of obs   =       1435
                                             LR chi2(4)      =     240.32
                                             Prob > chi2     =     0.0000
Log likelihood = -511.42874                  Pseudo R2       =     0.1903
```

blcrisis	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
gdp	-.0420841	.0216538	-1.94	0.052	-.0845247	.0003565
niip	-.0098775	.003156	-3.13	0.002	-.0160632	-.0036918
dc	-.0293038	.0035453	-8.27	0.000	-.0362525	-.0223551
extdebttot	.0378912	.0057914	6.54	0.000	.0265403	.0492422
_cons	-3.389307	.5185996	-6.54	0.000	-4.405744	-2.37287

Model specification 3

```
Logistic regression                          Number of obs   =       1435
                                             LR chi2(5)      =     247.97
                                             Prob > chi2     =     0.0000
Log likelihood = -507.60647                  Pseudo R2       =     0.1963
```

blcrisis	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
gdp	-.0412019	.0218509	-1.89	0.059	-.0840289	.0016251
niip	-.0104888	.0031586	-3.32	0.001	-.0166797	-.004298
dc	-.0507628	.0080806	-6.28	0.000	-.0666005	-.0349251
dcsq	.0001906	.000059	3.23	0.001	.0000749	.0003062
extdebttot	.0391665	.005882	6.66	0.000	.0276379	.050695
_cons	-3.104005	.5313483	-5.84	0.000	-4.145428	-2.062581

Model specification 4

```
Logistic regression                          Number of obs   =        1428
                                             LR chi2(6)      =      259.67
                                             Prob > chi2     =      0.0000
Log likelihood = -500.52853                  Pseudo R2       =      0.2060
```

blcrisis	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
gdp	-.0396745	.0217619	-1.82	0.068	-.082327	.002978
niip	-.0080543	.0032407	-2.49	0.013	-.014406	-.0017026
dc	-.052943	.0084471	-6.27	0.000	-.069499	-.036387
dcsq	.0001583	.0000636	2.49	0.013	.0000336	.0002829
dcdevavg	.0214535	.0059871	3.58	0.000	.009719	.033188
extdebttot	.0424802	.0060164	7.06	0.000	.0306881	.0542722
_cons	-3.073883	.5390812	-5.70	0.000	-4.130463	-2.017303

Model specification 5

```
Logistic regression                          Number of obs   =        1428
                                             LR chi2(7)      =      314.46
                                             Prob > chi2     =      0.0000
Log likelihood = -473.13519                  Pseudo R2       =      0.2494
```

blcrisis	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
gdp	-.002544	.0230821	-0.11	0.912	-.0477841	.042696
niip	-.0071722	.0033793	-2.12	0.034	-.0137955	-.000549
dc	-.049663	.0086051	-5.77	0.000	-.0665287	-.0327972
dcsq	.0001541	.0000641	2.40	0.016	.0000285	.0002797
dcdevavg	.0154696	.0061531	2.51	0.012	.0034097	.0275296
extdebttot	.0446208	.0064037	6.97	0.000	.0320699	.0571717
lvcrisis	1.704728	.2312137	7.37	0.000	1.251557	2.157898
_cons	-3.729005	.5795971	-6.43	0.000	-4.864994	-2.593015

Model specification 6

```
Logistic regression                          Number of obs   =        1428
                                             LR chi2(8)      =      353.43
                                             Prob > chi2     =      0.0000
Log likelihood = -453.64826                  Pseudo R2       =      0.2803
```

blcrisis	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
gdp	-.0387213	.0235798	-1.64	0.101	-.0849369	.0074944
niip	-.0034561	.0034606	-1.00	0.318	-.0102388	.0033267
dc	-.0366528	.0087816	-4.17	0.000	-.0538645	-.0194411
dcsq	.0001579	.0000626	2.52	0.012	.0000351	.0002807
dcdevavg	-.0037785	.0069623	-0.54	0.587	-.0174244	.0098674
extdebttot	.0421779	.0065515	6.44	0.000	.0293372	.0550186
lvcrisis	1.641243	.237875	6.90	0.000	1.175017	2.10747
eme	1.462656	.2467938	5.93	0.000	.9789494	1.946363
_cons	-4.857611	.6332043	-7.67	0.000	-6.098668	-3.616553

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