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Contingent Liabilities and Sovereign Risk: Evidence from Banking Sectors

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JEL Classification

G13,G21,G38

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Contingent Liabilities and Sovereign Risk: Evidence from Banking Sectors [1]

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Abstract

This paper proposes a simple method to estimate contingent liabilities that arise from (implicit and explicit) government guarantees to the banking sector. This method allows us to construct cross-country estimates on potential costs of bank failures. Furthermore, we empirically test whether the contingent liabilities from the banking sector is a significant determinant of sovereign risk based on the data from 32 countries. Our results suggest that a 1% of GDP increase in contingent liabilities is associated with an increase in sovereign CDS spreads of 24 basis points in advanced countries and 75 basis points in emerging economies

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1. Introduction

The recent global financial crisis and the euro area sovereign-debt crisis have shown that banking sectors that are "too-big-too-fail" can create large contingent liabilities for the government, with serious implications for the public sector balance sheet. Heightened concerns about the size of potential contingent liabilities from the banking sector have raised questioned about public debt sustainability in Ireland and Spain. Many other countries are also facing major challenges as a result of their sovereign contingent liabilities.

Even though the materialization of contingent liabilities can have serious implications for government balance sheets and fiscal positions, defining and measuring a contingent liability is not straightforward. According to the IMF's *Government Finance Statistics Manual* (GFSM 2001), contingent liabilities are obligations that have been entered into by government's commitments, but the timing and amount of which are contingent on the occurrence of some uncertain future event. These liabilities can arise from either explicit promises (public pension guarantees) or implicit expectations of government help in case of a failure (banking system support). Examples of sovereign contingent liabilities are provided in Appendix A.

Among a variety of sovereign contingent liabilities, in most cases, the financial sector constitutes the most important source of contingent liabilities for the government, which often backs deposits through explicit deposit insurance schemes, and/or other liabilities of distressed banks through implicit guarantees to limit the loss of confidence during periods of financial turbulence. Examples of government-provided explicit or implicit guarantees to financial institutions can be found all over the world. As a response to the recent global financial crisis stemming from U.S. subprime mortgage market, the British government announced a bank rescue package in August 2008, totaling approximately $850 billion. In September 2008, the United States decided to place Fannie Mae and Freddie Mac into government conservatorship. The numerous triggering of these government guarantees has resulted in considerable risk transfer to the government and rise in public debt. Across a sample of almost 60 countries, the recent banking crises have, on average, added around 10 percent of GDP to government debt, while three quarters of the countries in the sample spent up to 20 percent of GDP (Leaven and Valencia, 2011). Costs were higher in cases when the banking crisis was accompanied by a currency crash (see Hoggarth, et al. (2002), and Kaminsky and Reinhart (1999)). Given that contingent liabilities from the banking sector can be an important source of increase in public indebtedness, measuring and monitoring these liabilities are of great importance for sovereign risk management.

However, quantifying contingent liabilities from the banking sector ex-ante is difficult given that they are mainly implicit.[3] Estimating the associated contingent liabilities of this kind requires that we know not only the nominal value of all liabilities implicitly guaranteed by the government, but also the likelihood of each bank default and the possibility of government support. More specifically, the value of an explicit sovereign guarantee is due to two factors: the total amount guaranteed by the sovereign and the probability that the guarantee may be called. The value of an implicit guarantee, however, requires information about a third variable: the likelihood that the sovereign would step in and make the implicit guarantee explicit.

The main goal of this paper is to propose a simple methodology to estimate implicit (and explicit) contingent liabilities that may arise from stress in the banking system, since such an event potentially requires large government intervention to safeguard the stability of the financial sector. Based on our methodology, contingent liabilities are estimated for individual banks and then aggregated

[3] Depending on how governments commit to their obligations, sovereign contingent liabilities are classified into explicit and implicit groups. Explicit contingent liabilities are created by a law or contract, while implicit contingent liabilities are "political" obligation of government that reflects public and interest-group pressures.

appropriately to obtain the size of contingent liabilities from the whole banking sector. In doing so, the systemic risk of a country's entire banking system is taken into account by considering cross-correlations of bank's assets ("diversification benefit") and default correlations of banks that could become particularly relevant during periods of distress.

We illustrate the potential usefulness of this approach through its application to estimate contingent liabilities from the banking sector for a set of 32countries, including 18 advanced and 14 emerging market economies. Our estimated contingent liabilities become especially large in a number of countries, starting from 2008. Indeed, in a number of advanced countries, these large liabilities materialized in the end (e.g Ireland). Meanwhile, with these estimated contingent liabilities, we empirically study whether they were a significant exploratory variable for the determination of sovereign risk, as measured by sovereign CDS spreads. Partly because contingent liabilities from the banking sector are not easy to measure, empirical studies on the relationship between these liabilities and sovereign risk have not been conclusive in the literature. This paper takes a step toward filling this gap.

Our empirical findings show a significant correlation between our estimate of contingent liabilities and sovereign risk. They indicate that a one percent GDP increase in contingent liabilities can provoke an increase in CDS spreads of about 24-75 basis points (bps), with emerging economies being more affected (≈ 75 bps on average) than advanced economies (≈ 24 bps on average). Overall, the results highlight the importance of contingent liabilities, and its impact on sovereign risk. It underscores the need for governments to make an effort to measure and monitor these contingencies.

We hope the results of this paper will add to the discussion on prudential regulation to deal with banking crisis. If the governments inevitably end up providing support to banks in crisis, then it would be advisable to build-up a prudential cushion to mitigate the impact of the materialization of these liabilities. The size of this cushion should be enough to meet at least the expected losses from banks defaults. In addition, the estimates constructed in this work can be used to identify the main drivers of these liabilities and provide useful insight into preemptive actions to avoid or minimize their materialization.

The paper is organized as follows. In Section II, we provide a briefly review of the literature on contingent liabilities, and introduce our methodology for estimating contingent liability in Section III. In Section IV, we provide a description of our contingent liability estimates for 32 countries and identify key trends across countries. Section V conducts an empirical analysis to investigate the relationship between contingent liabilities and sovereign risk, and we conclude in Section VI.

2. Literature Review

Although contingent liabilities account for a large share of the rise in government debt during the recent crisis, it tends to remain outside the framework of conventional public financial analysis, as they can arise depending on the outcome of a future event, and they are off-balance sheet. In many countries, the reality or prospect of unbudgeted fiscal risks coming due has been a recent wake-up call to debt managers and fiscal authorities. The importance of monitoring contingent liabilities was recognized in the *Guidelines for Public Debt Management* (IMF-World Bank, 2001). More recently, the IMF's "Stockholm Principles" for debt managers state that "the scope of debt management should be defined in a way that also accounts for explicit and implicit contingent liabilities".

Contingent claims analysis (CCA) is one of the main approaches to analyze contingent liabilities. There have been a number of studies that have used the contingent claims analysis (CCA) to measure corporate default risk and the public sector contingent liabilities that may arise in such events. Gapen et al. (2004) examine the ability of the CCA approach to identify corporate sector and economy-wide vulnerabilities. Gapen et al. (2005) and Gray and Malone (2008) extend the contingent claims analysis beyond corporate risk applications to estimate sovereign risks. Fisher and Gray (2006) use the CCA approach to measure sovereign and banking sector risk in Indonesia. Keller, Kunzel, Souto (2007) apply the framework to quantify the evolution of Turkey's sovereign risk. Gray and Walsh (2008) apply the CCA analysis to derive risk indicators for the Chilean banking system. Gray et al. (2008) propose a new framework for the analysis of public sector debt sustainability using the CCA approach. Gray, Merton, Bodie (2008) use the CCA framework to analyze the subprime mortgage crisis of 2007-08. Gapen (2009) applies the approach to evaluate the implicit guarantee to Fannie Mae and Freddie Mac during the global financial crisis. More recently, the CCA analysis has been used in the Stress Testing module of the FSAP for the United States (July 2010). Meanwhile, Gray and Jobst (2010) have developed a "systemic" CCA framework to measure systemic risk from the financial sector.

Meanwhile, Moody's KMV (now Moody's Analytics) has adapted the CCA for commercial use since the early 1990s. Moody's Analytics' Expected Default Frequency (EDF) metrics are not one of the most widely used probability of default measures in quantitative credit risk analysis. A number of empirical studies have been undertaken to evaluate the predictive power of these EDF measures. Bohn et al. (2005) test the performance of Moody's KMV (MKMV) EDF measures in the U.S. market during 1996-2004, and find that EDF is a superior measure to other popular credit risk measures, such as credit ratings, z-scores and simpler versions of the Merton default model. Dwyer and Korablev (2007) evaluate the performance of EDF in other three regions: North America, Europe, and Asia, and indicate that EDF credit measure has done consistently well across different time horizons. Munves et al. (2010) find that EDF measures performed well in rank ordering defaulters during the financial crisis, as financial institutions that subsequently defaulted has high EDF measures compared to their peers. Finally, Crossen and Zhang (2011) examine the performance of EDF measures during the last decade including the global financial crisis and find that, in general, EDF measures provided a useful forward-looking measure of credit risk for global financial firms.

Following up Gray and Jobst (2011), in this paper we estimate the size of contingent liabilities from the banking sector under systemic risk, and quantify the magnitude of potential risk transferring to the government from the entire banking system. Rather than parametrically estimating dependence structure of individual financial institutions as Gray and Jobst (2010) did, we separately consider cross-correlation between bank assets and default correlation between banks to account for diversification effect and distress transmission. Hence, our approach is much easier to be implemented than the one proposed by Gray and Jobst (2011), particularly for the banking sector with a large number of individual banks. Moreover, in terms of the empirical work on the interaction of sovereign and banking risk, this paper is the first one to investigate the effect of quantified contingent liabilities from the banking sector bailout on sovereign credit risk.

3. Methodology

We calculate contingent liabilities from the banking sector in three steps. In the first step, we calculate expected losses to the government from each bank failure. In the second step, we aggregate these losses from the whole banking system while adjusting for the diversification benefit that would arises to the extent that banks have less than perfectly correlated assets. In the third step, we calculate unexpected losses, defined as the standard deviation of expected losses, as a measure of losses that could arise under a worse-case scenario.

3.1 Expected losses from a single bank

We calculate expected losses (EL) to the government from an individual bank failure as follows:

$$\mathrm{EL}_{it} = \mathrm{TAL}_{it} \cdot \mathrm{PD}_{it} \cdot \mathrm{LGD} \cdot \mathrm{PSS}_{it}\,, \qquad (1)$$

where

TAL_{it}= Total adjusted liabilities of bank i at time t, provided by MKMV. This includes all current and long-term liabilities of the bank less minority interest and deferred taxes.

PD_{it}= Expected Default Frequency (EDF) of bank i at time t, provided by MKMV.[4]

LGD = Loss given default. We assume a constant LGD for all banks equal to 20 percent.

PSS_{it} = Probability of government support if bank i falls into financial distress at time t. When it is equal to 1, it indicates that markets expect all losses would be covered by the government. When it is equal to 0, it indicates that markets expect all losses would be covered by debt holders. We infer these expectations using the methodology developed by Bodie, Gray and Merton (2008) and the ownership structure of the bank, as provided by Bankscope.

More specifically, PSS_{it} is a measure as follows:

$$\mathrm{PSS_{it}} \ = \left[1 - \left(\frac{\mathrm{CDS_{it}}}{\mathrm{FVCDS_{it}}}\right) \cdot \ (1 - \mathrm{S_{it}})\right]. \qquad (2)$$

The $\left(\frac{\mathrm{CDS_{it}}}{\mathrm{FVCDS_{it}}}\right)$ term captures the markets' expectation that expected losses would be covered by the government in the event of default by bank i at time t. In particular, if markets expect that the government would cover all losses from a bank default, then the bank CDS spread would be equal to zero and PSS_{it} would be equal to 1. On the other hand, if the CDS spread is equal to the equity-implied "fair" value CDS spread (FVCDS), markets must assume that losses would be covered by debt

[4] EDF measures are actual, not risk-neutral, probability measures of default.

holders,[5] so that PSS_{it} would be equal to 0. For this calculation, we use CDS spreads on individual banks from Markit and FVCDS spreads from MKMV.

The other critical issue associated with the probability of government support is the state ownership of the bank. When a state-owned bank experience financial distress, the government, as an owner of the bank, is usually expected to avoid a default and cover losses. To capture this, we include another dummy variable, S_{it}, which is equal to 1 if bank i at time t has state controlling majority ownership and 0 otherwise. This is especially relevant for emerging markets with large state-owned banks. We use bank ownership information from bank annual reports and Bankscope to construct this variable.

A final factor is banking support measures announced by governments. When governments announce banking support programs under which banks can seek state support in case of need, as the U.S. did in October 2008, we set S_{it} to 1 in that month and onward. We use various publications to identify these public announcements.

3.2 Expected losses from the banking sector

Once we estimate the expected losses from each bank, we can add these losses to arrive at the total expected losses to the government from the whole banking sector. However, this calculation would overstate the true expected losses to the government for two reasons. First, banks can be merged or acquired (JPMorgan buying Bear Stearns). Second, as the U.S. Federal Deposit Insurance Corporation (FDIC) does in many instances, an intervened bank could be transferred quickly to a stronger bank through a purchase and assumption (P&A) operation. In both cases, no losses would materialize to the government when an individual bank fails.

[5] FVCDS is an alternative measure of credit risk provided by MKMV based on the contingent claims approach. Importantly, it is derived from equity prices and, as such, does not reflect expectations of a government bailout since equity holders are likely to be written-off even in the event of a government bailout.

In other words, the banking sector as a whole is less risky than each bank being treated individually, because losses in one bank could be offset by gains in another bank. Put differently, there is a "diversification benefit" that a government enjoys from having a diverse banking sector, as highlighted by Gray and Jobst (2010).

To model this benefit, we consider a "hypothetical" bank (like a "portfolio") that represents the whole banking system. The assets of this bank would be equal to the sum of assets of all banks in the system. The liabilities of this bank would be equal to the sum of liabilities of all banks in the system. The asset volatility of this bank would be a function of the individual bank asset volatilities and the covariance between them. Together, these three elements would allow us to calculate the distance-to-default (DD) of this hypothetical bank, through which we can calculate the default probability of the whole banking sector that accommodates the diversification benefit.

More specifically, we calculate the distance to default (DD) of the hypothetical bank as follows:

$$DD_t = \frac{(\sum_{i=1}^{n} Asset_i - \sum_{i=1}^{n} TAL_i)}{\sigma_A \cdot \sum_{i=1}^{n} Asset_i} \quad (3)$$ [6]

where $\sum_{i=1}^{n} Asset_i$ is the sum of individual banks total assets, $\sum_{i=1}^{n} TAL_i$ is the sum of individual banks total adjusted liabilities, and σ_A is the asset volatility of the hypothetical banks, estimated as:

$$\sigma_A = \sqrt{w_A \cdot \Sigma_A \cdot w_A'} \quad (4)$$

with w_A being the matrix of banks weights based on each bank's TAL, Σ_A is the variance-covariance matrix across banks assets, and w_A' the transposed matrix of w_A. From the DD_t, we infer the banking-sector probability of default (PD_t) as follows:

[6] Please refer to Moody's KMV document "Modeling default risk" for more details of formula derivations.

$$PD_t = f(DD_t) \quad \text{where } f(x) = ax^b \qquad (5)$$

where the values of a and b in the power function f are obtained by utilizing the historical relationship between DD and PD in the MKMV database.7 Finally, we calculate the expected losses, taking into account the full diversification benefit, as follows:

$$ELA_{it} = TAL_{it} \cdot PDA_t \cdot LGD \cdot PSS_{it} \qquad (6)$$

$$EL_t = \sum ELA_{it}\,. \qquad (7)$$

To summarize, the diversification benefit arises because the overall asset volatility of the whole banking sector is less than the sum of asset volatilities for each bank (as long as the asset correlation among banks is less than 1). The lower is the asset correlation between each bank (i.e. the more diversified the banking system), the higher is the diversification benefit. On the other hand, if all banks have exposure to the same sector, such as real estate, the diversification benefit would be low. Ireland may be a good example of the latter.

3.3 Unexpected losses from the banking sector

All the analysis so far is based on the assumption that the default probabilities of banks are independent. However, in practice the default risk of one bank could be transmitted to the others, especially in periods of financial distress. Put differently, systemic risk can lead to correlated defaults among banks, as witnessed during the recent financial crisis. Correlation among default probabilities do not affect our calculation of expected losses, but they can have a large impact on the variance of these losses. In particular, the correlation of bank default probabilities could lead the actual

[7] The estimated power function relationship between PD and DD usually has an R-squared of 0.99.

government contingent liabilities to deviate significantly from the expected losses based on equation (7).

To capture the variance of expected losses (EL), as well as to incorporate the issue of default correlation in our calculations, we estimate "unexpected losses" (UL) to the government as the standard deviation of the expected losses from the whole banking sector. Accordingly, UL is defined as:

$$UL_t = sqrt\left(Var\left(\sum_{i=1}^{n} EL_{it}\right)\right) = \sqrt{X_t \cdot \Sigma_{PD} \cdot X_t'} \qquad (8)$$

where

X_t = Vector in which the ith element is equal to $TAL_{it} \cdot PSS_{it} \cdot LGD$

Σ_{PD} = Variance-Covariance matrix for default probabilities. For example, the (i,j) element of this matrix is the covariance of default probabilities between bank i and bank j, which we refer as Σ_{PD} (i, j). Assuming that PD_i and PD_j are default probabilities of bank i and bank j, we have

$$\Sigma_{PD}(i, j) = PD_{ij} - PD_i \cdot PD_j, \qquad (9)$$

where PD_{ij} is the joint default probability of bank i and bank j, which is calculated by

$$PD_{ij} = PD_i \cdot PD_j + \rho_{ij} \cdot \sqrt{PD_i \cdot (1 - PD_i) \cdot PD_j \cdot \left(1 - PD_j\right)} \quad (10)$$

where ρ_{ij} is the default correlation between bank i and bank j, which is imputed from correlation of default probability measures for each bank in the MKMV database. See Schlögl (2004) for more details about mathematical derivation of the joint default probability.

If EL reflects the level of losses that the government may expect to bear on average, UL represents the additional losses that the government may incur under a worse-case scenario. In the final analysis, we define contingent liabilities as expected losses from the whole banking sector plus two standard deviations of losses (i.e. ELt+2ULt). Roughly, this reflects contingent liabilities that could materialize with a likelihood of 5 percent in an adverse scenario.8

4. Data (Contingent Liability Estimates)

4.1 Estimates

In this section, we implement the above method to provide estimates of contingent liabilities from the banking sector for 32 countries, including 18 advanced and 14 emerging market economies. The data sources for these estimates are Moody's KMV (MKMV), Markit, and Bankscope. The time frame for the analysis is monthly and covers the period from June 2006 to June 2012.

Banks were included in the sample in descending order of their asset size in each country. The exercise was conducted at the highest level of consolidation covering all subsidiaries and branches including those operating in foreign countries. This effectively means that foreign-owned banks in host countries were excluded from the sample. In another word, for each country, we capture domestically controlled banks with consolidated assets across borders and assets owned by branches and subsidiaries located outside. The banks selected represent at least 50 percent of the national banking sector total assets for each country (based on end- 2011 figures). Table 1 provides all the countries and banks in our sample

[8] We choose two standard deviations to reflect the 95 percentile of the distribution of losses from the whole banking sector defaults assuming that the distribution of losses is normal. Strictly speaking, the losses are not normally distributed, but it can be approximated as a normal distribution when the sample size (i.e the number of banks in the sample) is large, consistent with the Central Limit Theorem. Given the negative skewness of the loss distribution from a credit portfolio, these are losses that may arise with 5 percent *or less* likelihood.

We firstly calculate bank-by-bank contingent liability estimates for a total of 245 banks from the 32 countries. Most of these banks have publicly traded equity for which we use standard EDF measures from MKMV as a measure of default probability. But for a few other that are not publicly traded (e.g. regional banks in Germany and some cajas in Spain and Portugal), we use the CDS-implied EDF measure from MKMV to be a proxy of default probability. See Appendix B and Moody's Analytics, 2010 for more details about the two measures.

Countries in our sample can be broken down into (i) two groups by income: Advanced and Emerging; and (ii) six groups by region, as follows:

• Advanced Countries (North America): Canada, United States (2)

• Advanced Countries (Core Europe): Austria, France, Finland, Denmark, Germany, Norway, Sweden, Switzerland, United Kingdom (9)

• Advanced Countries (Periphery Europe): Greece, Ireland, Italy, Portugal, Spain (5)

• Advanced Countries (Asia): Australia, Japan (2)

• Emerging Market Countries (Asia)[9]: China, India, Indonesia, Korea, Malaysia, Philippines Singapore, Thailand (8)

• Emerging Market Countries (Non-Asia): Brazil, Chile, Colombia, Russia, South Africa, Turkey (6)

Advanced Countries

[9] Including newly industrialized Asian economies (Korea and Singapore).

For advanced countries, the sample covers 130 banks in 18 countries with total assets of around US$ 65 trillion. In particular, for the United States, the sample includes 22 bank holding companies (BHC), each with assets greater than $50 billion at end-2011. Their total assets are about $12 trillion and they cover all the financial institutions that were subject to the 2009 U.S. Supervisory Capital Assessment Program (SCAP) exercise, except for an auto-finance company (GMAC) and an insurer (Met Life). For Canada, the largest 9 banks are included in the sample, with total assets of about $3 trillion. For Europe, the sample includes 76 banks in 14 countries with total assets of $38 trillion. These banks cover most of the EU banks included in the 2011 recapitalization exercise of the European Banking Authority (EBA). Finally, the largest banks in Australia and Japan are included in the sample with total assets of $3 trillion and $8 trillion, respectively.

Emerging Countries

For emerging market countries, the sample covers 115 banks in 14 countries with total assets of around US$ 21 trillion. In particular, for Asian countries, the sample includes 81 banks with total assets of around $17 trillion at end-2011. The majority of these assets are accounted by 15 Chinese banks with assets of around $12.5 trillion. Among others, Indian and Korean banks have about $1.4trillion of assets each; Singaporean banks have $700 billion of assets; Malaysian banks $500 billion of assets; Thai banks $300 billion of assets; Indonesian banks $200 billion of assets; and Philippine banks $100 billion of assets. For non-Asian countries, the sample includes 34 banks with about $4 trillion of assets. Among these, Brazilian banks have about $2 trillion of assets; Russian banks have about $700 billion of assets; Turkish banks have $400 billion of assets; South African banks have $300 billion of assets; and Chilean and Colombian banks have about $100 billion of assets each.

Table 2 summarizes statistics of these bank-by-bank contingent liability estimates before and after crisis. It is clear to see that the recent crisis led to a large increase in the size of total liabilities and the highly correlated expectations of government support across numerous banks in every country, and hence induced a considerable risk transferred from banks to governments through the hugely increased contingent liabilities. The periphery European countries are particularly suffering from this challenge. The average bank-by-bank contingent liabilities in Greece and Ireland are respectively jumping from 1.14 % of GDP to 21.23% of GDP, from 1.88% of GDP to 55.57% of GDP after crisis. These increases account for more than 20% of GDP in these countries, and are creating a large burden on governments' fiscal positions.

We then aggregate contingent liabilities from individual banks to obtain joint contingent liabilities from the whole banking system for the above countries. Figure 1 report the sizes of the estimated contingent liabilities and their recent trends for these country groups[10], based on a simple average of contingent liabilities across all countries in each group. We observe that the build-up of contingent liabilities in many country groups have started as early as 2008, indicating already high potential government exposure to joint banking sector distress in the advent of recent financial crisis. This highlights the importance of monitoring contingent liabilities and putting preventive actions in place, at least to mitigate the impact of the materialization of these liabilities.

Moreover, these contingent liabilities are sizeable. The average contingent liabilities in advanced countries exceeded 1 percent of GDP at the end of 2008, and almost reached 10 percent of GDP in 2009. Particularly, the contingent liabilities in core European and periphery European advanced countries are even above 1.5percent and 10percent of GDP in 2009, and as such drive the whole country into a debt crisis as has happened recently in Europe. Even though the emerging countries

[10] Due to space limitation, the figure only displays the size of aggregated contingent liabilities of all countries, advanced countries and emerging countries. The figure displays the size of aggregated contingent liabilities of other country groups is available upon request.

have a relative small size of contingent liabilities, and these contingent liabilities have diminished since the peak of the crisis in 2009, the banking system in emerging countries are growing more steeply as compared to advanced countries, and prudential regulations on these contingent liabilities will become essential as their banking sector become larger.

In addition, we notice some differences in the dynamics of expected government support across country groups. The plot of this series has been pretty flat in the case of EM countries, but has a time-varying pattern in the case of AM countries. The expected government support remains at 70% from 2006 to 2012 in EM countries, but that varies over time in AM counties, with a big drop from 70% to 30% from 2007 to 2008. These findings indicate that the banking sectors in EM countries rely on the government more than those of advanced countries, and the associated contingent liabilities are more likely realized when banks default in EM countries.

Meanwhile, we take United States as an example to illustrate how the diversification and dependence effects between banks can be controlled by our method. Figure 2reports the expected losses and unexpected losses from banking sector failure in United States. The blue line, which is referred to as “E1” in the figure, represents the simple summation of expected losses from each bank. It spikes as early as April 2008, and peaks at about 250 billion U.S dollars at the end of March 2009, indicating high government risk exposure to joint financial sector distress in the wake of the Bear Stearns bailout.

After introducing the “diversification effect”, the expected losses from the whole banking sector is presented by red line, which is referred to as “EL2” in the figure. Although this line is also highest between the periods just after the collapse of Lehman Brothers in September 2008 and end-July 2009, it drops significantly from EL1. This provides strong evidence that the U.S government indeed has a diverse banking sector, in which the potential losses from some banks can be offset by potential gains in other banks, and our method is able to successfully remove this “diversification” effect when calculating contingent liabilities.

The orange dotted line in the figure represents the unexpected losses, that is, the expected losses from the whole banking sector plus two standard deviations of losses (EL2+2UL). Compared with EL1 and EL2, the unexpected losses have much higher magnitude, particularly from September 2008 to the end of 2009. As discussed in Section 3, the unexpected losses reflect the potential tail risk transferred to the government from the banking sector under a worse-case scenario, the orange dotted line in the figure verifies that the systemic tail risk becomes particularly significant during the crisis period due to the bank distress contagion.

4.2 Attribution Analysis

Overall, we observe a large change in contingent liabilities over the last five years for all the countries. The main drivers of these changes can be summarized into three factors: (i) changes in the size of bank balance sheets (which is represented by banks' total liabilities in Figure 1); (ii) changes in the riskiness of bank balance sheets (which is represented by expected default frequency in Figure 1); and (iii) changes in the expectation of state support to the banking sector in event of distress (which is represented by expected government support in Figure 1).

Among the three factors, the riskiness of bank's balance sheets becomes the largest driver. Figure 3 illustrates the proportions of the three factors contributing to the increase of contingent liabilities, and it shows that, for advanced and emerging countries alike, most of the changes in contingent liabilities can be explained by the market’s perception of the likelihood of banks falling into distress.

The second most important driver differs among advanced and emerging countries. For advanced countries, the second most important driver has been the expectation of state support to the banking sector, which contributed most significantly to contingent liabilities in 2008. For emerging market countries, on the other hand, the second largest driver has been the growing size of their bank balance sheets. In fact, despite a temporary slowdown in 2008, bank balance sheets have continued to grow for emerging countries. For advanced countries, however, bank balance sheets have declined after 2008, leading to somewhat lower contingent liabilities for the government.

The different role played by these factors point to the following conclusions. Although emerging markets seem to have less contingent liabilities coming from government support expectations, the growing size of the banking balance sheet in these countries, may make it more likely for the government to intervene when and if needed. At the same time, for advanced countries, the risk of bank balance sheets is along with the ongoing expectations of government support in case something happens to the banking sector. In the long run, if this expectation does not change, contingent liabilities are likely to remain high for advanced countries.

5. Contingent Liability and Sovereign CDS Spread

Based on the above constructed contingent liability database, in this section, we can establish an important relationship between contingent liabilities from the banking sector and sovereign credit risk, which could help explain how the risk is transferred from banks to the government in the event of distress.

More specifically, we first employ both ordinary least square (OLS) regressions and Vector Auto-Regressive (VAR) projections to investigate whether the contingent liabilities for the banking sector is a significant exploratory variable for the determination of sovereign risk, as measured by sovereign CDS spreads. We also investigate if the relationship between contingent liabilities and sovereign CDS spreads changed during the recent global financial crisis.

5.1 Panel Unit Root Test and Panel Co-integration Test

As macroeconomics variables are usually non-stationary, at first it is important to know about the stationary properties of contingent liabilities and sovereign CDS spreads. Our sample is a panel database including 32 countries' time series spanning from June, 2006 to June, 2012, therefore, four panel unit root tests are applied to examine the null hypothesis of having unit root in series of contingent liabilities and sovereign CDS spread.

The four panel unit root tests employed here include Levin et. al. (2002) (herein referred to as LLC), Im et al. (2003) (herein referred to as IPS), Breitung (2000) (herein referred to as BRT), and Fisher-type test proposed by Maddala and Wu (1999) and Choi (2001).

The results of the four panel unit root tests on the level of series of contingent liabilities and sovereign CDS spreads for different country groups suggest that the null hypothesis of unit root is unable to reject on the two series by all the tests, which indicates that contingent liabilities and sovereign CDS spreads are both non-stationary in levels.[11] We therefore take first difference on both series to see whether the non-stationary will be removed or not. The fact that the two non-stationary series become stationary after taking first difference implies that both contingent liabilities and sovereign CDS spreads are I(1) processes.

However, a structural break may cause a series is mistakenly regarded as a non-stationary process. As shown by Perron (1989), allowing for a structural break when testing for a unit root is extremely important. In our study, a robust check has been carried out to perform panel unit root tests with structural breaks on the two series, because we aware that it is possible to have homogeneous breaks in each cross section unit triggered by the recent financial crisis[12].The two series are still characterized as I(1) processes after taking structural breaks into account.

[11] The results are not reported here, and they are available upon request.

[12] The results are not reported here, and they are available upon request.

As both contingent liabilities and sovereign CDS spread are I(1) process, we further investigate whether there is a co-integration relationship between them or not, so that we can decide an appropriate model to exam their causality. We employ three panel co-integration tests, including Pedroni (1999, 2004) tests, Persyn and Westerlund (2008) test and Johansen-type panel co-integration test developed by Maddala and Wu (1999) to examine the null hypothesis that there is no co-integration between contingent liabilities and sovereign CDS spreads.

The results of the three co-integration tests[13] on contingent liabilities and sovereign CDS spreads for different country groups indicate that the null hypothesis that there is no co-integration between the two variables cannot be rejected, which implies that the contingent liabilities and sovereign CDS spreads are not co-integrated.

Overall, the contingent liabilities and sovereign CDS spreads are I(1) processes with a unit root, but they are not co-integrated. We will use OLS regression and VAR model to study their causality.

5.2 Ordinary Least Square (OLS) Regression

To avoid unit root problems with the OLS estimation, we use first differences for the sovereign CDS spreads (variable "dsov") as dependent variable and first differences for the contingent liability (variable "dcliab") as independent variable to simply explore the impact of contingent liability on sovereign risk for each country (see regression (5.2) below). Since the relationship needs to be evaluated across time and across countries, we also implement a panel data regression to obtain the aggregate relationship and country-specific heterogeneity (see regression (5.3) below). For the sake of testing if there is a structure break in the relationship during the crisis, we incorporate a dummy variable "crisis" into the regressions, where crisis=1 from July, 2007 to Dec, 2009; otherwise crisis=0. These OLS regressions are specified as:

$$\mathrm{dsov}_{it} = \beta_{1i} + \beta_{2i}\mathrm{dcliab}_{it} + \beta_{3i}\mathrm{crisis}_{it} + \beta_{4i}\mathrm{dcliab}_{it} * \mathrm{crisis}_{it} + \varepsilon_{it}, \quad (5.2)$$

[13] The results are not reported here, and they are available upon request.

$$\mathrm{dsov}_{it} = \beta_1 + \beta_2 \mathrm{dcliab}_{it} + \beta_3 \mathrm{crisis}_{it} + \beta_4 \mathrm{dcliab}_{it} * \mathrm{crisis}_{it} + f_i + \varepsilon_{it}, \qquad (5.3)$$

where $i = 1,2, \dots, N,$ and f_i is introduced as fixed effects in the panel regression to allow for "individual heterogeneity".

We firstly run the regression (5.2) for each country in our sample, and the results are reported in Table 3. Then, we implement panel regression (5.3) for three big groups of countries: (i) all countries, (ii) advanced countries, (iii) emerging countries, and six small country groups as listed in Section 4. Results of these panel regressions are reported in Table 4. Contingent liabilities are significantly and positively correlated with sovereign CDS spreads in all samples, at the 1% confidence level, with the exception of the advanced Asian group, where it is significant at only 10% level, and the emerging non-Asian group, where it is significant at 5% level. Contingent liabilities have the largest impact on the sovereign risk in the emerging non-Asian countries, with 1% increase in contingent liabilities would cause around 30bps increase in sovereign CDS spreads, while the smallest impact in the advanced Asian countries, with 1% increase in contingent liabilities would cause only around 2bps increase in sovereign CDS spreads. In addition, contingent liabilities seem to matter more for the emerging economies group, as a 1% increase in contingent liabilities would be associated with 25bps increase in sovereign CDS spreads, while the impact for the advanced group is close to 8bps.

After introducing the dummy variable "crisis" into the regression, we do observe a significant structure break in the relationship between contingent liabilities and sovereign CDS spread during the crisis. The coefficients of the dummy intercept term are all significantly positive for each country and most of country groups at the 5% level, indicating that the impact of contingent liabilities on the sovereign CDS spreads is larger during crisis period.

To investigate whether the inclusion of macro-financial variables would change the results above and how macro-financial variables are interlinked with the sovereign credit risk, we also run multivariate regressions in an effort to include some control macro-financial variables. The original set of macro-financial variables used in this analysis is listed in Table 5.

In order to identify which macro-financial variables are most relevant for explaining sovereign risk dynamics, we run regressions for each country (see regression (5.4)) and the panel data (see regression (5.5)) against the full set of macro-financial variables as:

$$\mathrm{dsov}_{it} = \beta_{1i} + \beta_{2i}\mathrm{dcliab}_{it} + \beta_{3i}x_{it} + \varepsilon_{it},\ \ i = 1,2,\ldots,N, \quad (5.4)$$

$$\mathrm{dsov}_{it} = \beta_{1} + \beta_{2}\mathrm{dcliab}_{it} + \beta_{3}x_{it} + f_i + \varepsilon_{t},\ \ i = 1,2,\ldots,N, \quad 5.5)$$

where x_{it} is the full set of the first difference of macro-financial variables, as our test results show that all of them have a unit root.[14]

We report results from these multivariate regressions for country groups in Table 6. These results show that the positive relationship between sovereign risk and contingent liabilities continue to be statistically significant at the 1% confidence level, even after controlling for macro-financial factors. It also further highlights how the market perceives the impact of contingent liabilities on sovereign risk more acutely for the emerging markets group. Now, an increase of 1% of GDP in the contingent liabilities would be associated with an increase of about 16bps for the emerging markets group, compared to a 8bps increase for the advanced groups. The relationship between macro-financial factors and the sovereign risk seem to be generally intuitive and in the expected direction.

5.3 Vector Auto-Regressive (VAR) Model

The above OLS analysis suggests that the contingent liability triggered by the banking sector is a significant source of sovereign risk, and its impact on the sovereign risk varies across the country groups. However, as banks in most countries hold sovereign bonds as part of their assets, there could be a feedback loop from sovereign risk to contingent liabilities from the banking sector. This effect may cause OLS regression we used above to not be a robust technique to analyze the causality

[14] The test results are not reported here, which is available upon request.

between the two variables. To control for this potential endogeneity problem, we employ the VAR estimation as a robust check to investigate the impact of contingent liability on sovereign risk.

As contingent liabilities and sovereign CDS spreads are not co-integrated, we can use the standard Panel VAR model on the first difference of the two variables to study their interaction. We estimate unrestricted VAR models for each country (See VAR specification system (5.6)) and the panel data (see VAR specification system (5.7)), in which the contingent liabilities and sovereign risk are included as endogenous variables, as follows:

$$(5.6)\begin{cases} dsov_{it} = \alpha_{1i} + \sum_{j=1}^{k} \Pi_{11i,j}\, dsov_{it-j} + \sum_{j=1}^{k} \Pi_{12i,j}\, dcliab_{it-j} + \varepsilon_{it}, \quad i = 1,2,\dots,N \\ dcliab_{it} = \alpha_{1i} + \sum_{j=1}^{k} \Pi_{21i,j}\, dsov_{it-j} + \sum_{j=1}^{k} \Pi_{22i,j}\, dcliab_{it-j} + \varepsilon_{it}, \quad i = 1,2,\dots,N \end{cases}$$

$$(5.7)\begin{cases} dsov_{it} = \alpha_{1} + \sum_{j=1}^{k} \Pi_{11,j}\, dsov_{it-j} + \sum_{j=1}^{k} \Pi_{12,j}\, dcliab_{it-j} + f_i + \varepsilon_{it}, \quad i = 1,2,\dots,N \\ dcliab_{it} = \alpha_{1} + \sum_{j=1}^{k} \Pi_{21,j}\, dsov_{it-j} + \sum_{j=1}^{k} \Pi_{22,j}\, dcliab_{it-j} + f_i + \varepsilon_{it}, \quad i = 1,2,\dots,N \end{cases},$$

where the coefficients $\Pi_{11,j}$ and $\Pi_{12,j}$ represents the impact of past sovereign CDS spreads and contingent liabilities on the current sovereign CDS spreads, and $\Pi_{21,j}$ and $\Pi_{22,j}$ represents the impact of past sovereign CDS spreads and contingent liabilities on the current contingent liabilities.

Table 7 reports the estimation results from unrestricted panel VAR model with three lags, and top panel of Figure 4 presents the impulse response graphs from the VAR model forall the countries[15]. They indicate a negative feedback loop between sovereign CDS spreads and financial stability. In all the countries of our sample, an increase in contingent liabilities from the banking sector leads to an

[15] Due to space limitation, the figure does not present the impulse response graphs from the VAR model for other country groups. These graphs are available upon request, and we provide the corresponding descriptions of these graphs in the main text later.

increase in sovereign CDS spreads for the next six months, while an increase in sovereign CDS spreads is associated with an increase in contingent liabilities from the banking sector for the next four months. Among the different country groups, the advanced periphery European country group exhibits the strongest interaction between contingent liabilities and sovereign CDS spreads, with 1% increase in contingent liabilities would cause around 20bps increase in sovereign CDS spreads after around one month, and 1bps increase in sovereign CDS spreads would lead around 4% increase in contingent liabilities after around two months. Meanwhile, the interaction between contingent liabilities and sovereign CDS spreads is stronger and lasts longer in the advanced countries than the emerging countries.

Moreover, we still employ the macro-financial variables listed in Table 5 as exogenous control variables in the VAR model. To reduce the dimensionality of the state space, we follow Gray and Walsh (2008) to apply principal component analysis (PCA) to the system of 13 macro-financial variables and obtain three principal factors called “financial factor”, “cyclical factor” and “domestic factor” for each country. The procedure produces 13 orthogonal factors, each of which is actually a linear combination of all the macro-financial variables. In most countries, the first four factors account for more than 70% of the variation of all the underlying variables. Hence, we select the first three factors and apply a varimax rotation to them. The rotation procedure does not change the orthogonality of the factors, but scale the factor loadings as close to either one or zero, which allows us to interpret these factors as something highly correlated with a small number of these variables, rather than a linear combination of all 13 of them. The “financial factor” commoves strongly with returns on the S&P 500 index, the domestic equity index and the VIX index. The “domestic factor” weighs most largely country-specific variables such as unemployment rate, industry production and inflation. The third factor is heavily associated with changes to oil and copper prices, which we label as “cyclical factor”, since oil and copper prices tend to move with the business cycles.

We next estimate VAR models for each country (see VAR specification (5.8)) and the panel data (see VAR specification (5.9)), in which the contingent liabilities and sovereign risk are included as endogenous variables, and the three macro-financial factors are treated as exogenous variables, as follows:

$$(5.8)\begin{cases} \mathrm{dsov}_{it} = \alpha_{1i} + \sum_{j=1}^{k} \Pi_{11i,j}\,\mathrm{dsov}_{it-j} + \sum_{j=1}^{k} \Pi_{12i,j}\,\mathrm{dcliab}_{it-j} + \sum_{j=1}^{k} \Pi_{13i,j}\,x_{it-j} + \varepsilon_{it}, \\ \qquad i = 1,2,\dots,N \\ \mathrm{dcliab}_{it} = \alpha_{1i} + \sum_{j=1}^{k} \Pi_{21i,j}\,\mathrm{dsov}_{it-j} + \sum_{j=1}^{k} \Pi_{22i,j}\,\mathrm{dcliab}_{it-j} + \sum_{j=1}^{k} \Pi_{23i,j}\,x_{it-j} + \varepsilon_{it}, \\ \qquad i = 1,2,\dots,N \end{cases}$$

$$(5.9)\begin{cases} \mathrm{dsov}_{it} = \alpha_{1} + \sum_{j=1}^{k} \Pi_{11,j}\,\mathrm{dsov}_{it-j} + \sum_{j=1}^{k} \Pi_{12,j}\,\mathrm{dcliab}_{it-j} + \sum_{j=1}^{k} \Pi_{13,j}\,x_{it-j} + f_i + \varepsilon_{it}, \\ \qquad i = 1,2,\dots,N \\ \mathrm{dcliab}_{it} = \alpha_{1} + \sum_{j=1}^{k} \Pi_{21,j}\,\mathrm{dsov}_{it-j} + \sum_{j=1}^{k} \Pi_{22,j}\,\mathrm{dcliab}_{it-j} + \sum_{j=1}^{k} \Pi_{13,j}\,x_{it-j} + f_i + \varepsilon_{it}, \\ \qquad i = 1,2,\dots,N \end{cases}$$

The estimation results of panel VAR including macro-financial factors for different country groups are reported in Table 8. The impulse responses from the above VAR specification for all the countries are provided in bottom panel of Figure 4. The negative feedback between sovereign CDS spreads and financial stability in all the country groups are still preserved after introducing control variables. The contingent liabilities stemming from the banks have a significant impact on the creditworthiness of the sovereigns, and in turn, high sovereign credit spreads could then spill over and increase bank spreads and funding pressures, and the corresponding contingent liabilities. This further verifies that the health of the banking system and the sovereign risk have become more closely intertwined as a result of the unprecedented public support for banking systems during the crisis.

6. Conclusion

In this paper, we have constructed estimates of contingent liabilities from banking sector for many countries, and identified some recent trends of these contingent liabilities. The results of our study point to the following conclusions:

- Size of the banking sector matters. Countries that had higher banking sector are, all else equal, more likely to have higher contingent liabilities from the banking sector;

- Banking sector leverage matters. Countries, in which banks have a high "market leverage", measured as market value of assets / market value of equity, tend to have higher contingent liabilities;

- Volatility of banking sector assets matter. Countries whose banks have more volatile business models, measured through their volatility of market assets, are exposed to higher contingent liabilities; and

- Concentration matters. Banking systems that are concentrated into a few banks will benefit less from the "diversification benefit" as we explained earlier in the paper. Hence contingent liabilities may be much higher in these cases. This was indeed the case for Ireland, where the domestic banking sector was consisted mainly of three large banks.

In principle, this study is able to provide some practical guideline for the government risk management. According to the estimated contingent liabilities, the government can set up a contingent fund which could be financed by charging banks the value of the sovereign guarantee. One way the pricing of such a fund could work is as follows. The annual fee of the fund could be set to cover expected losses. The capital base of the fund could be set to provide a cushion against unexpected losses at a desired confidence level. If desired, the government could also include a risk premium in the annual fee to charge a "fair-value" fee for the guarantee that it is providing. However, given that the risk premium usually rises during financial turmoil, this could create adverse dynamics to financial stability and undermine the government's role as the "insurer of last resort."

Meanwhile, we investigate the relationship between sovereign risk, as measured by sovereign CDS spreads, and the estimated contingent liabilities, and how countries' fundamentals could change this relationship.

We find that changes in sovereign CDS spreads are associated with changes in contingent liabilities from the banking sector, even after controlling for relevant macro-financial determinants of sovereign spreads. This is an important result. It suggests that markets pay attention to contingent liabilities, even though they are not always easy to measure and/or disclosed by country authorities. The fact that markets think that contingent liabilities matter suggests that country authorities should pay more attention to them, including by disclosing more information about them in government financial accounts (as recommended by GFSM 2001), which could help reduce sovereign spreads or, at least, reduce market uncertainty. It also suggests that rating agencies should pay more attention to contingent liabilities in the issuance of sovereign ratings.

We also find that sovereign CDS spreads of emerging market countries are more sensitive to changes in contingent liabilities from the banking sector than advanced countries. In particular, a 1 percent of GDP increase in these liabilities is associated with a 75 bps increase in G20EM spreads, while the same increase is associated with a 24 bps increase for G20AM spreads. This could potentially be an indication that markets have more confidence in advanced countries than emerging market economies for managing contingent liabilities, given the arguably better institutional framework that exists in advanced countries for crisis management and resolution.

Finally, a negative feedback looks seems to exist between sovereign risk and financial stability. The VAR analysis shows that both sovereign CDS spreads and contingent liabilities have an impact on each other. This confirms the view that sovereign risks and financial stability have two way linkages. Any deterioration in one leads to a deterioration in the other. This suggests that the link between sovereign risk and financial stability needs to be monitored closely by bank regulators to avoid vicious cycles.

Appendix A. Some Examples of Contingent Liabilities

Explicit Contingent Liabilities:

- Commercial bank deposit and other balance sheet guarantees
- State insurance programs (crops, flood)
- Loan guarantees (for other levels of government, public corporations)
- Exchange rate guarantees
- Demand/revenue guarantees in public-private partnership contracts
- Underfunded entitlement programs
- Uncalled capital and other potential legal obligations
- Guarantees issued against possible environmental liabilities

Implicit Contingent Liabilities

- Banking system bailouts
- Coverage of liabilities of privatized entities
- Investment failure of nonguaranteed pension, employment, and social protection funds
- Environmental and disaster relief

- Debt obligations of sub-national governments

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Table 1A. Sample of Countries and Banks (Advanced Countries)

Australia
National Australia Bank Ltd
Commonwealth Bank of Australia
Westpac Banking Corporation
Australia and New Zealand Banking Group
Macquarie Group Ltd
Suncorp Group Ltd
Bendigo and Adelaide Bank Ltd
Bank of Queensland Ltd

Austria
Erste Group Bank AG *
Raiffeisen Bank International (RBI) *
Oesterreichische Volksbank AG *
BAWAG PSK Group
Hypo Alpe-Adria-Group

Canada
Royal Bank of Canada (RBC)
Toronto-Dominion Bank
Bank of Nova Scotia
Bank of Montreal
Canadian Imperial Bank of Commerce (CIBC)
National Bank of Canada
Laurentian Bank of Canada
Manulife Bank of Canada
Canadian Western Bank

Denmark
Danske Bank *
Jyske Bank *
Sydbank *

Finland
Pohjola Bank Plc *
Aktia Bank Plc
Bank of Aland Plc

France
BNP Paribas *
Credit Agricole *
Societe Generale *
BPCE *
Banque Federative du Credit Mutuel

Germany
Deutsche Bank AG *
Commerzbank AG *
DZ Bank AG *
Landesbank Baden-Wuerttemberg *
Bayerische Landesbank *
Hypo Real Estate Holding AG *
Norddeutsche Landesbank GZ (Nord/LB) *
Landesbank Hessen-Thüringen GZ (HELABA) *
WestLB AG *
HSH Nordbank AG *
Landesbank Berlin Holding (LBB) *

Greece
National Bank of Greece SA *
Eurobank Ergasias SA *
Alpha Bank *
Piraeus Bank SA *
Agricultural Bank of Greece SA (ATEbank) *
TT Hellenic Postbank SA *

Ireland
Bank of Ireland *
Allied Irish Banks Plc *
Permanent TSB Plc (formerly Irish Life & Permanent) *
Anglo Irish Bank (until Dec 2008) ***

Italy
UniCredit SpA *
Intesa Sanpaolo *
Banca Monte dei Paschi di Siena SpA *
Banco Popolare *
Unione di Banche Italiane Scpa (UBI Banca) *

Japan
Mitsubishi UFJ Financial Group
Mizuho Financial Group
Sumitomo Mitsui Financial Group
Norinchukin Bank
Resona Holdings
Fukuoka Financial Group
Bank of Yokohama
Chiba Bank
Hokuhoku Financial Group
Shizuoka Bank
Yamaguchi Financial Group
Shinsei Bank
Joyo Bank
Sapporo Hokuyo Holdings
Nishi-Nippon City Bank

Norway
DnB Bank ASA *
SpareBank 1 SR-Bank
Sparebanken Vest
SpareBank 1 SMN
Sparebank 1 Nord-Norge

Portugal
Caixa Geral de Depositos SA *
Banco Comercial Portugues SA (BCP) *
Espirito Santo Financial Group SA (ESFG) *
Banco BPI SA *
Banco Internacional do Funchal SA (BANIF)

Spain
Banco Santander SA *
Banco Bilbao Vizcaya Argentaria SA (BBVA) *
BFA-Bankia *
Caixabank SA (formerly Caja de Ahorros y Pensiones de Barcelona) *
Banco Popular Espanol SA *
Banco De Sabadell SA
Catalunya Caixa
Nova Caixa Galicia

Sweden
Nordea Bank AB *
Svenska Handelsbanken AB *
Skandinaviska Enskilda Banken AB (SEB) *
Swedbank AB *

Switzerland
UBS AG
Credit Suisse Group AG
Basler Kantonalbank
Banque Cantonale Vaudoise
Luzerner Kantonalbank AG
St. Galler Kantonalbank AG
Valiant Holding
Berner Kantonalbank AG

United Kingdom
HSBC Holdings Plc *
Barclays Plc *
Royal Bank of Scotland Group Plc *
Lloyds Banking Group Plc *
Standard Chartered Plc
HBOS Plc (until Dec 2008) ***
Northern Rock (until Jan 2008) ***

United States
JP Morgan Chase & Co. **
Bank of America Corporation **
Citigroup Inc **
Wells Fargo & Company **
Goldman Sachs Group, Inc **
Morgan Stanley **
U.S. Bancorp **
Bank of New York Mellon Corporation **
PNC Financial Services Group Inc **
State Street Corporation **
Capital One **
SunTrust Banks, Inc. **
BB&T Corporation **
American Express Company **
Regions Financial Corporation **
Fifth Third Bancor **
KeyCorp **
M&T Bank Corporation
Discover Financial Services
Comerica Inc
Huntington Bancshares Inc
Zions Bancorporation
Bear Stearns Companies Inc (until Mar 2008) ***
Lehman Brothers Holdings Inc (until Sep 2008) ***
Merrill Lynch & Co Inc (until Sep 2008) ***
Wachovia Corporation (until Sep 2008) ***
Washington Mutual Inc (until Sep 2008) ***

Note: Banks included in the 2011 EBA recapitalization exercise are market above with a *. Banks included in the 2009 US SCAP exercise are market above with a **. Banks that are not included in the full sample period (June 2006-June 2012) are market above with a ***, as they have ceased to exist either because they became bankrupt, liquidated, or acquired by another bank in the sample. Banks without publicly traded equity are in italics.

Table 1B. Sample of Countries and Banks (Emerging Market Countries)

Brazil
Banco do Brasil SA
Itau Unibanco Holdings
Banco Bradesco SA
Banco Nacional de Desenvolvimento Economico e Social (BNDES) *
Caixa Economica Federal *

Chile
Banco de Chile
Banco de Credito e Inversiones (BCI)
CorpBanca
Grupo Security

China
Industrial & Commercial Bank of China (ICBC) *
China Construction Bank *
Bank of China *
Agricultural Bank of China *
China Development Bank *
Bank of Communications *
China Merchants Bank *
China CITIC Bank *
Shanghai Pudong Development Bank *
China Minsheng Banking Corporation
Industrial Bank *
China Everbright Bank *
Ping An Bank *
Hua Xia Bank *
Bank of Beijing *

Colombia
Bancolombia
Banco de Bogota
Banco Davivienda
Banco de Occidente
Banco Popular

India
State Bank of India *
ICICI Bank Limited
Punjab National Bank *
Bank of Baroda *
Bank of India *
Canara Bank *
HDFC Bank Ltd
IDBI Bank Ltd *
AXIS Bank Limited
Union Bank of India *
Central Bank of India *
Indian Overseas Bank *
Allahabad Bank *
Syndicate Bank *
UCO Bank *
Oriental Bank of Commerce *
Corporation Bank *
Indian Bank *
Andhra Bank *
United Bank of India *
Vijaya Bank *
Kotak Mahindra Bank
Bank of Maharashtra *
Dena Bank *

Indonesia
Bank Mandiri *
Bank Rakyat Indonesia (Bank BRI) *
Bank Central Asia
Bank Negara Indonesia (Bank BNI) *
Bank Danamon Indonesia Tbk
Bank Pan Indonesia (Panin Bank)
Bank Internasional Indonesia (until Sep 2008)
Bank Tabungan Negara (Bank BTN) *
Bank Mega

Korea
Woori Financial Group
NH Financial Group
Shinhan Financial Group
KB Financial Group
Industrial Bank of Korea *
Hana Financial Group
Korea Exchange Bank (until Feb 2012) **

Malaysia
Malayan Banking Bhd (Maybank) *
CIMB Group Holdings Bhd
Public Bank Bhd
Hong Leong Financial Group Bhd
RHB Capital Bhd
AMMB Holdings Bhd
EON Capital Bhd (until May 2011) **
Affin Holdings Bhd
Alliance Financial Group Bhd

Philippines
BDO Unibank
Metropolitan Bank & Trust Company
Bank of the Philippine Islands (BPI)
Rizal Commercial Banking Corp. (RCBC)
Philippine National Bank
Union Bank of the Phlilippines
China Banking Corporation (Chinabank)
Security Bank Corporation

Russia
Sberbank *
VTB Bank *
Gazprombank *
Bank of Moscow (until Dec 2011) *, **
Alfa-Bank OJSC
NOMOS-Bank
Promsvyazbank
TransCreditBank (until Dec 2010) **
MDM Bank
Bank Saint-Petersburg

Singapore
DBS Group Holdings
Oversea-Chinese Banking Corporation (OCBC)
United Overseas Bank (UOB)

South Africa
Standard Bank of South Africa Ltd
FirstRand Bank Ltd
Nedbank Group Ltd
Investec Bank Ltd
African Bank Investments Ltd
Capitec Bank Holdings Ltd

Thailand
Bangkok Bank
Krung Thai Bank *
Siam Commercial Bank
Kasikorn Bank
Bank Of Ayudhya
Thanachart Bank
TMB Bank
Tisco Bank
Kiatnakin Bank

Turkey
Turkiye is Bankasi A.S.
Turkiye Garanti Bankasi A.S.
Akbank T.A.S.
Yapi Ve Kredi Bankasi A.S.
Turkiye Vakiflar Bankasi TAO *
Turkiye Halk Bankasi A.S. *

Note: Government-controlled banks are marked above with a *. Banks that are not included in the full sample period (June 2006-June 2012) are market above with a **, as they have ceased to exist either because they became bankrupt, liquidated, or acquired by another bank in the sample. Banks without publicly traded equity are in italics.

Table 2. Summary Statistics of Contingent Liabilities

	Before Crisis[1/]								After Crisis[2/]							
	Total Liabilities[3/]		Expected Default Frequency[4/]		Expected Government Support[4/]		Contingent Liabilities[3/]		Total Liabilities[3/]		Expected Default Frequency[4/]		Expected Government Support[4/]		Contingent Liabilities[3/]	
	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.	Average	St. Dev.
Advanced Countries (North America)	**118.6**	**4.6**	**0.0**	**0.0**	**51.8**	**12.8**	**0.4**	**0.2**	**125.7**	**8.6**	**0.8**	**0.6**	**66.6**	**12.3**	**1.7**	**0.7**
Canada	152.3	5.1	0.0	0.0	65.2	16.2	0.6	0.2	178.1	12.8	0.4	0.1	38.9	7.2	1.3	0.4
United States	84.9	4.1	0.1	0.1	38.4	9.4	0.2	0.1	73.2	4.3	1.2	1.1	94.4	17.3	2.1	0.9
Advanced Countries (Core Europe)	**236.5**	**12.8**	**0.2**	**0.0**	**66.3**	**10.9**	**1.2**	**0.3**	**247.1**	**23.1**	**1.1**	**0.7**	**73.2**	**15.8**	**5.4**	**2.9**
Austria	136.2	7.8	0.0	0.0	49.8	24.8	0.3	0.2	145.9	6.2	1.5	0.6	93.8	24.5	3.7	1.9
Denmark	182.5	13.3	0.0	0.0	65.8	6.6	1.1	0.6	206.9	11.9	0.4	0.3	37.9	26.0	2.0	1.6
Finland	19.3	0.3	0.9	0.0	65.6	1.3	0.1	0.0	25.3	3.0	0.9	0.6	71.5	2.0	0.4	0.3
France	268.1	12.0	0.1	0.0	61.7	15.6	1.0	0.2	306.6	12.8	0.8	0.9	96.2	14.9	6.7	5.1
Germany	176.4	16.9	0.1	0.0	77.1	7.4	1.0	0.2	202.2	9.9	3.0	1.3	75.5	6.7	5.8	2.6
Norway	68.4	1.9	0.1	0.0	66.4	1.2	0.3	0.1	83.4	7.7	0.7	0.4	47.2	30.7	1.1	0.9
Sweden	263.3	10.9	0.0	0.0	86.3	6.4	1.6	0.3	338.1	26.2	0.3	0.3	70.9	6.9	4.5	2.7
Switzerland	712.0	16.9	0.1	0.1	68.5	12.5	4.3	1.1	516.1	97.3	1.0	0.8	70.7	12.3	13.6	5.3
United Kingdom	302.6	35.5	0.0	0.0	55.2	22.3	1.1	0.3	398.9	32.9	1.1	0.8	95.3	18.5	11.2	5.5
Advanced Countries (Periphery Europe)	**153.9**	**9.9**	**0.1**	**0.0**	**40.5**	**14.1**	**0.4**	**0.2**	**173.9**	**22.3**	**3.0**	**3.0**	**85.8**	**25.6**	**8.0**	**5.2**
Greece	101.3	9.6	0.1	0.0	39.0	18.1	0.3	0.1	139.1	11.2	4.9	5.7	94.0	23.6	10.8	9.3
Ireland	263.0	19.3	0.1	0.1	46.7	16.0	0.8	0.2	249.7	24.7	5.1	3.9	96.9	15.0	17.0	8.2
Italy	91.5	11.5	0.0	0.0	16.6	11.7	0.1	0.0	123.3	4.7	0.8	1.0	89.0	26.4	3.1	2.4
Portugal	168.9	3.9	0.1	0.1	71.9	7.6	0.9	0.5	164.3	38.7	3.6	3.7	68.9	25.9	5.4	2.9
Spain	144.9	5.2	0.0	0.0	28.3	17.2	0.2	0.1	193.3	32.0	0.5	0.5	80.4	37.0	3.5	3.1
Advanced Countries (Asia)	**127.0**	**7.0**	**0.1**	**0.1**	**61.7**	**20.5**	**0.7**	**0.5**	**145.2**	**6.7**	**2.2**	**1.0**	**41.1**	**4.1**	**3.3**	**0.9**
Australia	139.1	10.4	0.0	0.0	48.8	29.0	0.3	0.2	155.7	6.5	0.4	0.2	5.1	2.7	0.3	0.2
Japan	114.8	3.5	0.2	0.2	74.6	11.9	1.1	0.8	134.7	6.9	4.0	1.8	77.2	5.5	6.4	1.6
Emerging Market Countries (Asia)	**88.5**	**6.0**	**0.2**	**0.1**	**65.4**	**9.3**	**0.5**	**0.2**	**104.0**	**9.8**	**0.6**	**0.4**	**52.1**	**8.6**	**1.3**	**0.6**
China	89.6	19.0	0.1	0.1	100.0	0.0	0.5	0.5	130.9	28.1	0.9	0.3	100.0	0.0	3.9	1.5
India	57.5	4.8	0.5	0.3	71.2	7.2	0.8	0.3	71.0	4.4	1.4	0.9	75.0	4.9	1.9	0.6
Indonesia	24.3	0.9	0.3	0.1	79.8	4.6	0.3	0.1	22.6	1.5	0.7	0.6	79.8	2.2	0.4	0.2
Korea	109.0	5.0	0.1	0.0	63.6	13.1	0.4	0.1	125.0	7.0	0.4	0.2	44.3	8.0	1.3	0.5
Malaysia	133.4	6.9	0.1	0.0	61.5	9.0	0.6	0.2	152.3	14.5	0.1	0.1	44.0	8.9	0.8	0.2
Philippines	35.2	1.9	0.3	0.3	37.5	2.9	0.2	0.2	36.9	1.5	1.0	0.8	13.7	21.1	0.2	0.4
Singapore	187.2	7.3	0.0	0.0	47.5	25.3	0.5	0.2	213.3	13.7	0.2	0.1	30.8	18.8	1.2	1.0
Thailand	71.8	1.9	0.2	0.0	61.9	12.1	0.5	0.1	80.0	7.7	0.4	0.3	28.8	5.0	0.6	0.3
Emerging Market Countries (Non-Asia)	**31.4**	**2.3**	**0.2**	**0.1**	**32.1**	**5.5**	**0.1**	**0.1**	**41.2**	**4.7**	**0.6**	**0.4**	**40.1**	**10.0**	**0.3**	**0.2**
Brazil	52.7	2.8	0.1	0.0	14.7	13.6	0.1	0.0	77.2	10.3	0.3	0.1	47.9	11.9	0.6	0.2
Chile	28.7	1.7	0.1	0.0	0.0	0.0	0.0	0.0	35.1	2.7	0.1	0.0	7.9	14.9	0.0	0.1
Colombia	22.0	1.7	0.1	0.0	0.2	0.9	0.0	0.0	26.3	2.3	0.2	0.2	11.8	20.1	0.1	0.1
Russia	23.2	1.3	0.2	0.0	100.0	0.0	0.1	0.1	32.4	4.2	1.4	1.4	99.3	1.0	0.8	0.5
South Africa	30.5	2.6	0.1	0.1	67.6	1.0	0.2	0.1	29.9	3.1	0.4	0.2	65.9	1.8	0.4	0.1
Turkey	31.0	3.9	0.5	0.4	10.1	17.4	0.1	0.2	46.3	5.8	1.3	0.7	8.0	10.5	0.2	0.2

1/ From Jun-2006 to Jun-2008
2/ From Jul-2008 to Jun-2012
3/ In percentage of GDP
4/ In percent

Table 3 Univariate Regression for Individual Countries

$$dsov_{it} = \beta_{1it} + \beta_{2it} dcliab_{it} + \varepsilon_{it}, i = 1, 2, \ldots, N$$

Country	β_{1it}	β_{2it}	Overall R^2
Canada	1.2125(0.55)	51.3366(3.17)**	0.1892
United States	0.4723(0.57)	12.6242(4.50)***	0.3810
Austria	0.5770(0.25)	18.2201(5.51)***	0.3462
France	0.2616(0.23)	9.4546(7.62)***	0.5202
Finland	0.4202(0.42)	24.9124(2.75)**	0.1242
Denmark	1.3128(0.87)	6.9143(1.74)*	0.0997
Germany	0.7690(0.70)	3.4499(2.03)**	0.1045
Norway	0.2947(0.40)	3.2818(1.07)	0.0206
Sweden	0.3556(0.27)	9.7128(2.56)**	0.2675
Switzerland	-1.4208(-0.91)	1.2392(1.34)	0.0498
United Kingdom	0.2408(0.18)	2.7363(2.43)**	0.1922
Greece	151.4015(0.42)	84.0790(0.76)	0.0070
Ireland	7.9793(1.41)	3.6156(2.89)**	0.1709
Italy	1.6069(0.46)	42.5275(4.27)***	0.3454
Portugal	3.1435(0.32)	6.8801(0.44)	0.0060
Spain	5.8986(1.31)	60.0249(2.26)**	0.1143
Australia	0.8876(0.51)	39.9284(0.159)	0.0576
Japan	0.6163(0.34)	3.5471(1.65)*	0.0387
China	-3.5203(-1.46)	33.4495(3.50)***	0.3536
India	-0.4932(-0.10)	39.7927(1.70)*	0.1059
Indonesia	-1.2942(-0.26)	516.4045(6.08)***	0.5969
Korea	-1.5802(-0.38)	132.7940(3.22)***	0.2864
Malaysia	0.0259(0.01)	105.4628(1.99)**	0.1739
Singapore	1.1826(0.57)	2.1420(0.59)	0.0011
Thailand	0.8184(0.24)	114.8442(2.00)**	0.0855
Brazil	-3.7765(-1.12)	252.0748(2.21)**	0.1904
Chile	0.3422(0.12)	453.3765(2.05)***	0.1421
Colombia	-2.7212(-0.66)	459.4739(1.91)*	0.1337
Philippines	-1.0589(-0.22)	231.5410(2.87)***	0.2322
Russia	-2.7667(-0.46)	315.1253(4.17)***	0.5191
South Africa	1.2390(0.33)	105.4012(1.24)	0.0387
Turkey	-3.4564(-0.80)	195.4722(1.58)	0.0970

Note: 1.* p-value<0.01, ** p-value<0.05, * p-value<0.1.**
2. t-statistics are reported in the brackets.

$dsov_{it} = \beta_{1it} dcliab_{it} + \beta_{2it} crisis_{it} + \beta_{3it} dcliab_{it} \times crisis + \varepsilon_{it},\ i = 1, 2, \ldots, N$				
Country	β_{1it}	β_{2it}	β_{3it}	**Overall R^2**
Canada	0.9714(1.98)**	3.8956(0.98)	46.5153(4.57)***	0.5151
United States	6.8257(2.35)**	0.9425(0.59)	2.4656(1.39)	0.4080
Austria	15.7155(3.19)***	2.1456(2.49)**	0.9941(2.40)**	0.3597
France	9.6141(6.81)***	0.1331(0.09)	1.2123(0.70)	0.5483
Finland	27.0879(4.42)***	0.4710(3.27)***	0.0122(0.00)	0.1378
Denmark	1.2782(0.58)	0.1816(0.08)	7.2676(3.51)***	0.2644
Germany	6.9093(2.94)**	0.2631(2.15)**	1.5918(3.13)***	0.1437
Norway	3.0772(3.22)***	0.1822(3.13)***	0.6566(2.25)**	0.2650
Sweden	3.9771(2.42)**	4.2082(1.97)**	8.5402(6.68)***	0.5953
Switzerland	2.1674(3.57)***	2.8455(0.90)	0.7969(1.21)	0.1166
United Kingdom	0.9614(3.31)***	0.2388(2.12)**	2.2299(4.21)***	0.4126
Greece	96.2145(3.77)***	5.6289(1.13)	25.9412(0.62)	0.0092
Ireland	3.5419(1.83)*	2.2659(2.43)**	0.2828(3.25)***	0.1722
Italy	51.6800(5.01)***	2.1563(2.60)**	12.1643(2.42)**	0.4215
Portugal	6.9720(2.39)**	0.4668(3.19)***	1.7992(3.22)***	0.3079
Spain	66.9868(2.38)**	0.8649(3.35)***	6.9732(3.57)***	0.3385
Australia	2.4201(5.11)***	1.9351(3.57)***	25.6017(3.38)***	0.3108
Japan	1.8314(3.61)***	0.9551(2.35)**	2.8440(2.53)**	0.1670
China	27.2603(2.16)**	3.5319(3.80)***	4.5113(6.83)***	0.3534
India	6.8652(1.84)*	2.5964(0.23)	14.9798(1.34)	0.1331
Indonesia	570.5397(2.54)**	3.0456(4.32)***	2.5669(2.03)**	0.5975
Korea	84.4775(2.54)**	8.1640(4.10)***	39.8649(2.58)**	0.3458
Malaysia	201.725(5.06)***	0.6755(3.11)***	45.1715(2.71)**	0.2319
Singapore	33.0982(2.25)**	4.6653(1.38)	3.0911(9.11)***	0.3522
Thailand	225.0405(2.65)**	0.6679(4.11)***	47.3452(2.26)**	0.1082
Brazil	192.7665(1.75)*	3.3773(0.48)	24.9914(0.39)	0.1870
Chile	456.3207(2.06)**	1.1405(3.21)***	20.2245(5.78)***	0.1435
Colombia	306.4579(2.34)**	2.4481(0.29)	53.4177(1.92)**	0.1341
Philippines	798.0547(2.67)**	2.2352(3.24)***	187.8214(1.16)	0.2354
Russia	102.1946(2.34)**	3.2536(2.30)**	97.1465(3.34)***	0.6073
South Africa	15.2347(2.46)**	3.5475(3.42)***	78.5494(2.51)**	0.5943
Turkey	96.9365(3.91)***	2.1982(2.25)**	71.6030(0.79)	0.1210

Note: 1.* p-value<0.01, ** p-value<0.05, * p-value<0.1.**

2. t-statistics are reported in the brackets.

Table 4 Univariate Panel Regression Results

$dsov_{it} = \beta_{1it} + \beta_{2it} dcliab_{it} + \varepsilon_{it}, i = 1, 2, \dots, N$					
	□□□□	□□□□	**Within** □□	**Between** □□	**Overall** □□
All countries	5.5652(0.47)	24.3009(3.32)***	0.0260	0.5337	0.0311
AM countries	10.3187(0.49)	24.1120(6.17)***	0.0240	0.5630	0.0290
EM countries	-1.2989(1.04)	72.6501(10.51)***	0.1083	0.0530	0.1062
AM countries(North American)	0.7409(0.60)	18.6877(4.71)***	0.1469	1.000	0.1466
AM countries(Core Europe)	0.6573(1.27)	6.5154(9.12)***	0.1248	0.0587	0.1210
AM countries(Periphery Europe)	39.5184(0.52)	30.4465(3.98)***	0.0130	0.9332	0.0350
AM countries(Asia)	0.7738(0.61)	3.7479(1.84)*	0.0256	1.0000	0.0254
EM countries(Asia)	-1.1550(-0.68)	51.0129(7.23)***	0.1033	0.0189	0.1010
EM countries(nonAsia)	-1.7744(-1.06)	90.7604(2.13)**	0.2753	0.3240	0.2750

$dsov_{it} = \beta_{1it} + \beta_{2it} dcliab_{it} + \beta_{3it} crisis_{it} + \beta_{4it} dcliab_{it} \times crisis_{it} + \varepsilon_{it}, i = 1, 2, \dots, N$							
	□1□□	□2□□	□3□□	□4□□	Within □2	Between □2	Overall □2
All countries	9.2663 (0.60)	21.5729 (2.49)**	8.4270 (3.35)***	8.0030 (2.01)**	0.0320	0.5721	0.0380
AM countries	17.4541 (0.63)	21.5046 (1.85)*	16.3036 (2.38)***	8.5527 (3.80)***	0.0320	0.5754	0.0380
EM countries	-1.2660 (0.78)	33.4534 (3.50)***	0.3028 (2.12)**	26.1111 (5.71)***	0.1396	0.0771	0.1386
AM countries(North American)	-0.3090 (-0.19)	6.0018 (1.83)*	2.2950 (1.93)*	7.0287 (2.38)**	0.1886	1.0000	0.1882
AM countries(Core Europe)	0.8791 (1.28)	3.2789 (6.20)***	0.4437 (0.43)	0.6639 (1.92)*	0.1303	0.0792	0.1262
AM countries(Periphery Europe)	68.5885 (0.69)	39.2634 (1.97)*	66.5320 (2.43)**	11.1624 (3.69)***	0.0431	0.8011	0.0502
AM countries(Asia)	0.4834 (0.29)	1.5863 (2.49)**	0.3995 (0.15)	3.3323 (1.60)	0.0449	1.0000	0.0428

EM countries(Asia)	-1.0494	30.0213	0.0024	14.5579	0.1227	0.0121	0.1213
	(-0.48)	(3.11)***	(0.00)	(3.14)***			
EM countries(nonAsia)	-1.7293	96.5578	1.0579	80.4451	0.3196	0.3671	0.3197
	(-0.80)	(2.55)**	(2.32)**	(5.38)***			

Note: 1.* p-value<0.01, ** p-value<0.05, * p-value<0.1.**

2. t-statistics are reported in the brackets.

Table 5: Macro-financial Variables

Variables	Descriptions
Inflation rate	It is estimated using CPI prices, source: Haver analytics.
Unemployment rate	Source: Haver analytics.
Equity index	Continuous compounded return on a country broad market equity index, source: DataStream
Interest rate	Domestic deposit interest rate, source: Bloomberg
Exchange rate	Continuous compounded return on exchange rate, defined as domestic currency over US dollar, source: Bloomberg
SP500	Continuous compounded return on the S&P500 index, source: Bloomberg
VIX	Continuous compounded return on the VIX index, source: Bloomberg
Slope	The difference between Tb10 and Tb1. Tb10 is U.S 10-year Treasury bill rate, and Tb1 is U.S 1-year Treasury bill rate, source: Federal Reserve Bank of Saint Louis website (FRED)
Oil price	Continuous compounded return on the oil price, source: Bloomberg
Copper price	Continuous compounded return on the copper price, source: Bloomberg

Table 6 Multivariate Panel Regression Results

$$dsov_{it} = \beta_{1it} + \beta_{2it}dcliab_{it} + \beta_{3it}x_{it} + \varepsilon_{it}, i = 1, 2, \dots, N$$

Variables	**All Countries**	**AM Countries**	**EM Countries**
dcliab	24.649009(2.07)**	24.1548(2.16)**	48.9358(3.63)***
Exchange rate	0.1678(0.66)	9.6697(0.01)	0.0952(9.85)***
Inflation	-11.4311(-2.38)	-32.8639(-0.67)	1.8615(1.44)
Unemployment	22.2118(1.30)	45.5464(3.14)***	-0.1374(-0.06)
Equity Index	-3.3115(0.14)	-18.7201(-3.28)***	0.0686(0.001)***
Interest Rate	0.1955(2.09)**	5.8995(4.95)***	0.1758(0.61)
SP500	-0.060(0.29)	-0.2426(1.09)	-0.2177(-7.41)***
VIX	2.5582(0.53)	5.3836(8.68)***	1.2442(4.80)**
Slope	65.1543(5.79)***	60.3267(4.23)***	11.07784(2.74)***
Oil	1.4334(0.39)	3.9040(0.90)	-0.2685(-1.81)*
Copper	-0.0237(-3.16)***	-0.0455(7.69)***	-0.0065(-3.41)***
Constant	5.1063(0.43)	6.8059(0.32)	0.4443(0.47)
Observations	2112	1188	924
R-squared	0.2891	0.3031	0.5041
No. of Countries	32	18	14

Variables	**AM countries (North American)**	**AM Countries (Core European)**	**AM Countries (Periphery European)**
dcliab	18.3624(3.73)***	1.2884(3.05)**	30.0866(3.09)**
Exchange rate	60.7383(1.05)	4.5470(1.35)	864.5582(0.33)
Inflation	1.3410(0.397)	3.4929(2.88)**	-46.2966(-0.66)
Unemployment	3.3888(1.11)	2.2450(3.28)***	74.3616(1.20)
Equity Index	-1.0306(-2.68)**	-0.3708(-0.26)	-6.2913(-0.33)
Interest Rate	-8.3558(-1.37)	0.5184(0.32)	-121.4074(-0.23)
SP500	-0.0680(-2.11)**	-0.1101(-7.09)***	0.6838(0.69)
VIX	0.1363(1.02)	0.7467(0.038)*	15.7786(0.42)
Slope	4.7775(0.91)	9.4205(4.27)***	586.5350(0.62)
Oil	-0.2287(-1.07)	-0.4457(-1.56)	8.3142(0.66)
Copper	-0.0037(-0.18)	-0.0012(-1.33)	-0.1729(-1.05)
Constant	0.6235(0.52)	1.6703(3.75)***	-3.6892(-0.05)
Observations	132	594	330
R-squared	0.2985	0.3851	0.1670
No. of Countries	2	9	5

Variables	AM countries (Asia)	EM Countries (Asia)	EM Countries (nonAsia)
dcliab	3.9927(2.22)**	10.8021(2.82)**	147.7097(8.30)***
Exchange rate	0.5200(1.57)	0.1040(10.93)***	0.0851(2.25)**
Inflation	2.5209(0.10)	1.5354(0.79)	0.6318(0.27)
Unemployment	9.0368(0.16)	0.8853(0.86)	0.9035(0.37)
Equity Index	-0.5108(0.30)	0.2570(2.46)**	0.0650(3.08)**
Interest Rate	9.3711(0.92)	0.0036(0.24)	0.5855(0.20)
SP500	-0.1314(-3.71)***	-0.1455(-4.24)***	-0.2458(-5.97)***
VIX	0.8183(0.28)	0.9245(3.45)***	1.2016(3.33)***
Slope	-6.0424(-1.77)*	1.9328(6.84)***	11.7327(2.08)**
Oil	-0.0979(-0.19)	-0.3007(0.23)	-0.2491(-1.20)
Copper	-0.0009(-0.01)	-0.0110(3.15)***	-0.0054(-2.02)**
Constant	1.6161(1.59)	-6.9502(2.20)**	-0.1935(-0.15)
Observations	132	462	462
R-squared	0.4707	0.5251	0.5730
No. of Countries	2	7	7

Note: 1.* p-value<0.01, ** p-value<0.05, * p-value<0.1.**

2. t-statistics are reported in the brackets.

Table 7 Unrestricted Panel VAR Model Results

	$\Pi_{11,1}$	$\Pi_{11,2}$	$\Pi_{11,3}$	$\Pi_{12,1}$	$\Pi_{12,2}$	$\Pi_{12,3}$	$\Pi_{21,1}$	$\Pi_{21,2}$	$\Pi_{21,3}$	$\Pi_{22,1}$	$\Pi_{22,2}$	$\Pi_{22,3}$
All Countries	0.2317	-0.0554	-0.0060	4.8774	0.1490	0.4783	0.0015	0.0084	0.0051	0.2777	0.2044	-0.2792
	(4.50)***	(-1.23)	(-0.10)	(4.15)***	(-0.16)	(0.59)	(0.47)	(2.09)**	(2.43)***	(2.11)**	(0.99)	(-3.03)***
AM Countries	0.2668	-0.0249	-0.0703	4.5827	-0.0648	0.6864	0.0031	0.0239	0.0079	0.2499	0.1556	-0.3596
	(3.51)***	(-0.34)	(-0.71)	(3.97)***	(-0.06)	(0.75)	(0.40)	(2.43)***	(1.56)	(1.90)	(0.72)	(-3.79)***
EM Countries	0.1808	-0.0778	0.0443	18.1811	3.6828	-1.6562	0.0005	-0.0005	0.0024	0.2128	-0.0785	0.0052
	(2.56)**	(-1.30)	(0.59)	(3.48)***	(0.89)	(-0.34)	(0.86)	(-1.03)	(3.44)***	(2.17)**	(-1.25)	(0.05)
AM Countries	0.3241	-0.1693	-0.0372	13.8378	1.5364	1.4348	0.0009	0.0015	0.0091	0.4829	-0.0843	-0.1309
(North American)	(1.70)	(-1.32)	(-0.16)	(1.99)**	(0.28)	(0.22)	(0.18)	(0.33)	(2.08)	(1.82)	(-0.67)	(-0.60)
AM Countries	0.3055	-0.0392	0.0923	0.8918	-1.5689	1.5798	0.0158	0.0160	0.0174	0.1661	-0.1135	-0.2154
(Core European)	(2.76)**	(-0.44)	(0.84)	(0.88)	(-1.48)	(1.61)	(1.97)**	(2.75)**	(1.55)	(1.54)	(-1.15)	(-1.98)**
AM Countries	0.01089	0.1421	-0.1629	6.9663	0.8532	-1.0531	-0.0143	0.0478	0.0045	0.3668	0.2955	-0.5730
(Periphery European)	(0.91)	(1.17)	(-1.15)	(4.86)***	(0.72)	(-0.96)	(-0.73)	(2.29)***	(0.68)	(1.92)	(0.84)	(-4.00)***
AM Countries	0.4378	-0.1034	0.0111	-0.1137	0.2179	-0.6115	0.0038	-0.0054	0.0021	0.2225	0.1343	0.1245
(Asia)	(3.17)***	(-0.60)	(0.07)	(-0.18)	(0.33)	(-0.49)	(0.83)	(-0.70)	(0.33)	(2.53)**	(1.19)	(0.87)
EM Countries	0.1808	-0.1051	-0.0024	16.3126	3.9034	-0.3779	0.0007	-0.0011	0.0033	0.2345	-0.8942	0.0073
(Asia)	(1.84)	(-1.30)	(-0.03)	(3.00)***	(0.91)	(-0.07)	(0.77)	(-1.15)	(3.07)***	(2.15)**	(-1.30)	(0.07)
EM countries	0.1675	-0.0453	0.1003	32.7862	7.2316	-3.4574	0.0003	0.0001	0.0012	0.0618	-0.0200	-0.0679
(nonAsia)	(1.70)	(-0.52)	(0.85)	(2.93)**	(0.51)	(-0.24)	(0.60)	(0.15)	(1.70)	(0.47)	(-0.17)	(-0.47)

Note: 1.* p-value<0.01, ** p-value<0.05, * p-value<0.1.**

2. t-statistics are reported in the bracket

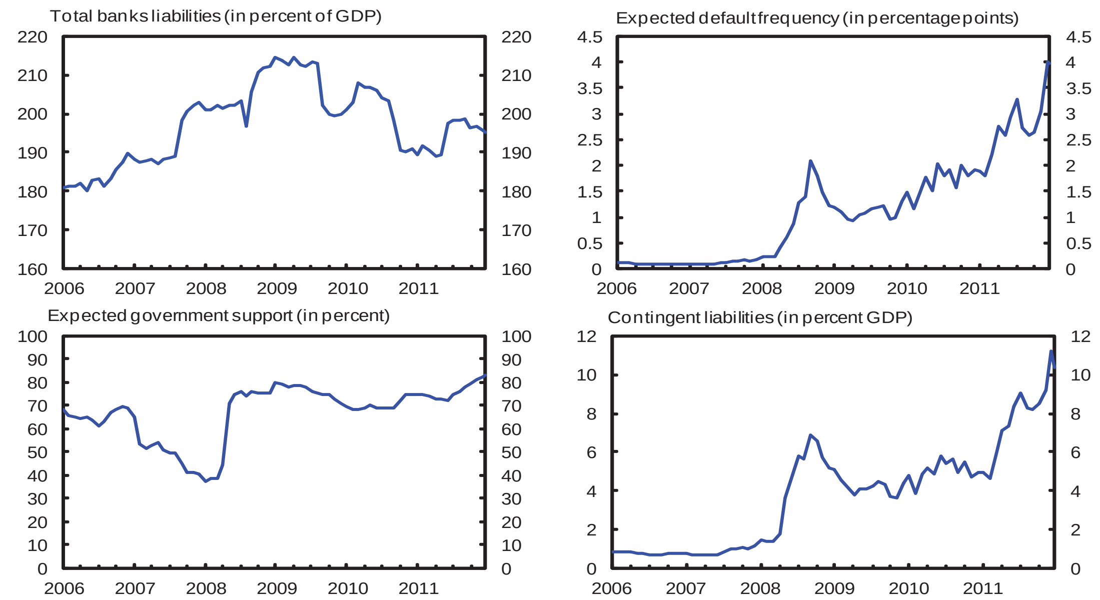
Table 8 The Estimation Results of Unrestricted Panel VAR Model Including Macro-financial Factors

	All Countries	AM Countries	EM Countries	AM Countries(North America)	AM Countries (Core European)	AM Countries (Periphery European)	AM Countries (Asia)	EM Countries (Asia)	EM countries (nonAsia)
□□□,□	0.2198 (3.90)***	0.2281 (2.72)**	0.1847 (2.51)**	0.3330 (1.87)	0.2559 (1.88)	-0.0026 (-0.02)	-0.0046 (-0.46)	0.1712 (1.75)	0.1726 (1.53)
□□□,□	-0.0329 (-0.07)	0.0048 (0.06)	-0.0569 (-0.92)	-0.1996 (-1.47)	0.0018 (0.018)	0.1675 (1.18)	-0.0169 (-1.43)	-0.0974 (-1.19)	-0.0003 (-0.01)
□□□,□	-0.0503 (-0.77)	-0.1049 (-1.03)	0.0166 (0.20)	-0.1130 (-0.50)	0.0567 (0.53)	-0.2008 (-1.55)	0.0102 (0.76)	-0.0804 (-0.76)	0.1121 (0.94)
□□□,□	4.5724 (3.97)***	4.2581 (3.89)***	17.3351 (3.13)***	12.3212 (1.87)	0.3260 (0.31)	6.6818 (5.30)***	0.0350 (0.32)	13.7019 (2.37)***	33.9310 (2.99)***
□□□,**2**	0.0792 (0.08)	0.0488 (0.05)	4.4321 (1.14)	1.2378 (0.23)	-1.4693 (-1.51)	1.6024 (1.24)	0.0795 (0.94)	5.7201 (1.49)	2.2447 (0.16)
□□□,□	0.3622 (0.44)	0.4740 (0.53)	-1.8382 (-0.37)	4.2449 (0.77)	0.0567 (0.53)	-0.6453 (-0.60)	0.0054 (0.03)	-2.3737 (-0.47)	-0.0229 (-0.01)
□□□,□	0.0012 (0.40)	0.0015 (0.20)	0.0004 (0.69)	0.0015 (0.35)	0.0128 (1.52)	-0.0140 (-0.87)	-0.0032 (-2.16)**	0.0008 (0.85)	-0.0001 (-0.01)
□□□,□	0.0079 (1.93)	0.0233 (2.35)**	-0.0012 (-1.65)	-0.0023 (-0.64)	0.0147 (2.12)**	0.0412 (2.06)**	-0.0005 (-0.30)	-0.0020 (-1.72)	0.0001 (0.15)
□□□,□	0.0031 (1.43)	0.0046 (0.85)	0.0021 (3.34)***	0.0086 (2.07)**	0.0131 (1.17)	0.0021 (0.29)	-0.0011 (-0.57)	0.0031 (3.15)***	0.0008 (1.15)
□□□,□	0.2712 (2.16)**	0.2341 (1.92)	0.1966 (2.09)**	0.3506 (1.42)	0.1405 (1.19)	0.3304 (2.07)**	-0.0085 (-0.72)	0.2244 (2.11)**	0.0403 (0.31)
□□□,□	0.1914 (0.98)	0.1428 (0.73)	-0.0729 (-1.22)	-0.0985 (-0.87)	-0.1271 (-1.22)	0.2744 (0.97)	-0.0192 (-1.67)	-0.0832 (-1.32)	-0.0057 (-0.05)
□□□,□	-0.2846 (-3.26)***	-0.3708 (-4.20)***	-0.0080 (-0.09)	-0.0939 (-0.50)	-0.2528 (-2.14)**	-0.5456 (-4.62)***	-0.0470 (-3.19)***	-0.0123 (-0.12)	-0.0732 (-0.56)

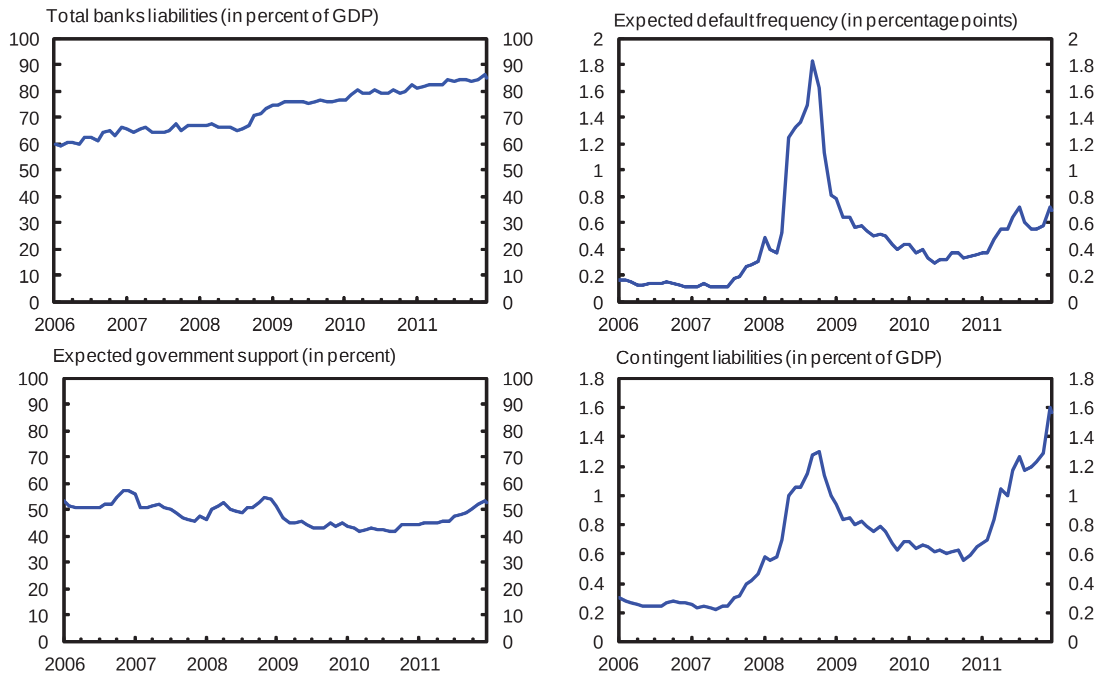
Note: 1.* p-value<0.01, ** p-value<0.05, * p-value<0.1. 2. t-statistics are reported in the brackets.**

Figure 1. Size of Contingent Liabilities

Advanced Countries



Emerging Countries



- Figure 2 Expected Losses and Unexpected Losses from Banking Sector in United States

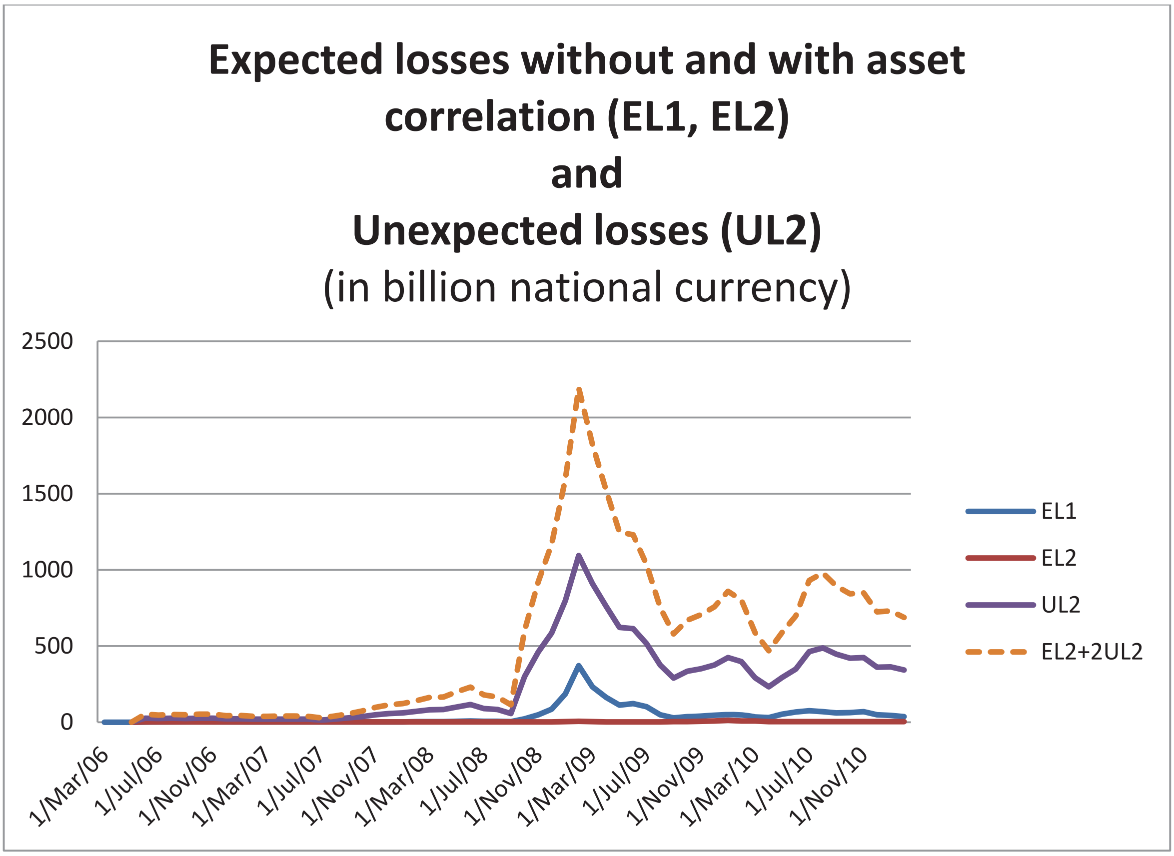


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Figure 3. Attribution Analysis: Factors Explaining Changes in Expected Losses

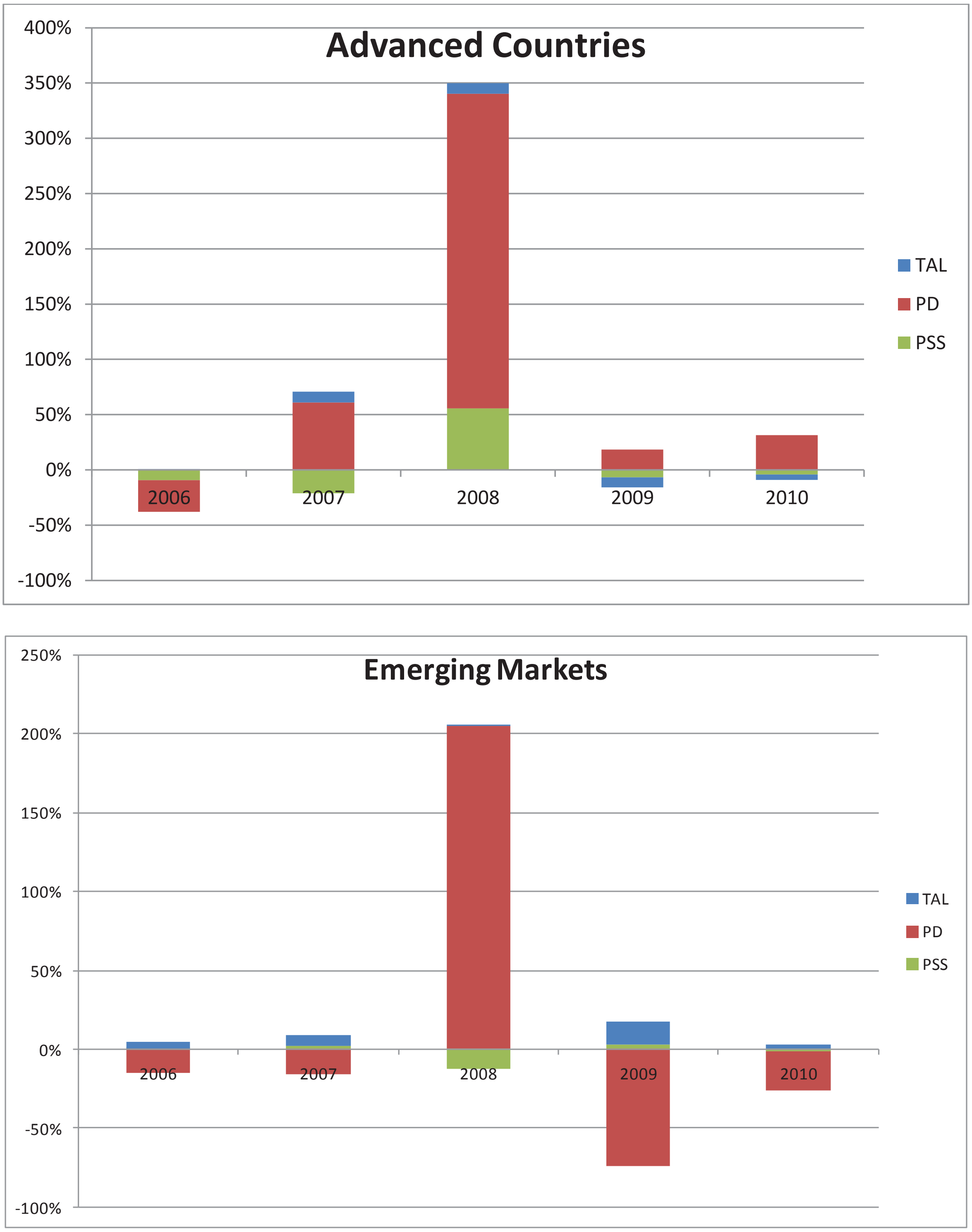
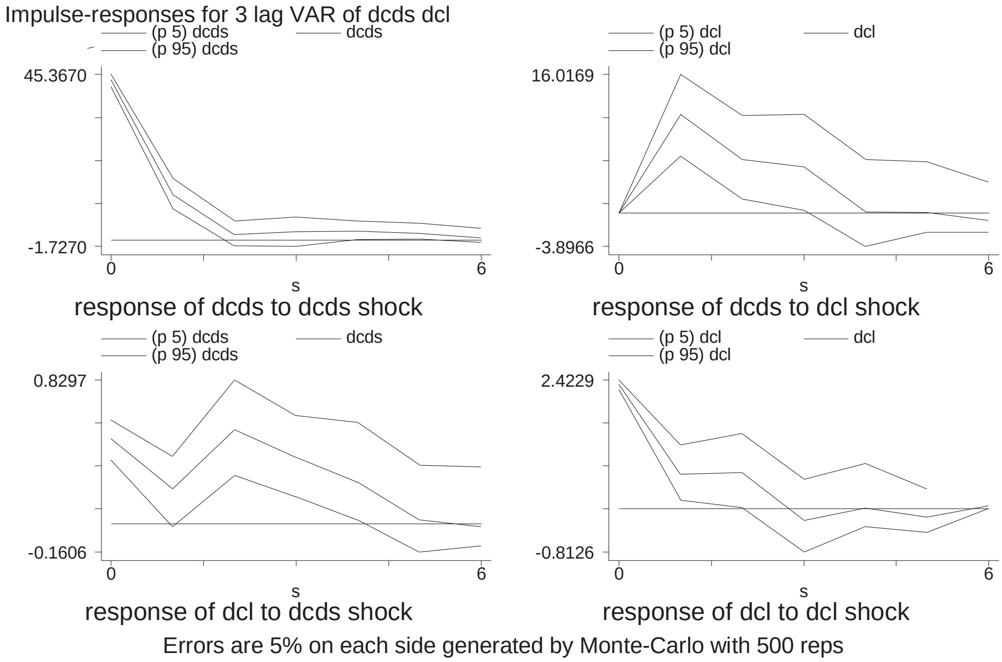


Figure 4. Impulse Response Graphs

under Unrestricted VAR model



under Unrestricted VAR model with macro-financial factors