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The role of external balance sheets in the financial crisis

Yaser Al-Saffar, Wolfgang Ridinger and Simon Whitaker

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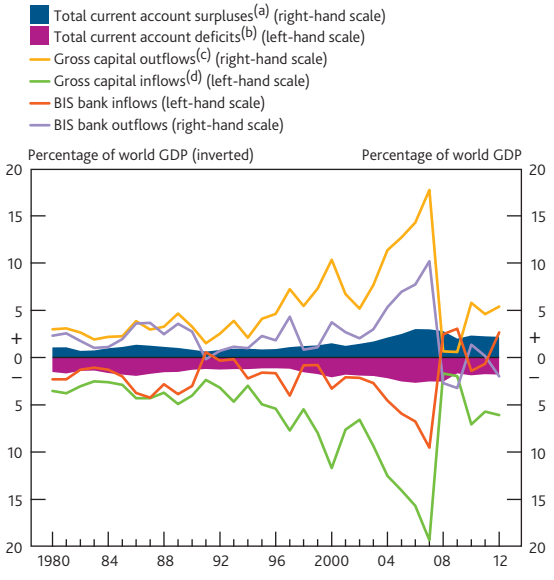
Yaser Al-Saffar, Wolfgang Ridinger and Simon Whitaker

Gross external balance sheets are important in explaining the incidence of the financial crisis across economies. Just as for banks, leverage of the national balance sheet was an indicator of subsequent vulnerability. Countries that also experienced strong domestic credit growth, in part fuelled by 'savings glut' net capital inflows, suffered particularly badly. And banks' balance sheets were critical in the transmission mechanism: high gross external interbank debt — the 'banking glut' — and maturity and currency mismatches, contributed to foreign rollover risk.

1 Introduction

One key fault line in the international monetary system identified in the run-up to the 2008–09 global financial crisis[1] was the accumulation of current account imbalances — 'the origins of the crisis lie in the imbalances in the world economy that built up over a decade or more' (King (2009)). Broadly speaking a 'savings glut' in China and other emerging market economies (EMEs) led to large net capital flows to advanced economies in search of financial assets, fuelling a boom in asset prices and spending relative to domestic saving (Bernanke (2005)). **Chart 1** shows the accumulation of global current account imbalances. There is both empirical and theoretical evidence to support this proposition, see for example Sá, Towbin, and Wieladek (2011). Others contend that current account imbalances just reflected domestic credit booms and asset price bubbles (Laibson and Mollerstrom (2010)). A third school of thought, for example Borio and Disyatat (2011), has focused specifically on the behaviour of the banking system and points to an increase in the 'elasticity' of the financial system over time, as a result of financial deregulation, which generated very large *gross* capital flows (**Chart 1**). In the words of Shin (2012) there was a global 'banking glut'.

Chart 1 Global current account imbalances and gross capital flows

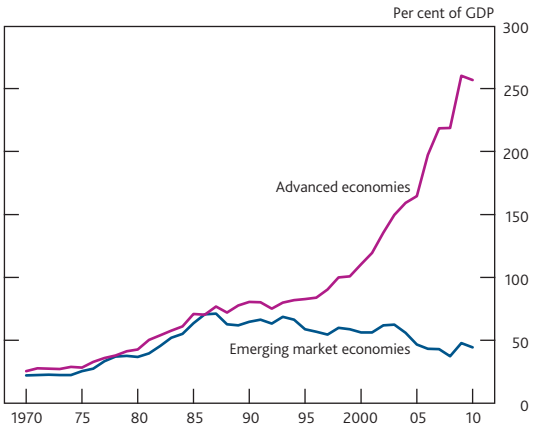


Sources: Bank for International Settlements, International Monetary Fund (IMF) *World Economic Outlook* and Bank calculations.

(a) Sum of global current account surpluses.
(b) Sum of global current account deficits.
(c) Sum of global net purchases of foreign assets by residents.
(d) Sum of global net purchases of domestic assets by foreigners.

The rapid expansion in gross external financial assets and liabilities ahead of the crisis was almost wholly accounted for by advanced economies (**Chart 2**). And advanced economies were at the epicentre of the crisis. The focus of this paper is, therefore, on how the size and structure of advanced economy

Chart 2 Evolution of gross external debt in advanced and emerging market economies



Source: Reinhart and Rogoff (2009).

gross balance sheets may help explain the extent to which these countries were affected by the financial crisis. Rather than the global 'savings glut' and 'banking glut' offering competing explanations for the crisis, this paper finds an important interaction between the two. A given level of gross external debt had a more powerful association with declines in gross domestic product (GDP) during the crisis for those countries where domestic credit had been growing rapidly before the crisis, fuelled by net borrowing from abroad. Banks' balance sheets were critical in the transmission mechanism: high gross external interbank debt — the 'banking glut' — and maturity and currency mismatches, contributed to foreign rollover risk. But the paper also finds a role for non-bank external debt.

2 Related literature

There is already an extensive literature that attempts to explain the incidence of this financial crisis across countries using macroeconomic and financial indicators prevailing just prior to the crisis — 'initial conditions'. Two examples are Lane and Milesi-Ferretti (2010) and Claessens *et al* (2010). Between them they identify variables such as pre-crisis credit growth, asset price inflation and current account imbalances — 'home-grown' vulnerabilities — as indicators of the severity of the crisis experienced. Giannone, Lenza and Reichlin (2011) show that policies that favour liberal credit markets are a good predictor of crisis intensity. And Barrell *et al* (2010a) find that low levels of capital and liquidity helped explain the incidence of banking crises in OECD countries over the past 30 years. But Claessens *et al* conclude that the explanatory power of initial conditions is weak and that much of how crises start and spread remains unknown. Rose and Spiegel (2011) are even more sceptical. They attempt to sift through all the potential explanatory variables for a very broad set of countries and find

(1) All subsequent references to 'the crisis' in this paper refer to the 2008–09 global financial crisis.

few clear and reliable indictors in the pre-crisis data. The relative lack of success may arise from trying to fit one model to a very heterogeneous set of countries. For example, it is evident from **Chart 2** that EMEs, perhaps reflecting their bitter experiences in the previous crises during the 1980s and 1990s, had actually been running down the size of their gross external balance sheets, in stark contrast to advanced economies.

The role of gross balance sheets in the crisis

It is to the size of gross balance sheets and leverage, rather than current account deficits, that research has recently turned in seeking explanations for the vulnerability of countries to the financial crisis. Current account deficits (CADs) result from domestic savings (S) being insufficient to finance domestic investment (I), which in addition needs to be financed by issuing debt (D) or equity (E) to foreign investors.

$$I - S = CAD = \Delta D + \Delta E$$

Issuing debt can expose a country to financing difficulties if the debt matures before the income from the domestic investment projects is available. But with open capital markets, countries are also borrowing from abroad to finance investment opportunities *abroad*. So even with a balanced current account, there can be gross debt inflows used to finance an equal amount of equity investment abroad ($\Delta D = -\Delta E$). And it is these gross financial flows that expanded so rapidly ahead of the crisis. A country can be vulnerable to rollover risk on its foreign liabilities even without a current account deficit.

Rollover risk arising from gross external debt

Gross debt can give rise to rollover risk for two reasons. The ownership of a given country's gross external assets and debt liabilities may be distributed over different residents of that country. If the residents with foreign debt liabilities are unable to rollover their debt then other residents with foreign assets will not automatically be able or willing to sell those assets to fill this funding gap. Additionally, the external assets and liabilities of a country may have different maturities or be denominated in different currencies, so in illiquid market conditions assets may not be readily available to pay off maturing liabilities even if the assets are held by the same agent. The true measure of a country's vulnerability is, therefore, how the structure and ownership of the accumulated *stock* of external liabilities compares to that of its assets. Neither the current account deficit, nor the net foreign asset position (its stock counterpart), adequately captures these potential vulnerabilities. An economy running a balanced current account can actually be engaged in large-scale international financial intermediation activity via its financial institutions. In such circumstances, a shock to the quantity and cost of funding available to these financial institutions may be transmitted to the quantity and price of their lending to the real economy, thereby depressing the level of real activity. And because of the large size of advanced economies' gross balance sheets, variations in a country's net foreign asset position (net solvency) are dominated by fluctuations in the market values of assets and liabilities rather than the incremental net acquisition of assets or liabilities represented by the current account.

For example, developed financial markets like the United States and the United Kingdom have tended to provide a maturity transformation service for the rest of the world — issuing debt liabilities and investing in foreign equity and direct investment (see for example Whitaker (2006)) and Gourinchas and Rey (2007)). Borio and Disyatat (2011) and Shin (2012) also highlight how in the run-up to the current crisis, European banks intermediated a huge increase in gross capital flows associated with the US housing market.

Between 2002 and 2007 more than half of the gross capital inflows into the United States came from the United Kingdom and the euro area and a similar share of outflows from the United States was directed to these areas. The problem, as Bernanke *et al* (2011) show, is that a substantial share of these inflows into the United States went into the acquisition of long-maturity securitised residential assets. These instruments became increasingly illiquid in the run-up to the crisis, as doubts about the credit risks of the underlying residential assets rose. By contrast, these asset-backed securities were financed short-term in US wholesale funding markets, giving rise to the dollar funding shortages experienced by European banks. On the eve of the financial crisis, the current account of the euro-area as a whole *vis-à-vis* the United States was approximately in balance. So looking at that measure gave no clue as to the role that European banks, rather than net capital inflows from EMEs, was having on credit conditions in the United States. And it was the gross dollar financial positions of European banks which exposed European economies to a bank funding shock. A more specific example is Germany, which experienced neither a current account deficit nor a housing boom in the 2000s. Yet gross flows between German banks and economies that did display those symptoms led to problems in German banks and its real economy later on.

This paper, therefore, focuses on the role that gross balance sheet positions played in explaining the severity of the crisis across countries. But, like Obstfeld (2012), it also argues that a country's net current account or net international investment position still contains important information. In his words 'A current account deficit creates a basic vulnerability to a sudden stop in financial inflows, but…the nature of gross foreign asset and liability positions will be a critical determinant of the *denouement*' (*op cit*, page 32).

For emerging market economies, Blanchard, Faruqee and Das (2010) and Lane and Milesi-Ferretti (2010) find a significant role for gross external debt in explaining the depth of the

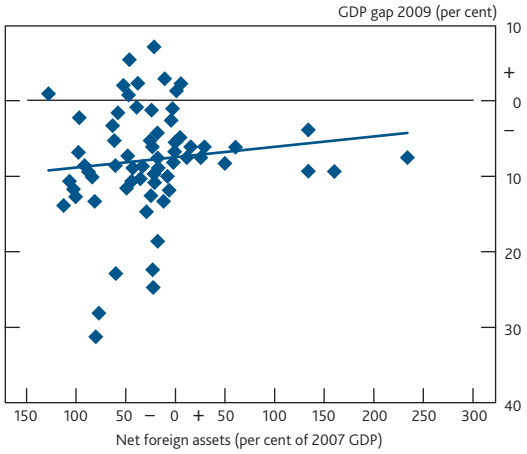
financial crisis. But this paper fills something of a gap in the current literature by focusing on the gross balance sheets of advanced economies, using the Quarterly External Debt Statistics (QEDS) compiled by the Bank for International Settlements (BIS), International Monetary Fund (IMF) and World Bank and more detailed BIS bank data. Various aspects of a country's external balance sheet as at 2007, just prior to the onset of the crisis, are correlated with the depth of the subsequent crisis, measured by the deviation of GDP in 2009 from its pre-crisis (1997–2007) trend. The focus on the impact in 2009 rather than later is to avoid the results being affected by variation across countries in the degree to which monetary and fiscal policy reacted to alleviate the impact of the crisis. But alternative GDP measures are looked at to check the robustness of the results (see the appendix).

The paper is structured as follows. The first section looks at the relative explanatory power of gross versus net balance sheet positions. The roles of the debt and equity components of the balance sheet are then compared and how external debt interacts with domestic credit growth, leaving countries vulnerable to funding stops. The focus next is on the different types of debt, and in particular, given its relative size, the role that external bank debt played in the crisis. By looking at different measures of external bank debt and mismatches on their balance sheets the paper attempts to tease out which elements of bank behaviour contributed to the funding stops. At each point the incremental role of these balance sheet variables relative to other more traditional 'initial conditions' used in the literature is assessed.

3 Net versus gross balance sheets

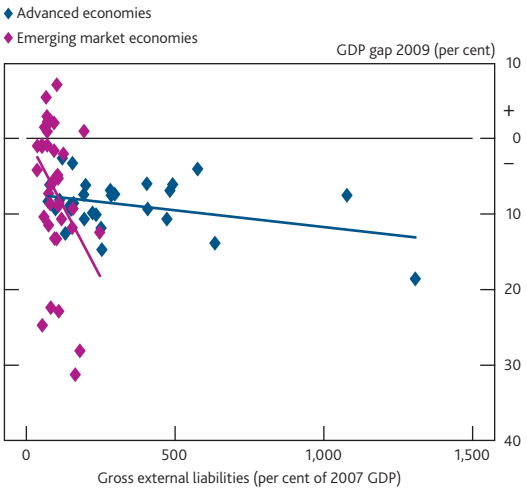
Our analysis is based on a data set comprising of external assets and liabilities for 63 countries — 25 advanced economies and 38 emerging market (EM) economies. All external balance sheet variables are from end-2007 and measured in per cent of annual GDP. **Chart 3** shows the relationship between each countries' net foreign asset (NFA) positions in 2007 and its deviation of GDP in 2009 from its pre-crisis (1997–2007) trend. The slope of the relationship is positive as we might have expected, suggesting that net creditor countries appear to have been more insulated from the crisis. The relationship is not, however, statistically significant. Because NFA positions reflect the accumulation of current account flows, this is consistent with the very mixed evidence that current account deficits alone are good crisis indicators. By contrast, **Chart 4** looks at the relationship between the GDP gap and gross external liabilities, distinguishing between advanced and EM economies. This confirms, as noted earlier, that advanced economies had much bigger gross balance sheets. There is a significant negative relationship between gross external liabilities and the GDP gap for both sets of countries, although the relationship between the GDP gap and external liabilities is much stronger for EMEs than for advanced economies. That is consistent with other evidence that financial markets penalise EMEs more than advanced economies for holding a given level of external debt (Reinhart, Rogoff and Savastano (2003)).

Chart 3 Net foreign assets and output losses



Sources: IMF, Lane and Milesi-Ferretti (2010) and QEDS.

Chart 4 Gross external liabilities and output losses



Sources: IMF, Lane and Milesi-Ferretti (2010) and QEDS.

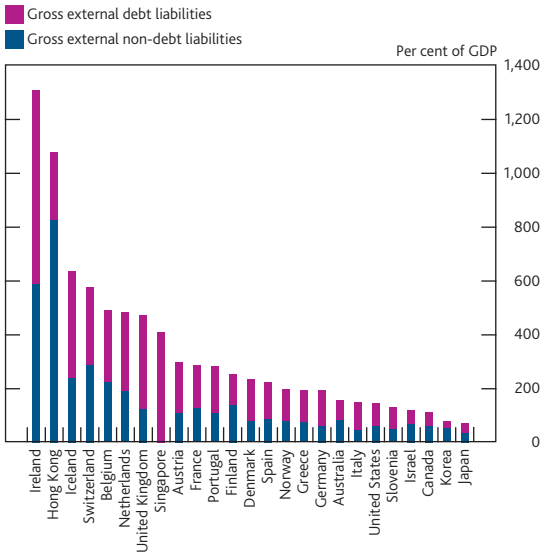
Bivariate correlations cannot evaluate the marginal information content of gross balance sheet measures over and above the simple NFA position of a country, or other plausible 'initial condition' indicators. The next section of the paper therefore explores the role of gross balance sheet measures using multivariate regressions. First looking at the relative role of gross debt versus equity liabilities and then how much gross external debt adds to the impact of other variables that have been found in various studies to be associated with the incidence of the crisis. Next the paper explores the possible transmission mechanism from gross external debt to declines in GDP — how the funding vulnerabilities arising from external debt interacted with domestic fragilities associated with rapid domestic credit growth. For example, the United Kingdom and Ireland had large gross external debt, negative NFA positions,

and very strong pre-crisis domestic credit growth. That combination was associated subsequently with particularly sharp declines in GDP during the crisis. By contrast, while Hong Kong, Germany and Switzerland also had high gross external debt, they had positive NFA positions, weak domestic credit growth and fared better. Finally, the paper examines the role that may have been played by mismatches on banks' gross balance sheets.

Debt is more important than equity — leverage matters

For most countries a high proportion of gross external liabilities at the onset of the crisis was accounted for by debt — almost three quarters for the United Kingdom (the magenta bars in **Chart 5**). And most of that external debt was issued by banks (**Chart 6**). Debt repayments have to be made regardless of the state of the economy and the value of a bank's assets, leaving leveraged debtors exposed when asset prices fall. And debt financing is vulnerable to rollover risk. Countries that leverage up their balance sheets by issuing debt to buy assets can therefore be vulnerable to illiquidity and insolvency. In contrast, for equity claims there is flexibility over the timing and size of dividend payments, thereby allowing risk-sharing between investors and issuers. In addition, they have no pre-determined redemption date and so they do not threaten a country with external illiquidity or insolvency.

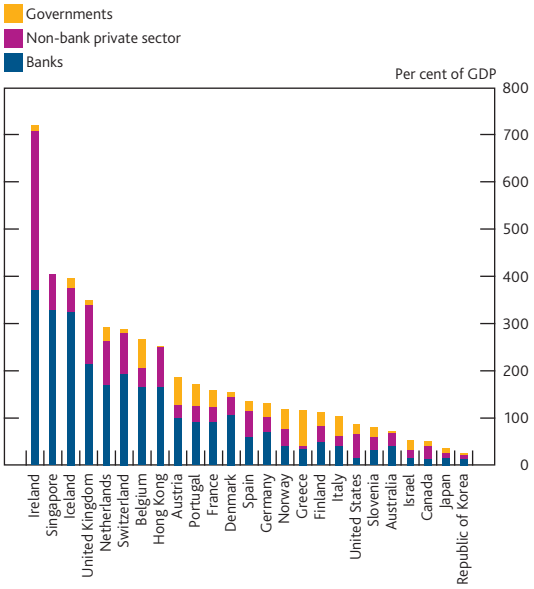
Chart 5 Composition of gross external liabilities in 2007



Sources: IMF, Lane and Milesi-Ferretti (2010) and QEDS.

The focus here is on gross external debt of the private (bank and non-bank) sector, which accounted for the bulk of external debt in most countries in 2007. A notable exception was Greece. In other vulnerable euro-area economies the financial crisis later turned into a sovereign crisis, but in the initial phase private debt played the key role. In our sample there is no

Chart 6 Gross external debt by sectors in 2007



Sources: IMF, Lane and Milesi-Ferretti (2010) and QEDS.

significant negative relationship between external government debt in 2007 and subsequent falls in GDP.

Controlling for other factors

One could think of a number of alternative reasons for why GDP fell by more in countries that also had higher levels of gross external debt, without gross external debt actually driving the deeper recession. It is important therefore to control for other factors to rule out potential spurious correlations of gross external debt with the GDP gap.

First, countries that are financially open are also likely to be open to trade in goods and services. For our sample the correlation between trade openness, measured as exports of goods and services over GDP, and private gross external debt is 0.45. So, without controlling for trade openness, our gross external debt measure may simply capture the fact that open economies were hurt most by the drop in international trade during the crisis.

Second, gross external private debt may be expected to be high in countries where overall (domestic and foreign-sourced) credit to the private non-financial sector is high, and it may be elevated debt levels rather than the foreign-sourced component of debt that is the source of vulnerabilities. To distinguish between the effect of generally high levels of debt and high levels of debt to foreigners in particular, the regression contains the stock of credit to the domestic non-financial private sector relative to GDP as a control variable. The stock of credit will also to some degree capture the size of the banking sector. Banks tend to hold the biggest share of cross-border debt (**Chart 6**), so gross external debt is likely to be correlated with the size of a country's banking

sector. As the financial crisis was largely a banking crisis, the correlation between external debt and GDP may simply be picking up the fact that countries with large banking sectors suffered more.(1) Domestic credit is only a crude proxy for the size of the banking system but the best available one for the full sample of countries. The World Bank (2012) find that across a wide sample of countries domestic credit and bank assets are highly correlated. Later in the paper, where the focus is specifically on the role of banks in advanced economies, total bank assets relative to GDP is used as a more precise control variable.

Finally, large gross external debt liabilities may reflect the domestic financial system pursuing a risky overall business model. To try to distinguish between financial systems having taken on high risks in various ways and the risk stemming from gross external debt specifically, an index of credit market regulation is one of the control variables. Giannone, Lenza and Reichlin (2011) find that countries with more market-friendly credit market regulation suffered worse recessions in 2008 and 2009.

Additionally the regression controls for current account balances prevailing in 2007, which have been identified as an initial condition correlated with crisis incidence by Lane and Milesi-Ferretti (2010), Claessens *et al* (2010), and Barrell *et al* (2010b).

Table A confirms that it is gross private external debt rather than equity liabilities that drive the relationship with GDP apparent in **Chart 4**, and private gross external debt remains significant even after controlling for these other potential causal factors. Of the control variables, only the proxy for the degree of credit market regulation is significant. That would be consistent with lax credit market regulation being one of the factors permitting the accumulation of large gross external debt liabilities. The insignificance of the current account balance suggests that it may have showed up in some previous studies simply because of its correlation with omitted gross external debt.

The regression is run on the whole sample of countries, but it allows for different coefficients on gross external private debt for advanced countries and EMEs. The coefficient on gross external private debt without the EME dummy is the impact on advanced economies; combining that with the interaction term gives the coefficient for EMEs; and the interaction term itself shows the difference between the two. Consistent with **Chart 4**, EMEs do seem much more sensitive to external debt. The impact on GDP was tempered by the much lower levels of external debt that EMEs were carrying at the outset of the crisis (**Chart 2**). But even so, the estimated coefficients indicate that the impact on GDP for the average EME was around -5%, compared to -2½% for the average advanced economy. **Chart 7** illustrates considerable variation in the estimated impact across advanced economies, with external debt making an economically significant contribution to the large declines in GDP experienced by Ireland, Iceland and the United Kingdom.

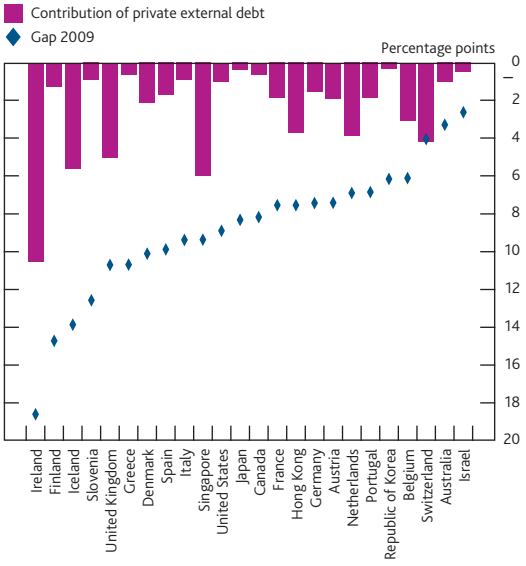
Table A Gross external liabilities and debt

Dependent variable: GDP gap 2009

EME dummy	2.553 (0.468)	2.498 (0.494)	4.680** (0.041)
Net foreign assets	-0.0158 (0.498)	-0.0221 (0.427)	-0.0193 (0.335)
Exports	-0.0147 (0.671)	-0.0314 (0.348)	0.0205 (0.519)
Domestic credit	0.00316 (0.877)	-0.00242 (0.901)	0.0145 (0.438)
Credit market regulation	-2.822*** (0.006)	-2.682*** (0.007)	-2.144** (0.032)
Current account	0.384** (0.046)	0.457** (0.037)	0.251 (0.110)
Gross external liabilities	-0.00282 (0.620)		
Gross external liabilities * EME dummy	-0.0249 (0.437)		
Gross external non-debt liabilities		0.00313 (0.770)	
Gross external non-debt liabilities * EME dummy		-0.0352 (0.503)	
Gross external private debt			-0.0148** (0.022)
Gross external private debt * EME dummy			-0.174** (0.016)
N	57	57	57
R^2	0.419	0.418	0.519

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Chart 7 Estimated contributions of private external debt to output losses



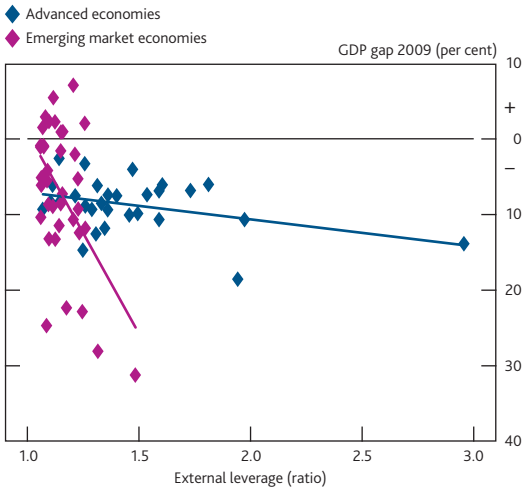
Sources: IMF and authors' calculations.

(1) Cecchetti and Kharroubi (2012) look at the effect of the size of the financial system on trend productivity growth and finds, for example, that credit to the non-financial private sector relative to GDP in excess of 100% is associated with lower productivity growth.

The appendix also contains robustness checks, which change the definition of the dependent variable (GDP gap) and down weight outliers in the regression. The results are broadly robust to these changes.

The finding that the more a country's NFA position was leveraged through borrowing from abroad the greater the decline in GDP is consistent with evidence that bank leverage was a good predictor for subsequent financial vulnerability in the banking system (see for example Haldane and Madouros (2012)). By analogy with the balance sheet of a financial institution, Gourinchas and Obstfeld (2012) define the external leverage of a country as the ratio of its total (domestic and foreign) assets to its gross equity liabilities (domestic and foreign). High external leverage indicates that a country is financing a large portion of its assets through external debt issuance.(1) **Chart 8** plots this measure against the GDP gap. Consistent with the regression results, this ratio has a significantly negative relationship with GDP, again with EMEs being more sensitive to leverage than advanced economies.

Chart 8 External leverage and output losses



Sources: IMF and Gourinchas and Obstfeld (2012).

While issuing debt and investing in equity may make a country's balance sheet vulnerable to funding and equity price shocks, their impact could be moderated by movements in exchange rates. For example, advanced economies largely issue debt in their domestic currency, whereas their foreign assets will tend to be mainly denominated in foreign currency. Should a country with this currency mix experience a decline in the value of its currency during a financial crisis, then, all else equal, the value of foreign assets in domestic currency terms would tend to increase relative to the value of their liabilities, boosting the country's net wealth. Larger gross balance sheets potentially mean that these net wealth effects could have significant effects on GDP, see Kubelec, Orskaug and Tanaka (2007). Unfortunately, currency decompositions of external assets and liabilities are not readily available for many countries. And official data on countries' gross external positions do not fully capture the impact of changes in asset prices.(2) While measured valuation effects in net foreign asset positions were large for many countries at the time of the crisis, no correlation with GDP was found.

4 The interaction between external debt and domestic credit

A growing body of evidence, two recent examples being Gourinchas and Obstfeld (2012) and Schularick and Taylor (2012), points to rapid domestic credit growth as playing the dominant role in predicting subsequent financial crises. And prior to the 2008–09 crisis, work at the BIS by, *inter alia*, Borio and Lowe (2002) had pointed to excessive credit growth and associated asset price inflation as key warning indicators.

Some studies find a strong association between net capital inflows and the incidence of credit booms, for example Ostry *et al* (2011) and Furceri, Guichard and Rusticelli (2011). And Caballero (2012) finds that banking crises are more likely when net capital inflows accompany a domestic credit boom. The link between net capital inflows and credit growth is consistent with the 'savings glut' view of the financial crisis — under this hypothesis, excess savings from EMEs were invested in advanced-economy assets thereby driving up credit growth and asset prices in those economies. But this emphasises 'push' type capital flows whereas net capital inflows and credit growth can also be associated with 'pull' factors, ie excessive demand for credit due to unrealistic expectations of future income by borrowers and financial markets pulling in capital flows from abroad. For example, Laibson and Mollerstrom (2010) explain net capital inflows in OECD economies in terms of consumption booms supported by increases in house prices. Sá, Towbin and Wieladek (2011) attempt to discriminate between push and pull factors and find that both net capital inflow shocks (push) and domestic monetary policy shocks (pull) have a significant positive effect on real house prices, real credit to the private sector and residential investment in OECD countries.

Others, more recently, have emphasised that an increase in *gross* external debt, related to a 'banking glut', can also be associated with a domestic credit boom, see for example, Hahm, Shin and Shin (2012) and Shin (2012). In fact Borio and Disyatat (2011) emphasise that the current account, or net capital flow, says nothing about the extent to which domestic investment is financed from abroad. Even if, say, a country's current account is in balance, or no imports and exports take place at all, the whole of its investment expenditures may be

(1) The market value of foreign assets is taken from Lane and Milesi-Ferretti (2007) and the market value of domestic assets is proxied by assuming it is a fixed multiple (three times) of GDP, see Gourinchas and Obstfeld (2012), page 48.
(2) For example, foreign direct investment assets and liabilities are often measured using book rather than market values.

financed from abroad. The financial transaction only generates offsetting *gross* capital flows.

One possible transmission mechanism from gross external debt to crisis vulnerability is that gross debt inflows from abroad fuel credit booms and unsustainable growth in asset prices and real economic activity — a similar story to that told for net capital inflows. The other transmission mechanism, which this paper has emphasised so far, is that large gross external debt liabilities expose a country to funding stops, or rollover risk. These may not necessarily occur because of a sudden change in perceptions about that country's fundamentals, but rather because of fragilities in the gross balance sheets of borrowing banks resident in that country, or in the balance sheets of creditor banks.

So a key issue to explore is whether the accumulation of external debt gives information about the vulnerability of a country to a crisis over and above rapid domestic credit growth. For example, Lane and Milesi-Ferretti (2010) conjecture that part of the vulnerability caused by rapid growth in credit comes from the exposure to foreign credit that it brings. And Hahm, Shin and Shin (2012) find that external bank liabilities increase the probability of having a financial crisis in emerging markets over and above the effect of domestic credit growth.

Table B reports that gross external debt remains a significant variable after controlling for the pre-crisis growth in domestic credit, consistent with Hahm, Shin and Shin's results. For EMEs that result holds even after including all the other controls. But the results for advanced economies (the coefficient on external debt without the EME dummy) are less robust to the inclusion of controls. The correlation between domestic credit growth and gross external debt is quite high making it more difficult to distinguish the statistical significance of each variable.

Table B Gross external debt and domestic credit growth

Dependent variable: GDP gap 2009

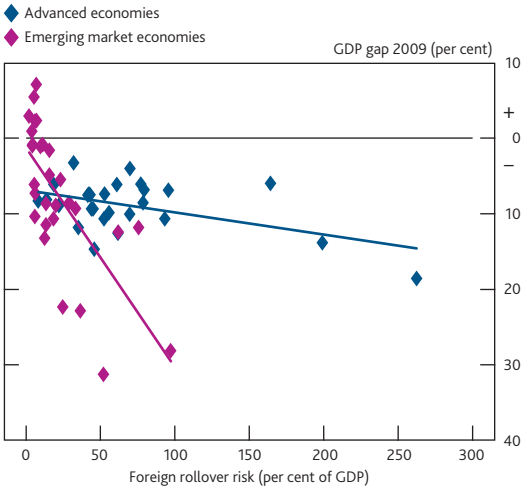
EME dummy	7.548*** (0.000)	5.352** (0.018)
Net foreign assets	-0.000905 (0.932)	-0.0128 (0.496)
Domestic credit growth	-0.0491* (0.073)	-0.0379 (0.241)
Gross external private debt	-0.00819* (0.068)	-0.00979 (0.127)
Gross external private debt * EME dummy	-0.212*** (0.003)	-0.175** (0.034)
Controls		Exports, domestic credit, credit market regulation, current account
N	57	57
R^2	0.527	0.558

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

The significance of gross external debt over and above domestic credit growth points to vulnerabilities arising from rollover risk. Cerutti, Claessens and McGuire (2012) highlight two sources of rollover risk: borrowing by a country cross-border from foreign-owned banks; and borrowing locally from foreign affiliates resident in the country which are funded by their parent banks. They develop an overall measure they call *foreign rollover risk*. BIS consolidated banking statistics measure the extent to which a country borrows from foreign-owned banks, either cross-border or via locally based affiliates. Cerutti, Claessens and McGuire combine that information with estimates of the financing that resident foreign affiliates obtain from local customer deposits. On the one hand, foreign banks that are large local deposit-takers might be less affected by any shock to their parents' balance sheets. On the other hand, as shown by Cetorelli and Goldberg (2011), parent banks faced with funding shocks might be inclined to withdraw funds from their foreign subsidiaries that are more active in deposit-taking. Claessens and Van Horen (2012) find that on average locally based foreign affiliates reduced lending more than domestically owned banks during the global crisis, but foreign banks that generated an important part of their funding from local deposits were much less likely to reduce lending.

Chart 9 shows that greater foreign rollover risk was associated with larger falls in GDP and, in the same way as the other debt measures considered in previous sections, had a stronger effect on EMEs than on advanced economies. Cerutti, Claessens and McGuire argue that a global shock to wholesale funding markets, rather than deteriorating borrower country fundamentals, played a major role in the contraction of foreign claims. That is consistent with other research focusing on the role of foreign banks. For example, Aiyar (2011) finds that locally operating foreign subsidiaries and branches reduced

Chart 9 Foreign rollover risk and output losses(a)



Sources: Cerutti, Claessens and McGuire (2012) and IMF.

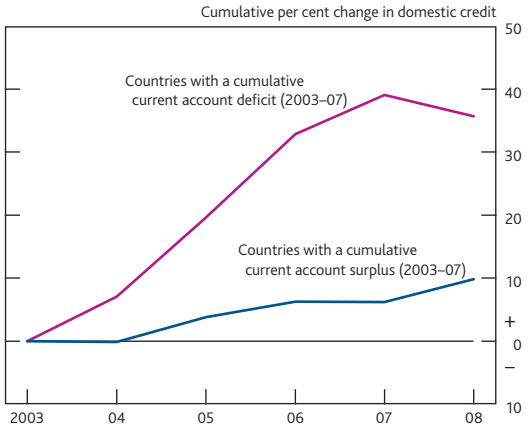
(a) Foreign rollover risk is defined by Cerutti, Claessens and McGuire (2012) as the sum of BIS banks' consolidated direct cross-border claims on a country and their local affiliates' claims that are not financed by local consumer deposits, the latter proxied by bank-level information on deposit to loan ratios of foreign affiliates.

lending to the UK private sector by a larger amount than domestically owned banks.

These results suggest that there are two distinct ways in which gross external debt makes a country vulnerable to crises: i) gross external debt often finances domestic credit expansion which can lead to unsustainable increases in asset prices and real activity and ii) gross external debt exposes a country to a potentially flighty source of capital. As each factor is destabilising in itself, one would expect countries which entered the crisis with large gross external debt *and* had experienced rapid domestic credit growth to have experienced the largest downturns. In other words, it is when GDP growth and asset price inflation have been supported by rapid credit growth, that the impact of a funding stop on GDP would be expected to be largest.

Although, as emphasised by Borio and Disyatat (2011), there is not necessarily always a connection between rapid domestic credit growth and *net* capital inflows (current account deficits), **Chart 10** illustrates that credit growth between 2003 and 2007 was stronger in countries that had cumulative current accounts deficits over the same period (the magenta line).

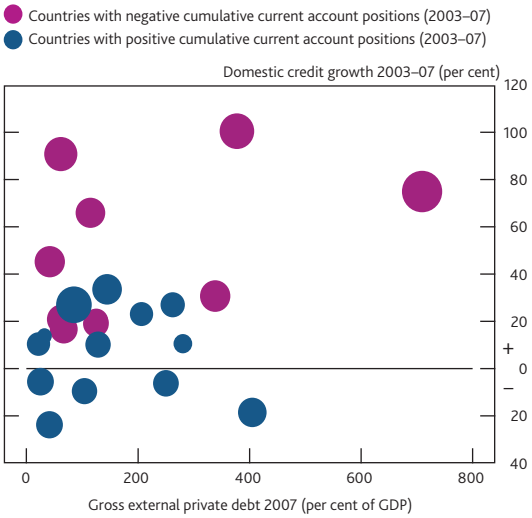
Chart 10 Growth in domestic credit in economies with current account deficits and surpluses



Source: World Bank World Development Indicators.

Chart 11, for advanced economies, draws these features together. It shows that countries that entered the crisis with high gross external debt also tended to have experienced rapid pre-crisis growth in domestic credit; high domestic credit growth was associated with current account deficits (the magenta circles); and, consistent with the regression results, the largest GDP gaps (represented by the size of the circles) tend to appear where large gross external debt and strong pre-crisis credit expansion coincide, towards the Northeast of the chart. So economies suffered most when they had been supported by strong credit growth, associated with net capital inflows, and had accumulated large gross external balance sheets.

Chart 11 The interaction between gross external debt and growth in domestic credit[(a)]

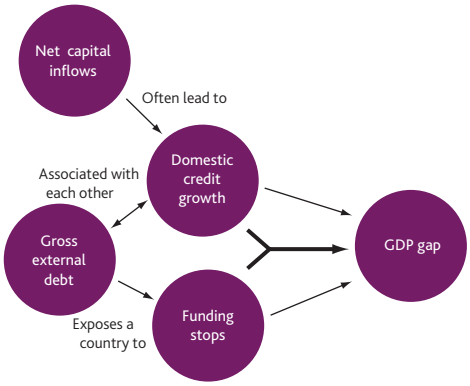


Sources: IMF, World Bank World Development Indicators and QEDS.

(a) Width of the circles is proportional to the absolute value of the GDP gap in 2009.

Chart 12 summarises the findings of this section. Net capital inflows (current account deficits) were associated with rapid growth in domestic credit. Rapid growth in credit in the run up to the crisis was also associated with high levels of gross external debt in 2007, exposing a country to a funding stop. Both rapid growth in credit and funding stops can lead to recessions. So the coincidence of rapid growth in credit and high gross external debt has the biggest impact on GDP, illustrated by the thicker arrow in **Chart 12**.

Chart 12 A schematic summary of the transmission channels[(a)]



(a) The thick arrow in the middle represents how domestic credit growth together with funding stops arising from large gross external liabilities leads to a particularly large fall in GDP.

Several papers have previously emphasised the importance of large net imbalances as the catalyst for the crisis, whereas more recent work has shifted the emphasis to gross imbalances. This paper finds that they interact with each other to magnify the impact on GDP. Key examples are Iceland and Ireland which had high gross external debt, strong pre-crisis credit growth and current account deficits — both countries

experienced very deep crises.(1) Countries like Germany and Hong Kong also experienced a funding shock, but the impact on their GDP was smaller because they did not have credit-fuelled expansions before the crisis and associated current account deficits.

5 The role of banks

In the analysis so far no distinction has been made between different components of the private sectors' gross external debt. Non-bank external debt can encompass the cross-border activities of domestic non-bank financial companies such as hedge funds and pension funds, and also the direct borrowing from abroad by large corporations from global banks and via international bond markets. But for many countries the bulk of external debt has been accumulated by banks, in part because banks act as intermediaries, sourcing overseas funding to supply lending to their domestic economies. **Table C** shows two regressions — one includes gross external debt of banks as an explanatory variable and the other includes gross external debt of the non-bank private sector as an explanatory variable. Both are statistically significant for advanced economies, but bank debt is typically around double the size of non-bank debt. **Chart 13** illustrates the estimated contribution each type of debt made to declines in GDP in advanced economies; for most countries, the impact from bank debt is larger.

Table C Gross external debt of banks and non-banks

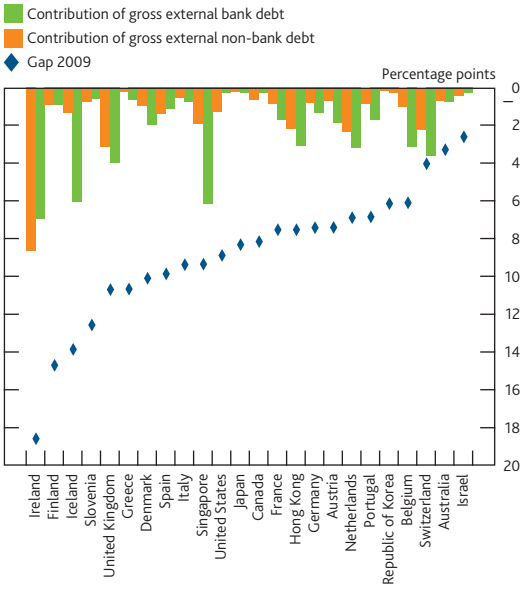
Dependent variable: GDP gap 2009

EME dummy	1.760 (0.567)	3.127 (0.102)
Net foreign assets	-0.0153 (0.466)	-0.0140 (0.456)
Gross external non-bank private debt	-0.0256** (0.022)	
Gross external non-bank private debt * EME dummy	-0.0887 (0.552)	
Gross external bank debt		-0.0187* (0.094)
Gross external bank debt * EME dummy		-0.322*** (0.000)
Controls		Exports, domestic credit, credit market regulation, current account
N	57	57
R^2	0.434	0.562

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

More granular data on the banking system is available for advanced economies to help illuminate the transmission mechanism. And tracing out a more detailed story for advanced economies may yield a better understanding of the risks to UK financial stability, given the United Kingdom's particularly high level of gross external bank debt. The following section therefore investigates the role of banks in advanced economies in more detail. It is important to bear in mind however that gross external debt of the non-bank private sector also appears to have had a significant impact on the GDP gap.

Chart 13 Estimated contributions of bank and non-bank external debt to output losses



Sources: IMF and authors' calculations.

Shin (2012) emphasises the role of global banks' gross balance sheets during the build up to the financial crisis and its transmission, in particular the rapid increase in European banks' gross assets and liabilities *vis-à-vis* the United States. European banks drew wholesale funding from the United States via their US-based offices and then lent it back to US residents via the purchase of mortgage-backed securities. Once the mortgage-backed securities market collapsed, European banks found it very difficult to roll-over their dollar wholesale funding.

Hahm, Shin and Shin (2012) also find that the most consistently reliable indicator of the vulnerability of emerging market countries to crises is the level of external bank liabilities. In their model of the credit cycle, when risk premia are perceived to be low, banks expand their lending more quickly than the pool of available domestic retail deposits, drawing in 'non-core' funding from abroad and building up vulnerabilities to deleveraging from foreign creditors. The banking sector, thereby, becomes the focal point for accumulating vulnerabilities.

Bank to bank liabilities

We can investigate these potential external funding vulnerabilities further by looking at who resident banks borrowed from. The BIS locational data on gross external

(1) Cyprus is not in the sample because of a lack of external debt data for 2007, but more recent data indicate it also has these characteristics and is expected to experience a very sharp decline in GDP in 2013.

liabilities held by all resident banks in each country can be split into liabilities to other banks (including intragroup to affiliated banks) and those to non-banks. Liabilities that banks have *vis-à-vis* other banks are likely to be debt instruments and to be short term, and so might lead to greater vulnerabilities.(1) The regressions in **Table D** test for the effects of each, using NFA and total bank assets relative to GDP as control variables, the latter controlling for the relative size of a country's banking sector. The results are thus not merely capturing a spurious effect of a large banking sector causing a large downturn in GDP in a banking crisis. It is the size of the banking system's external liabilities relative to its total assets that matters.(2) And it is liabilities to other banks, rather than non-banks, which appear to be playing a statistically significant role, consistent with other research pointing to a seizing up of the international interbank lending markets as a key feature of the financial crisis. For the median BIS advanced-economy banking system, cross-border liabilities *vis-à-vis* banks accounted for around 80% of the fall in their total cross-border liabilities by the end of 2009. Particular vulnerabilities arose from liabilities in foreign currency, which is explored in more detail later.

Table D Gross external bank liabilities to banks and non-banks

Dependent variable: GDP gap 2009

Sample: advanced economies

Net foreign assets	0.0139	0.0114	0.00182	0.0198
	(0.204)	(0.217)	(0.909)	(0.338)
Total bank assets	0.0001	0.00397	0.00949	0.000732
	(0.982)	(0.441)	(0.158)	(0.885)
Gross external bank liabilities to non-banks	-0.0293			
	(0.237)			
Gross external bank liabilities to banks		-0.0255*		
		(0.088)		
Gross external bank liabilities to unrelated banks			-0.0885**	
			(0.040)	
Gross external bank liabilities to affiliated banks				-0.0343
				(0.425)
N	24	24	18	18
R^2	0.116	0.215	0.376	0.174

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Bank liabilities to affiliated and unrelated banks

We can further disaggregate the BIS data to look at the relative roles of bank liabilities to affiliated banks abroad, and those to unrelated banks. **Table D** shows that the vulnerability arises from liabilities to unrelated banks abroad. Unrelated banks do not have any legal or reputational constraints that prevent them from restricting funding to each other in the event of shocks to the balance sheets of creditor banks or the banks they are lending to. This result is consistent with Hoggarth, Hooley and Korniyenko (2013), who find that in the run up to the crisis foreign branches resident in the United Kingdom were more reliant on cross-border funding from unrelated banks than UK-incorporated banks, and these branches subsequently reduced their lending to the UK economy more sharply than UK-incorporated banks. More broadly, across advanced-economy banking systems, BIS data indicate that during the crisis cross-border liabilities *vis-à-vis* unrelated banks fell more sharply than liabilities *vis-à-vis* related banks and accounted for most of the decline in total cross-border liabilities to banks.

Maturity and currency mismatches

Reliance on short-term funding from unrelated banks is a particular risk to those banks whose assets tend to be longer term. Unfortunately, data limitations make it difficult to obtain an aggregate maturity profile of banks' foreign assets and liabilities. McGuire and Von Peter (2009) and Cerutti, Claessens and McGuire (2012) use the counterparty sector breakdown available in the BIS banking statistics to serve as a rough proxy for maturity. Following their example we treat banks' non-bank assets (which for example will include retail and corporate lending) as 'long term'. The extent to which these long-term assets are not supported by 'long-term' (non-bank) liabilities gives rise to a gap which banks must fill with short-term funding that has to be rolled over before their assets mature. Of course this is only a crude measure. Because non-bank liabilities will include those to money market mutual funds, which were also withdrawn sharply during the crisis, it is likely to be a lower-bound estimate of their maturity mismatch. **Table E** shows that this maturity mismatch proxy does help explain the extent of GDP falls across countries, over and above the effect arising simply from having high gross external bank liabilities.

Table E Bank maturity and currency mismatches

Dependent variable: GDP gap 2009

Sample: advanced economies

Net foreign assets	0.00525	0.00701	0.00649
	(0.449)	(0.274)	(0.501)
Total bank assets	0.00659*	0.00580*	0.0108
	(0.063)	(0.081)	(0.242)
Gross external bank liabilities	-0.0193***	-0.0224***	-0.0318*
	(0.006)	(0.007)	(0.087)
Maturity mismatch[a]	-0.0655***		
	(0.006)		
Composite mismatch[b]		-0.0857***	
		(0.003)	
Composite US dollar mismatch[c]			-0.122**
			(0.025)
N	24	24	21
R^2	0.397	0.425	0.382

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

(a) Non-bank assets minus non-bank liabilities.
(b) Foreign currency non-bank assets in minus foreign currency non-bank liabilities.
(c) US dollar non-bank assets minus US dollar non-bank liabilities.

(1) Cerutti, Claessens and McGuire (2012) assume that cross-border interbank claims have a shorter maturity on average than positions with non-banks.
(2) That is confirmed by finding a significant role for external bank liabilities expressed as a ratio of bank assets.

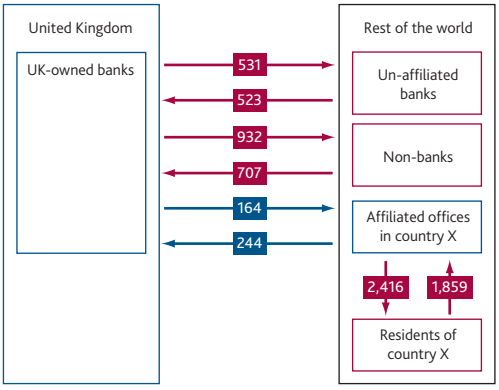
A maturity mismatch can become particularly acute when combined with a currency mismatch, in other words when long-term assets denominated in one currency are funded by rolling over short-term liabilities in another currency. A key element of short-term funding which seized up during the 2008–09 crisis was short-term dollar funding. European banks acquired relatively long-term US dollar assets secured against the US housing market, but these positions were not supported by longer-term US dollar liabilities. This gap was largely filled by tapping the interbank dollar market and using FX swaps to convert their domestic currency funding into dollars. An overall proxy for this type of combined maturity and currency mismatch can be constructed by comparing banks' foreign currency non-bank (long-term) assets with their foreign currency non-bank (long-term) liabilities. **Table E** indicates a significant role for this mismatch measure, and for one that focuses just on the US dollar mismatch element. A caveat against this measure of currency mismatches is that banks can have off balance sheet hedges against their foreign currency exposures. But during the crisis some of these hedges appeared to be less effective than anticipated since liquidity in the dollar swap market deteriorated materially.

Consolidated balance sheets

Some researchers have highlighted that when looking at fragilities arising from banks' balance sheets, it is important to look at the balance sheets of banking systems consolidated across all the jurisdictions in which they operate, since risks are managed globally. In this regard, McGuire and Von Peter (2009) argue that the propagation of the global financial crisis ran along the contours of banks' global balance sheets, rather than along national borders. For example, they show that for most banks headquartered in advanced countries more than half of their foreign claims are booked in their offices abroad. Because these transactions do not occur across borders, they will not be apparent in the BIS 'locational' banking system data used above, which only measure the cross-border assets and liabilities of banks located in a particular country, as reflected in balance of payments data.

Chart 14 shows that for the United Kingdom the activity of affiliates within other countries in 2007 was very large compared to the financial flows across borders. For example, UK-headquartered banks lent around $1½ trillion cross-border to unaffiliated banks and non-banks in the rest of the world, but their affiliated offices abroad lent nearly $2½ trillion to residents abroad. Most of this lending was funded by the overseas affiliates themselves, rather than by the parent bank in the United Kingdom, and there was relatively little upstreaming of funds from the overseas affiliates to the parent (the blue arrows in **Chart 14**). So a funding shock to an affiliate overseas might mainly have impacted on its lending in the host country, rather than be transmitted back to the parent bank and hence economic activity in the United Kingdom. On the other hand, the fact that an overseas affiliate had experienced funding problems could have indirectly led to funding problems for the parent if markets interpreted this as a signal about the creditworthiness of the banking group as a whole.

Chart 14 International activity of UK-owned banks, $ billions, 2007 Q1[(a)]



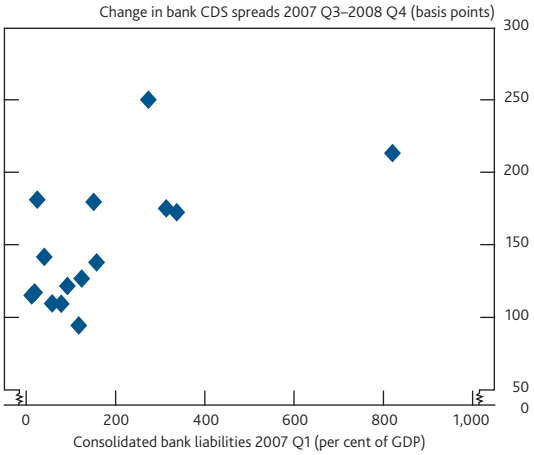
Source: BIS International Banking Statistics.

(a) Each arrow in the chart represents a claim from one entity on another.

An interesting question is, therefore, which definition of banks' external balance sheet matters more for a *country's* vulnerability: the respective country's bank balance sheet according to the balance of payments definition, which includes only cross-border transactions, but of all resident banks including locally operating foreign banks, or the global consolidated balance sheet just of banks headquartered in the respective country?

Data on banking systems' global external liabilities on a consolidated basis are not readily available — the published BIS consolidated banking statistics only cover the asset side of the balance sheet. McGuire and Von Peter (2009) have approximated the consolidated global external liabilities of banking systems by aggregating a combination of BIS consolidated and locational data, though only for fifteen countries. **Chart 15** shows there does seem to have been a

Chart 15 Changes in bank CDS spreads and consolidated liabilities of banking systems

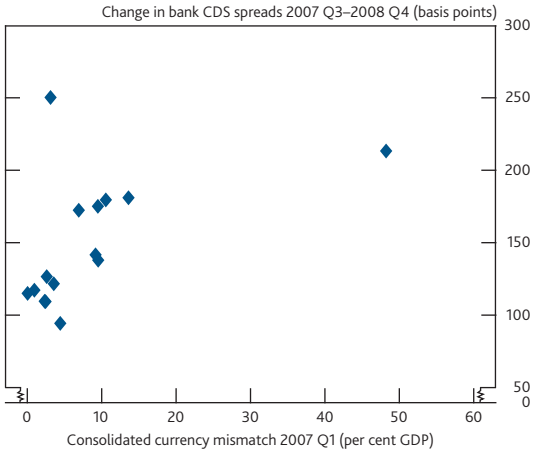


Sources: Kamin and DeMarco (2010), Markit Group Ltd., SNL Financial and McGuire and Von Peter (2009).

positive relationship between these estimates and the increase in banking system credit default swap (CDS) spreads in the early part of the crisis. But no relationship could be found with declines in GDP. For example, Swiss-owned banks had very large estimated consolidated gross external liabilities and experienced a sharp increase in their CDS spreads and hence funding costs. But the Swiss real economy seems to have been well insulated from the impact of that, perhaps because, like Germany, it had not experienced a credit-fuelled expansion before the crisis.

As already noted above, a key element of short-term funding which seized up during the crisis was short-term dollar funding. Using the same method described above, McGuire and Von Peter (2009) proxy consolidated banking systems' short-term dollar funding needs by calculating their net US dollar asset position *vis-à-vis* non-banks. **Chart 16** indicates that greater short-term dollar funding needs were associated with higher CDS spreads, but again no relationship could be found with the decline in GDP in the country in which those banks were headquartered.

Chart 16 Changes in bank CDS spreads and currency mismatches of consolidated banking systems(a)



Sources: Kamin and DeMarco (2010), Markit Group Ltd., SNL Financial and McGuire and Von Peter (2009).

(a) Mismatch defined as US dollar non-bank assets minus US dollar non-bank liabilities.

Of course the shock to the quantity and cost of funding for large global banks associated with higher CDS spreads could have had significant effects on economies other than those in which they were headquartered, because of a reduction in their cross-border lending and the local activity of their affiliates overseas. Many borrower countries experienced disruptions in funding from abroad as creditor banking systems had balance sheet problems elsewhere that forced them to reduce exposures globally. As a result, they did not roll over all cross-border credit, and diverted funds raised locally by their affiliates in particular countries, see for example Hoggarth, Hooley and Korniyenko (2013). That could explain why a country's external bank liabilities measured on a balance of payments or locational basis — including those of resident foreign-owned banks — might better capture vulnerabilities than the consolidated external liabilities just of banks headquartered in that country. On a restricted sample for which we have both sets of data, **Table A5** in the appendix confirms that the locational (balance of payments) measure of external bank liabilities does indicate country vulnerability better than the consolidated measure.

6 Summary equation

With a relatively small number of observations for some components of the story — for example the banking mismatch measures — it is difficult to present a summary equation that encompasses all the key elements discussed in this paper. **Table F** attempts to do this. The key variables — total private external debt liabilities, rapid domestic credit growth, and banking sector mismatches — are statistically significant when included together. The small number of observations precludes including all the potential control variables at the same time. Adding control variables sequentially does alter the statistical significance (ranges for coefficients and *p* values are show in the second column of the table) but the coefficients remain correctly signed.

Table F Summary equation

Dependent variable: GDP gap 2009

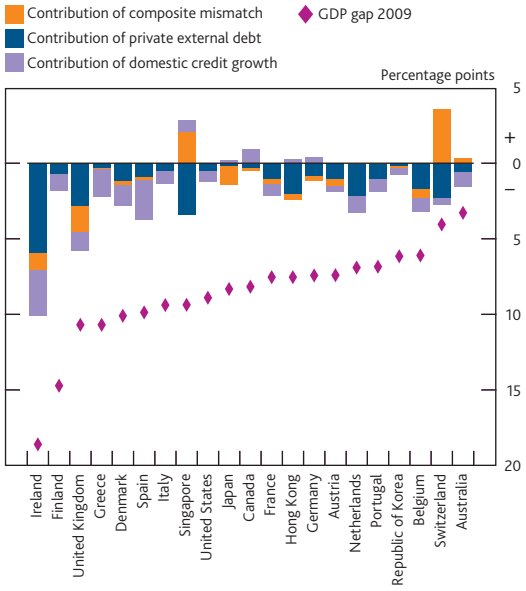
Sample: advanced economies

Gross external private debt	-0.00838** (0.037)	[-0.0094, -0.00545] [0.038, 0.319]
Composite mismatch	-0.0509** (0.029)	[-0.0596, -0.0485] [0.071, 0.131]
Domestic credit growth	-0.0398* (0.070)	[-0.0686, -0.0312] [0.124, 0.449]
Controls (one by one)		Net foreign assets, exports, domestic credit, credit market regulation, current account
N	21	21
R^2	0.478	[0.478, 0.499]

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Chart 17 illustrates the relative contributions of each of these variables to the GDP gap for this sample of advanced economies. For most countries the three factors work in the same direction, notably for Ireland and the United Kingdom where they account for around half of the declines in GDP, with private external debt making the largest contribution. But it is interesting that Singapore and Switzerland, which also had large private gross external debt stocks, had favourable mismatches (ie their banks' long-term foreign currency assets were more than matched by long-term foreign currency liabilities). Greater reliance on long-term foreign currency liabilities appears to have helped insulate them from the negative impact of their high gross external debt stocks. Of course there is still a large unexplained component so these three factors are not the full story.

Chart 17 Estimated contributions to output losses



Sources: IMF and authors' calculations.

7 Conclusion and lessons for policy

The findings of this paper suggest that the structure of gross external balance sheets is important in explaining the incidence of the financial crisis across advanced economies. High gross external debt, generated by banks and non-banks, was an indicator of subsequent vulnerability. Countries that also experienced strong domestic credit growth, in part fuelled by net capital inflows (related to the global 'savings glut' hypothesis), suffered particularly badly. And banks' balance sheets were critical in the transmission mechanism: high gross external interbank debt — linked to the 'banking glut' hypothesis — and maturity and currency mismatches, contributed to foreign rollover risk. Rather than the global 'savings glut' and 'banking glut' offering competing explanations for the crisis, this paper finds an important interaction between the two.

The Basel III overhaul of banking regulation is bringing about a significant increase in capital requirements that will leave banks better able to absorb any losses on their assets. In addition, a countercyclical capital buffer has been agreed as one tool to reduce the incidence of financial crises, with capital requirements increasing as credit expands relative to GDP. But the results in this paper suggest the expansion of domestic credit alone is not a sufficient indicator of the vulnerability of a country to a financial crisis that depresses real activity, depleting banks' capital buffers. More attention needs to be focused on the means by which an expansion in credit is financed, in particular whether a country has large gross external debt liabilities which can give rise to maturity and currency mismatches. In the words of Tucker (2012), 'All macro policymakers — monetary, macroprudential and fiscal — should, therefore, pay attention to the national balance sheet; and to the pattern of gross as well as net capital flows.' In the draft Policy Statement published by the United Kingdom's Financial Policy Committee (FPC) (Bank of England (2013)), total external debt liabilities and those incurred by banks are among the core set of indicators that the FPC will look at when setting macroprudential policy.

To promote structural changes in the liquidity risk profiles of banks away from short-term funding mismatches and toward more stable, longer-term funding of assets and business activities, international regulators under Basle III intend to implement a Net Stable Funding Ratio (NFSR) requirement. This will require long-term assets to be funded with at least a minimum amount of stable liabilities. The results in this paper point to fragilities arising from funding long-term assets with short-term debt liabilities, particularly to other banks, consistent with the need for an NFSR. A similar point applies to the related Basle III Liquidity Coverage Ratio, which will require banks to maintain sufficient liquid assets to meet liquidity needs for a 30 calendar day time horizon under a significantly severe liquidity stress scenario specified by supervisors.

The finding that a country's external bank balance sheet measured on a residency basis — including foreign banks — appears to contain more information about vulnerabilities than the consolidated balance sheets of banks headquartered in that country, reinforces the need for close co-operation between national banking supervisors. National supervisors need to be aware of significant cross-border activity carried out by resident foreign branches which are not within their supervisory control and need to consider the importance of resident foreign branches for financial stability. Indeed, that is why the Basel Concordat on cross-border banking supervision gives host authorities responsibility for the liquidity of resident foreign branches.

Calls for better monitoring of the risks inherent in national balance sheets and the removal of biases leading to over reliance on short-term debt were prominent in the aftermath of the EME crises of the 1990s, for example the Draghi Report (2000). More recently, the G30 report on 'Long-term finance and economic growth' and the Committee on International Economic Policy and Reform have called for policymakers to reduce incentives for short-term cross-border flows and for a reduction of biases in favour of debt over equity financing. The results of this paper are consistent with those recommendations about the *structure* of national balance sheets. But this paper does not consider the question of the optimal size of balance sheets or the costs and benefits of gross capital flows overall. In this regard, it is notable that large external equity liabilities were not associated with larger falls in GDP.

There are also important lessons for the type of data collected by national and international organisations. In the aftermath of the financial crisis important data gaps were apparent, which prompted the G20 Data Gaps Initiative. A key goal of this initiative is to promote the compilation of more comprehensive measures of external balance sheets and link them to domestic sectoral accounts, with data on non-bank financial institutions a particular priority (Heath (2013)). For example, this paper finds that high non-bank private sector external debt was associated with subsequent large declines in GDP. But the available data sets do not distinguish between the external positions of the non-bank financial sector and other parts of the non-bank private sector. For that reason the BIS are seeking to introduce more granular sectoral breakdowns (BIS (2012)), a task that has become more urgent given the risks that tighter regulation of the banking sector could see activity shift to the more lightly regulated shadow bank sector. More broadly, faster progress is needed in joining domestic sectoral accounts with cross-border flows of funds to be able to track who holds whose financial instruments and so reveal more useful currency and maturity mismatch information. In turn, that would enable institutions such as the IMF to better assess how shocks to financial markets are transmitted across countries.

Appendix

Definition of GDP gap

In calculating the GDP gap this paper follows most of the existing literature in using 2009 as the year under consideration. The GDP gap in 2009 is calculated as the percentage divergence between actual annual real GDP in 2009 and the hypothetical level of real annual GDP obtained by extrapolating its ten-year linear trend up to 2007. Two alternative definitions of the GDP gap are examined: i) the gap prevailing in 2009 Q2 to more precisely calibrate the size of the initial shock; and ii) the gap in 2010, which will allow for more persistent effects but risks the results being affected by variation across countries in the degree to which monetary and fiscal policy reacted to alleviate the impact of the crisis. Because for the former we need quarterly GDP data, at constant prices and seasonally adjusted, that restricts the sample to advanced economies. With either alternative GDP gap measure, gross external private debt remains significant, see **Table A1**. The reference period of 1997–2007 may of course have been, with hindsight, a period of unsustainably fast growth, which will contribute to the size of the measured output gap in 2009. Indeed, as explored in Section 4, this is an important element to the story: it is countries which grew rapidly between 1997 and 2007, supported by net inflows of capital and which accumulated high external debt stocks, which suffered most at the outset of the crisis.

Table A1 Alternative dependent variables

	GDP gap 2009	GDP gap 2009.2	GDP gap 2010
Net foreign assets	0.0163**	-0.00140	0.0446***
	(0.014)	(0.921)	(0.001)
Gross external private debt	-0.0136***	-0.0113***	-0.0206***
	(0.000)	(0.001)	(0.000)
R^2	0.414	0.246	0.593
N	24	24	24

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Table A2 reproduces the regression from **Table A** with gross external private debt and all control variables using the GDP gap 2009 and 2010 as dependent variables:

Robustness to outliers

Some advanced economies have very large financial sectors in relation to their economies. For example, Hong Kong, Iceland, Ireland, and Switzerland have gross external liabilities exceeding 500% of GDP, as shown in **Chart 5**. Using the robust regression command in STATA, which down weights outliers in the regression without discarding them, the role of private external debt remains significant, see **Table A3**. That is also true in regressions with control variables when we split the sample into advanced and emerging market economies (**Table A4**). Only in the regression using the full sample (and a dummy for EMEs), does the coefficient on gross external private debt in advanced economies become insignificant (third column). Given its significant effect in the other regressions however, we conclude that our results are broadly robust to outliers.

Table A2 Alternative dependent variables with controls

	Gap 2009	Gap 2010
EME Dummy	4.680**	5.931**
	(0.041)	(0.037)
Net foreign assets	-0.0193	-0.00407
	(0.335)	(0.852)
Exports	0.0205	0.0235
	(0.519)	(0.530)
Domestic credit	0.0145	0.0151
	(0.438)	(0.482)
Credit market regulation	-2.144**	-3.224***
	(0.032)	(0.007)
Current account	0.251	0.422**
	(0.110)	(0.027)
Gross external private debt	-0.0148**	-0.0213***
	(0.022)	(0.010)
Gross external private debt * EME dummy	-0.174**	-0.184**
	(0.016)	(0.024)
N	57	57
R^2	0.519	0.618

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Table A3 Regression which down-weights the role of outliers

Dependent variable: GDP gap 2009

	Full sample	Emerging markets	Advanced economies
Net foreign assets	0.0195	-0.0419	0.0170**
	(0.132)	(0.346)	(0.045)
Gross external private debt	-0.0208***	-0.324***	-0.0137***
	(0.002)	(0.000)	(0.002)
N	63	38	25

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Table A4 Regression which down-weights the role of outliers with controls

Dependent variable: GDP gap 2009

	Advanced economies	Emerging markets	Full sample
Net foreign assets	0.0146	-0.0608	-0.00631
	(0.468)	(0.343)	(0.755)
Exports	-0.0152	0.0362	-0.00957
	(0.581)	(0.658)	(0.756)
Domestic credit	0.00988	-0.0135	0.0000582
	(0.626)	(0.778)	(0.998)
Credit market regulation	-0.988	-2.030	-1.372
	(0.391)	(0.223)	(0.143)
Current account	0.130	0.299	0.255*
	(0.427)	(0.241)	(0.057)
Gross external private debt	-0.0125*	-0.233**	-0.0105
	(0.069)	(0.015)	(0.211)
EME dummy			6.479**
			(0.022)
Gross external private debt * EME dummy			-0.210***
			(0.000)
N	24	33	57

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Table A5 The role of locational and consolidated external bank liabilities

Dependent variable: GDP gap 2009

Net foreign assets	0.0196 (0.332)	0.0171 (0.295)
Total bank assets	0.0177* (0.059)	-0.0121 (0.302)
Gross external bank liabilities on locational basis	-0.0409* (0.054)	
Gross external bank liabilities on consolidated basis		0.0121 (0.127)
N	15	15
R^2	0.448	0.323

Robust *p* values appear in parentheses and ***, **, *, correspond to the 1%, 5% and 10% level of significance, respectively.

Description of the data

Sample of countries

Advanced economies: Australia, Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom and United States.

Note that we excluded Luxemburg from the sample because of its extremely large external balance sheet.

Emerging markets: Argentina, Armenia, Belarus, Bolivia, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Croatia, Czech Republic, Ecuador, Egypt, El Salvador, Estonia, Georgia, Hungary, India, Indonesia, Jordan, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Malaysia, Mexico, Moldova, Paraguay, Peru, Poland, Russian Federation, Slovak Republic, South Africa, Thailand, Tunisia, Turkey, Ukraine and Uruguay.

Variables

Name	Unit	Period	Sources
GDP gap 2009	Percentage difference relative to pre-crisis trend (1997–2007)	2009	IMF *World Economic Outlook*, October 2012.
Net foreign assets (NFA)	Percentage of GDP	2007	Lane and Milesi-Ferretti (2007).
Gross external liabilities	Percentage of GDP	2007	Lane and Milesi-Ferretti (2007).
External leverage	Ratio	2007	Definition from Gourinchas and Obstfeld (2012), page 48; data from Lane and Milesi-Ferretti (2007).
Gross external debt	Percentage of GDP	2007 Q1	QEDS.
Exports	Percentage of GDP	2007	World Bank World Development Indicators.
Domestic credit	Percentage of GDP	2007	World Bank World Development Indicators.
Credit market regulation	Index	2006	Rose and Spiegel (2011).
Current account	Percentage of GDP	2007	World Bank World Development Indicators
Bank assets and liabilities to banks and non-banks	Percentage of GDP	2007 Q1	BIS International Banking Statistics: locational data on residence basis.
Gross external bank liabilities on consolidated basis	Percentage of GDP	2007 Q1	McGuire and Von Peter (2009).
Net US dollar non-bank assets on consolidated basis	Percentage of GDP	2007 Q1	McGuire and Von Peter (2009).
Total bank assets	Percentage of GDP	2007	IMF and national sources. Measured on a residency basis.

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