

Assessing Macroprudential Policies: Case of Korea*

Valentina Bruno
bruno@american.edu

Hyun Song Shin
hsshin@princeton.edu

September 18, 2012

Abstract

This paper develops methods for assessing the sensitivity of capital flows to global financial conditions, and applies the methods in assessing the impact of macroprudential policies introduced by Korea in 2010. Relative to a comparison group of countries, we find that the sensitivity of capital flows into Korea to global conditions decreased in the period following the introduction of macroprudential policies.

JEL codes: F32, F33, F34

Keywords: Capital flows, credit booms, macroprudential policy

*Prepared for the symposium issue of the Scandinavian Journal of Economics on capital flows. One of the authors (Shin) was involved in the design of the macroprudential policy tools introduced in Korea in 2010, and hence is not a disinterested party in the findings reported in this paper.

1 Introduction

Beginning in June 2010, Korea introduced a series of macroprudential measures aimed at building resilience against external financial shocks, especially against its well-known vulnerability to capital flow reversals in the banking sector and the associated disruptions to domestic financial conditions. Korea was one of the countries hardest hit in the 1997 Asian financial crisis, and was again at the sharp end of the financial turmoil unleashed after the failure of Lehman Brothers in September 2008. In recognition of the sources of Korea’s vulnerabilities (on which more below), the macroprudential measures introduced from 2010 were aimed at moderating the procyclicality of the banking sector by dampening the fluctuations in the growth of so-called “non-core” bank liabilities, especially cross-border banking sector liabilities.

The purpose of our paper is to give a preliminary empirical assessment of the impact of the measures introduced by the Korean authorities, and to revisit the rationale behind their design so as to refine the thinking behind capital flows and financial stability.¹ Our assessment is based on the framework developed in our earlier paper on global liquidity (Bruno and Shin (2011)) where global financial conditions drive banking sector capital flows through the funding and lending operations of international banks. Our empirical proxies for global financial conditions draw on the institutional structure of cross-border banking and the status of the US dollar as the currency that underpins the global banking system, as explained below.

Our assessment of the performance of Korea’s macroprudential tools is based on a panel study where Korea is one of 48 countries in a sample that encompasses both advanced and emerging economies. Our approach is to treat the countries other than Korea as a comparison group and ask, first, how Korea’s susceptibility to the global factors in capital flows compares to the other countries during the entire sample period. Then, having obtained a benchmark for comparison from this cross-country panel study, we ask whether the empirical relationship between Korea and the comparison group changed in any noticeable way following the sequenced

¹One of the authors (Shin) was involved in the design of the macroprudential policy tools introduced in Korea in 2010, and hence is not a disinterested party in the findings reported in this paper.

introduction of macroprudential measures in Korea from June 2010.

To anticipate our main conclusion, we do indeed find evidence that capital flows into Korea became less sensitive to global factors after the introduction of its macroprudential measures. Interestingly, this change in Korea’s sensitivity to global conditions is in contrast to the other countries in the region. We find that Korea’s experience is the opposite of other comparable countries in Asia, whose sensitivity to global liquidity conditions actually *increased* after June 2010. Specifically, when we examine the same set of regressions applied one by one to the “Big Five” ASEAN countries (Indonesia, Malaysia, Philippines, Thailand and Vietnam) as well as to Australia, we find that their incremental sensitivity to global liquidity conditions was higher after June 2010. Thus, Korea’s lower sensitivity to global liquidity conditions after June 2010 stands out in contrast.

More broadly, we see the contribution of our paper as offering a simple but useful methodology for examining the impact of macroprudential policies by identifying variables that are known proxies for global liquidity, and then investigating how the sensitivity of a particular aggregate to global conditions varies over time, before and after the introduction of the new policies.

Our methods are based on time dummies, and hence cannot fully control for other events in the capital-recipient economy that occur at the same time as the introduction of the new policies. However, the methods may be useful as a first step when searching for instances that deserve more sustained scrutiny through much more carefully designed micro empirical investigations.

The outline of the paper is as follows. We begin by describing the background to our study by outlining the rationale for why the “non-core” liabilities of the banking sector are a good proxy for the underlying financial conditions and the vulnerability to a reversal. We further explain how, in the context of cross-border banking, capital flows through the banking sector are closely related to the fluctuations in non-core liabilities. We then describe the institutional background for Korea and outline the timing and sequencing of the macroprudential measures introduced in Korea. The core empirical investigation of the paper then follows in two sections. We conclude by drawing implications for the relationship between capital flows and financial stability.

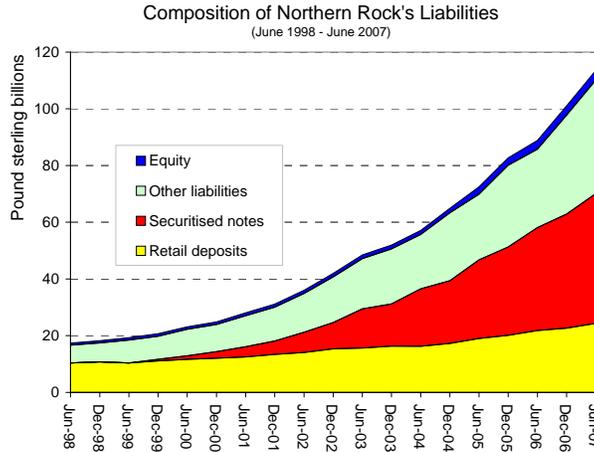


Figure 1. Liabilities of Northern Rock from June 1998 to June 2007 (Source: Shin (2009))

2 Background

2.1 Non-Core Bank Liabilities

Banking activity is a key driver of financial conditions both within and across borders. Rapid growth of bank lending is mirrored on the liabilities side of the balance sheet by shifts in the composition of bank funding. As intermediaries who borrow in order to lend, banks must raise funding in order to lend to their borrowers. In an economy with domestic savers, the primary source of funding available to the bank is the retail deposits of the household sector. When credit is growing faster than the pace of growth in the pool of available retail deposits, the bank will turn to other, *non-core* sources of funding to support its credit growth.²

Non-core funding by banks during lending booms is illustrated in Figure 1 which shows the composition of the liabilities of Northern Rock, the UK bank whose failure in 2007 heralded the global financial crisis. In the nine years from 1998 to 2007, Northern Rock's lending increased 6.5 times. This increase in lending far outstripped the funds raised through retail deposits (bottom

²The distinction between core and non-core funding is discussed in more detail in Shin and Shin (2010).

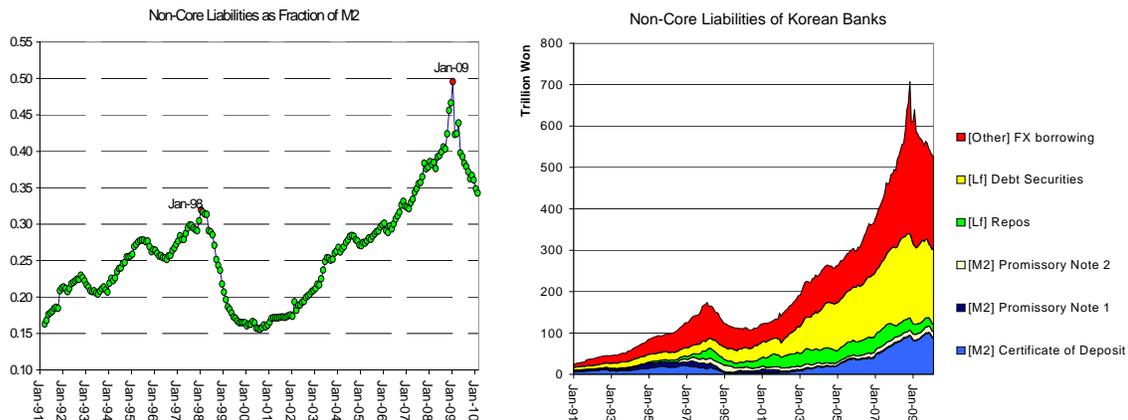


Figure 2. **Non-Core Liabilities of Korean Banks.** Panel on right plots six categories of non-core liabilities of Korean banks measured in Korean Won. Panel on the left plots the non-core series as a fraction of M2. Source: Bank of Korea and Shin and Shin (2010)

strip) with the rest of the funding gap being made up with wholesale funding.

Northern Rock’s case illustrates the general lesson that during a credit boom, the bank resorts to alternative, non-core liabilities to finance its lending when its access to core deposit funding does not keep pace with the growth of its lending. Therefore, the proportion of non-core liabilities in the total funding of banks can serve as a useful indicator of the stage of the financial cycle and the degree of vulnerability of the banking system to a downturn of the financial cycle. The exact dividing line between “core” and ‘non-core” liabilities depend on the institutional setting. However, cross-border bank funding is likely to be an important component of non-core funding when the financial system has an open banking sector as in Korea.

Figure 2 introduces the role played by non-core banking funding in Korea. The right panel of Figure 2 plots six categories of non-deposit funding of the Korean banking sector. The aggregate series in the right hand panel can be seen to be procyclical, with the first peak coinciding with the 1997 Asian financial crisis. After a lull in the early 2000s, non-core liabilities increase rapidly in the run-up to the 2008 financial crisis.

In the left hand panel of Figure 2, we plot the total non-core liabilities as a fraction of the M2

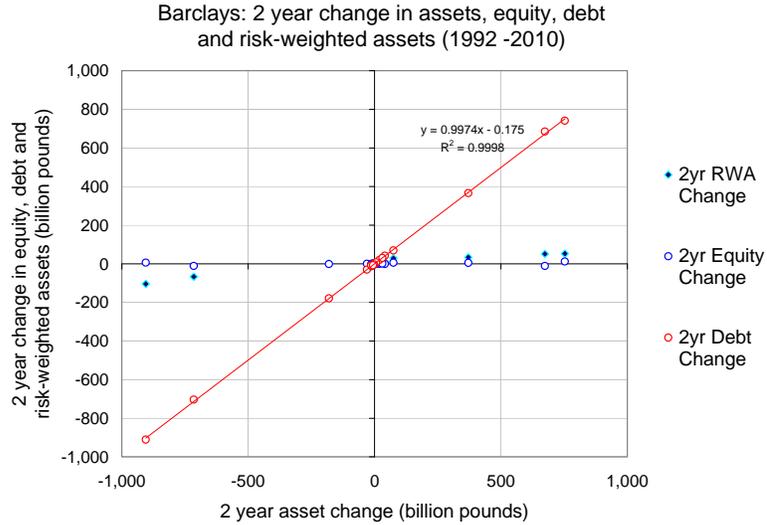


Figure 3. Scatter chart of relationship between the two year change in total assets of Barclays against two-year changes in debt, equity and risk-weighted assets (Source: Bankscope)

money stock in Korea, where M2 proxies for the core deposit funding. The left hand panel in Figure 2 highlights the procyclical nature of non-core liabilities, as evidenced by the substantial variation in the ratio of non-core liabilities to M2, ranging from around 15% of M2 to a peak of 50% at the height of the 2008 crisis.³

The informativeness of non-core bank liabilities and cross-border capital flows for gauging financial vulnerability is closely related to the procyclicality inherent in the way that banks manage their balance sheets. An illustration for a typical global bank is given in Figure 3 that shows the scatter chart of the two-year changes in debt, equity and risk-weighted assets (RWA) to changes in total assets of Barclays. The pattern in Figure 3 is typical of banks across countries and across business sectors.⁴ Figure 3 plots $\{(\Delta A_t, \Delta E_t)\}$, $\{(\Delta A_t, \Delta D_t)\}$ and $\{(\Delta A_t, \Delta RWA_t)\}$ where ΔA_t is the two-year change in assets measured at quarter t , and where ΔE_t , ΔD_t and

³The peaks in the series occur some weeks after the start of the crisis, as the non-core series are measured in Korean Won and the Won depreciated sharply during the 1997 and 2008 crises, increasing the Won value of foreign exchange-denominated liabilities.

⁴See Adrian and Shin (2010) for a more detailed study of the US investment banks.

ΔRWA_t are the two-year changes in equity, debt, and risk-weighted assets, respectively.

Especially notable in Figure 3 is how the relationship between the changes in the total assets and its risk-weighted assets is very flat. In other words, the risk-weighted assets barely change, even as the raw assets change by large amounts. The fact that risk-weighted assets barely increase even as raw assets are increasing indicates the compression of measured risks during lending booms when markets price in low probabilities of default. Lower measured risks are reflected in high prices of risky assets relative to their riskless counterparts, so that yield spreads on risky debt are compressed and measures of implied volatility are low.

The causation in the reverse direction may also be operating – that is, the compression of risk spreads is induced by the rapid increase in credit supply chasing available credits. In the presence of such two-way causation, there may well be the potential for a feedback loop in which greater credit supply by banks and the compression of risk spreads interact to generate an amplification of the credit boom. Borio and Disyatat (2011) have coined the term “excess elasticity” to describe the tendency of the banking system to expand when financial constraints are relaxed.

In our paper, we are interested in the consequences of such procyclical behavior of the banking sector for cross-border capital flows. Since banks are intermediaries who borrow in order to lend, and they must raise alternative sources of funding when the rapid expansion of domestic credit outstrips the pool of available domestic sources of funding. The prime source of such alternative funding is from global banks operating as wholesale lenders in the capital market. In this way, the procyclical behavior of banks provides the link between non-core funding of banks and capital inflows through the banking sector. Given the close connection between procyclicality and capital inflows, there are close parallels between *currency crises* and *credit crises* in countries that operate with open banking sectors. Hahm, Shin and Shin (2011) find in their panel probit study of financial crisis indicators that the ratio of non-core to core funding (especially the non-core liabilities to foreign creditors) is the most consistently reliable indicator of vulnerability of a country, both to a currency crisis and to a credit crisis.

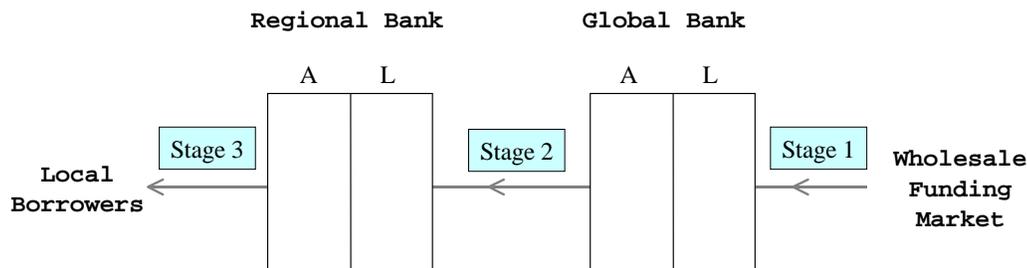


Figure 4. Three stages of cross-border banking sector flows.

2.2 Landscape of Cross-Border Banking

As well as tracking the demand for wholesale funding by local banks in the capital recipient economy, it is equally important to track the *supply* of wholesale bank funding in international capital markets. In this respect, understanding the structure of the global banking system is important in tracking the transmission of financial conditions.

Our empirical investigation rests on the interaction between local and global banks depicted in Figure 4 developed in Bruno and Shin (2011). The direction of financial flows goes from right to left, to stick to the convention of having assets on the left hand side of the balance sheet and liabilities on the right hand side. In stage 1 in Figure 4, global banks raise wholesale funding and supply wholesale funding to local banks in other jurisdictions. The local banks draw on the cross-border funding (stage 2) in order to lend to their local borrowers (stage 3). Stage 1 corresponds to the activity of global banks borrowing in financial centers.

A BIS (2010) study describes how the branches and subsidiaries of foreign banks in the United States borrow from money market funds and then channel the funds to their headquarters. Baba, McCauley and Ramaswamy (2009), McGuire and von Peter (2009), IMF (2011) and Shin (2012) note that in the run-up to the crisis, roughly 50% of the assets of U.S. prime money market funds were obligations of European banks. The funds channeled by the branch to headquarters (interoffice assets) constitute gross capital outflows from the United States.

Figure 5 plots the assets and liabilities of foreign banks in the United States (left panel) and

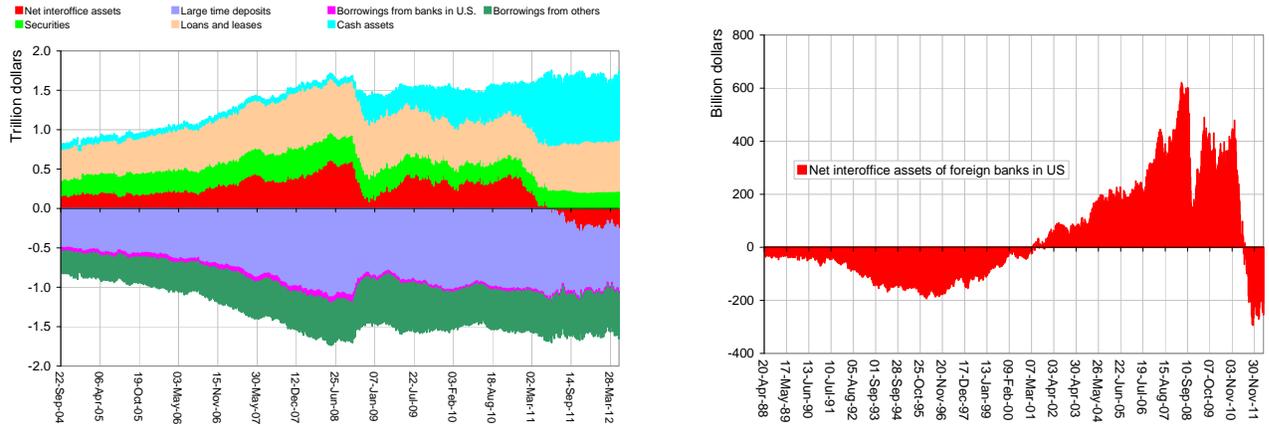


Figure 5. The left hand chart shows the assets and liabilities of foreign bank branches and subsidiaries (“foreign-related institutions”) in the US on their parent. The right hand chart shows the net interoffice assets of foreign banks in the US, given by the negative of the “net due to foreign-related offices”. (Source: Federal Reserve H8 series)

their net interoffice assets (right panel). Net interoffice assets measure the net claim of the branch or subsidiary of the foreign bank on its parent. Normally, net interoffice assets would be negative, as foreign bank branches act as lending outposts. However, we see that the decade between 2001 to 2011 was exceptional, when net interoffice assets turned sharply positive, before reversing into negative territory during the height of the European crisis in 2011. In effect, during the decade between 2001 and 2011, foreign bank offices became *funding sources* for the parent, rather than lending outposts. As noted by the BIS (2010) report, many European banks use a centralized funding model in which available funds are deployed globally through a centralized portfolio allocation decision. Cetorelli and Goldberg (2009, 2010) provide extensive evidence using bank level data that internal capital markets serve to reallocate funding within global banking organizations.

The net interoffice position of foreign banks in the US therefore reflects the extent to which global banks were engaged in supplying US dollar funding to other parts of the world. In our empirical investigation below, we will use the growth of the net interoffice account position of foreign banks in the US as a key empirical proxy for the availability of wholesale funding

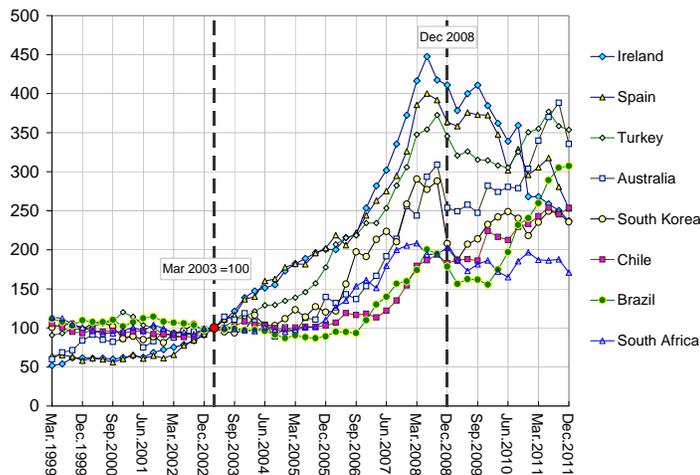


Figure 6. External claims (loans and deposits) of BIS reporting country banks on borrowers in countries listed. The series are normalized to 100 in March 2003 (Source: BIS Locational Banking Statistics, Table 7A)

provided to borrowers in the capital-recipient economy.

Stage 2 in Figure 4 corresponds to the cross-border capital flows through the banking sector, and is the focus of our paper. The empirical counterpart of Stage 2 in Figure 4 in our paper will be the cross-border claims of the banks in countries that report loan amounts to the Bank for International Settlements (BIS).

Figure 6 plots the the cross-border claims of BIS-reporting banks on counterparties listed in the countries on the right. The series have been normalized to equal 100 in March 2003. Although the borrowers have wide geographical spread, we see a synchronized boom in cross-border lending before the recent financial crisis.

The observed capital flows reflect the interaction of the supply and demand for wholesale funding between global and local banks. When local and global banks interact in the market for wholesale bank funding, the liabilities of local banks serve as the assets of the global banks, and the lending by global banks is the supply of wholesale funding, while the borrowing by local banks is its demand. Our earlier paper (Bruno and Shin (2011)) derived a closed-form solution for the equilibrium stock of cross-border lending when banks adjust their balance sheets using

Value-at-Risk rules that maintain a constant probability of default. The formula for the total stock of cross-border bank claims is given by

$$\text{Total cross-border lending} = \frac{\text{Global and weighted regional bank capital}}{1 - \text{spread} \times \frac{\text{regional leverage}}{\text{global leverage}}} \quad (1)$$

where leverage is normalized to lie between zero and one.

The distinction between the demand and supply of wholesale funding harks back to Calvo, Leiderman and Reinhart (1996), who distinguished the “push” and “pull” factors that drive capital flows into emerging economies. However, although demand and supply factors can be distinguished in theory, the closed form solution in (1) shows that both demand and supply factors enter co-mingled in the closed form solution, making it difficult fully to disentangle the two forces in practice. Nevertheless, global factors in the supply of wholesale funding will be important determinants of capital flows that affect all capital recipient countries, and we exploit this fact when examining the sensitivity of capital flows into a particular country by treating the other countries in the sample as a comparison group.

In our empirical investigation, we make use of two global factors. The first is the growth of the net interoffice assets of foreign banks in the United States (the series shown in the right hand panel of Figure 5), reflecting the activities of international banks that engage in the supply of wholesale bank funding. A rapid increase in the net interoffice assets series reflects an expansion of cross-border banking activities of global banks. We will see that the run-up in cross-border lending in Figure 6 closely mirrors the increase in wholesale funding raised by the global banks in Figure 5. In effect, Figure 5 reflects the liabilities side of global banks’ balance sheets (Stage 1 in Figure 4), while Figure 6 traces the movements on the asset side of global banks’ balance sheets (Stage 2 in Figure 4).

The second set of global factors we employ in our empirical investigation are those associated with the VIX index of implied volatility of equity index options in the United States. There is well-documented evidence that banking sector leverage is closely associated with fluctuations in the VIX index (see, for instance, Adrian and Shin (2010, 2012)). As shown in the formula

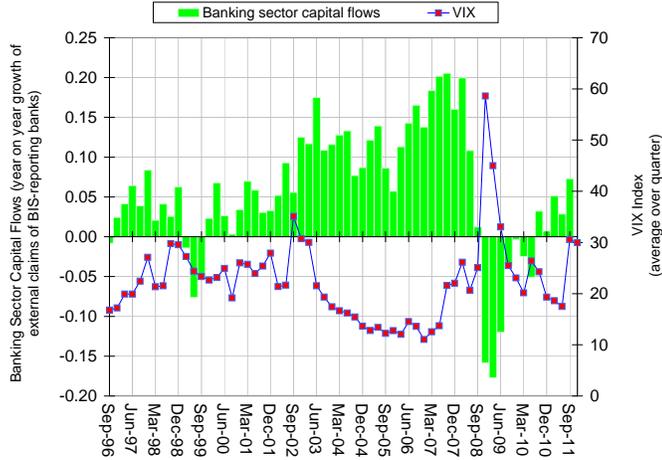


Figure 7. This figure plots cross-border banking sector capital flows as year-on-year growth in external claims of BIS-reporting banks (Table 7A). The VIX series is the quarterly average of CBOE VIX index. (Source: Bruno and Shin (2011))

for cross-border lending in (1), the leverage of the banking sector - both global and local - are important determinants of cross-border claims. When leverage is high, an additional unit of bank capital will translate into a higher level of cross-border claims. In addition, any *increase* in bank leverage will mean that existing bank capital will support higher amounts of lending. Therefore, since VIX is correlated with bank leverage, the theory predicts that both the *level* of the VIX, as well as the *change* in the VIX will show up as being determinants as capital flows. We will see that these predictions are borne out in the empirical investigation.

Figure 7 encapsulates the empirical association between the VIX measure and aggregate capital flows through the banking sector. It plots the fluctuations in aggregate capital flows in the banking sector from 1996, as measured by the four-quarter growth of cross-border claims of BIS-reporting banks. Aggregate banking flows are large when the VIX index is low, but crash when the VIX index spikes with the onset of the financial crisis. As the acute phase of the crisis passes in 2009, gross flows resume once more.

Figure 7 points to the merits of capturing accurately the impact of measured risks on

bank balance sheet management. It also suggests a close conceptual link between Forbes and Warnock's (2011) finding of the explanatory power of the VIX index for capital flows and the importance of leverage identified by Gourinchas and Obstfeld (2012). Figure 7 suggests that the connection is the banking sector's balance sheet management. For this reason, the VIX index will be another proxy for global liquidity conditions in our empirical investigation below.

2.3 Case of Korea

The procyclicality of the banking sector and its use of cross-border funding is a useful lens through which to view Korea's experience. Korea was one of the countries hardest hit during the 1997 Asian financial crisis, and its experience leading up to the 2008 financial crisis is revealing in several respects. From 2005 to 2007, locally-owned Korean banks and the foreign bank branches in Korea saw rapid increases in short-term foreign currency liabilities, which then subsequently reversed abruptly after the bankruptcy of Lehman Brothers in September 2008. The severity of the 2008 crisis for Korea can be attributed largely to the rapid deleveraging that took place by the banking sector (both domestic and foreign) with the onset of the 2008 financial crisis.

Figure 8 compares the capital inflows and outflows for two sectors – the equity sector and the banking sector. We see that the equity sector actually saw net *inflows* during the crisis in 2008. Thus, contrary to the common misperception that the exit of foreign investors from the Korean stock market is the main reason for capital outflows, flows in the equity sector was net positive immediately after the crisis. The reason for this net positive flow was that selling by foreigners was more than matched by the repatriation flow of Korean residents who sold their holdings of foreign equity.

However, the banking sector saw very substantial capital outflows, associated with the deleveraging of the banking sector. Deleveraging sets off amplifying effects through price changes, where the depreciation of the Korea won against the US dollar increases the size of external liabilities relative to domestic currency assets. In addition, the creditor banks in global

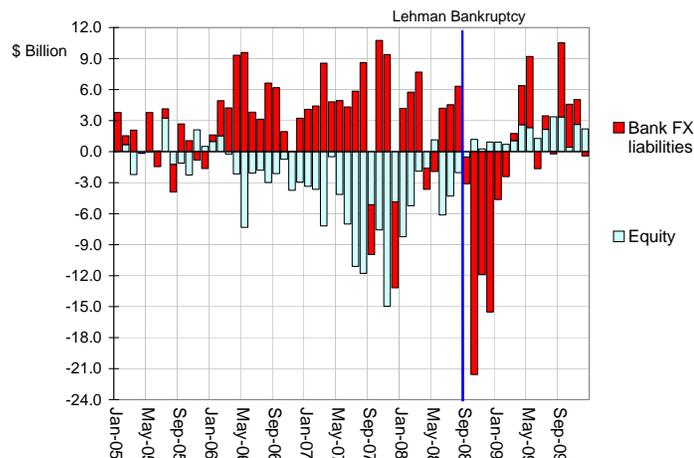


Figure 8. Net capital flows in the equity sector and banking sector for Korea (Source: Shin and Shin (2010), data from Bank of Korea)

capital markets are similarly shrinking their lending in response to heightened measures of risk. The feedback loop generated by such reactions to price changes can lead to amplification of shocks.⁵ Figure 8 shows that the banking sector in Korea saw very substantial capital outflows in the aftermath of the Lehman crisis. In the three months following the Lehman bankruptcy, the outflow from the banking sector was 49 billion dollars, which approximately accounts for the decrease in Korea's foreign exchange reserves from over 240 billion dollars before the Lehman crisis to 200 billion at the end of 2008.

The banking sector in Korea (including the foreign bank branches) also held dollar assets, but the counterparties were local borrowers, such as exporting companies who held long-term dollar assets arising from their export receivables. Although the overall currency mismatch on the consolidated balance sheet consisting of the corporate and banking sectors would then cancel out, a maturity mismatch between long-term dollar claims and short-term dollar liabilities took its place. In effect, the currency mismatch was replaced by a maturity mismatch which left the

⁵Theoretical developments of such feedback effects through prices and heightened risks can be found in Xiong (2001), Brunnermeier and Pedersen (2009), Danielsson, Shin and Zigrand (2011) and Brunnermeier and Sannikov (2011).

Korean financial system vulnerable to the global financial crisis in 2008 that followed in the wake of the bankruptcy of Lehman Brothers.

These lessons led to a concerted policy initiative on the part of Korean policy makers to mitigate some of the known vulnerabilities. Beginning in June 2010, the authorities in Korea introduced a sequence of macroprudential measures aimed at building resilience against its well-known vulnerability to capital flow reversals in the banking sector and the associated disruptions to domestic financial conditions. The policy initiative was widely reported in both the domestic and international press at the time, and the press reports are useful in dating the sequence of events.⁶

The first measure announced in June 2010 was a leverage cap on the notional value of foreign exchange derivatives contracts (encompassing currency swaps and forwards) that banks could maintain. For foreign bank branches, the leverage cap was set at 2.5 times their capital, while for domestic Korean banks, the cap was set at 50% of their capital. Foreign banks could in principle increase their positions by allocating greater capital to their branches in Korea, but the leverage cap lowers the return to capital for banks engaged in this segment of their business, thereby serving as a disincentive on expansion of derivatives positions.

The second component was the levy on the non-core liabilities of the banks (the “macroprudential levy”), applied to the foreign exchange-denominated liabilities of the banking sector. The Korean non-core liabilities levy was relatively unfamiliar compared to the standard bank capital-related tools or standard capital control tools such as the unremunerated reserve requirements (URR). For this reason, the roll-out took more time. Although the policy was discussed from February of 2010 (Shin (2010)) and press coverage trailed the introduction of the non-core levy from early in 2010,⁷ the measure was announced formally in December 2010, after the conclusion of the G20 Seoul summit in November. The legislation was passed in April of 2011, and the levy began its operation in August 2011.

⁶See, for instance, the June 2010 article in the Economist magazine, “The won that got away: a surgical strike in a volatile market” <http://www.economist.com/node/16381310>

⁷See Wall Street Journal, April 22, 2010: <http://blogs.wsj.com/economics/2010/04/22/is-obamas-bank-tax-plan-right-for-emerging-markets/>

The levy consists of an annualized 20 basis point charge on the wholesale foreign exchange denominated liabilities of the banks of maturity up to 12 months. Lower rates are applied in a graduated manner to maturities of over one year.

The levy was designed so that the proceeds of the levy are paid into a special segregated account of the foreign exchange reserves, rather than going into the general revenue of the government. In this respect, the Korean levy was designed from the outset as a financial stability tool, rather than as a fiscal measure. The outwardly similar bank levies introduced by France and the UK in 2010 had the proceeds being paid into general government revenue, and were designed as fiscal measures to supplement government revenue. By targeting non-core liabilities only, the levy was also designed to address the procyclicality of the banking sector while leaving unaffected (as far as possible) the intermediation of core funding from savers to borrowers.

For the purpose of our empirical investigation, the exact dating of the impact of the non-core liabilities levy is complicated by the long gestation period between initial discussions of its adoption and its final implementation. Some anticipation of the new measure will have affected behavior before the formal introduction of the levy, but the quantification of the anticipation effect is difficult, and is not attempted here. More useful for our purpose of timing the macroprudential policies is the cap of foreign exchange derivatives, which was announced and implemented in June 2010. Thus, in what follows, we will regard June 2010 as the threshold point for the new regime of macroprudential policies in Korea.

3 Empirical Findings

3.1 Data Description and Methodology

In conducting our assessment of the impact of Korea's macroprudential policies, we use a sample of countries consists of developed and emerging economies, but excluding offshore financial centers. The list of countries is drawn from Claessens, van Horen, Gurcanlar and Mercado (2008), who considered open economies where foreign banks play an economically significant

Table 1. **Summary Statistics.** This table summarizes our key variables in terms of their, mean, standard deviation, minimum and maximum.

Variable	Obs	Mean	Std. Dev.	Min	Max
BIS Loans Growth	3120	0.025304	0.103441	-0.77813	0.699696
Δ Interoffice	3120	0.102731	0.80411	-2.97728	4.705705
VIX	3120	3.037166	0.347399	2.432736	3.787366
RER	3120	1.679234	2.466732	-0.99713	10.16791
Δ Money Stock	3120	0.013791	0.02926	-0.04723	0.086367
GDP Growth	3120	0.089603	0.122039	-0.20757	2.292165
Debt to GDP	2892	0.546071	0.324553	0.03685	2.35825

role in the country’s financial system. The data set used in Bruno and Shin (2011) follows the list in Claessens et al. (2008).

In addition to the Claessens et al. list, the sample in this paper includes the Philippines and Vietnam in order to include all five of the “Big Five” countries in ASEAN, so as to facilitate a more complete comparison of Korea with other countries in the region.

The full list of countries included in our sample are Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Malaysia, Malta, Mexico, Netherlands, Norway, Philippines, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, Uruguay and Vietnam. Table 1 gives the main summary statistics of our sample of 48 countries.

Our measure of capital flows is the quarterly growth in external claims of BIS reporting country banks, as given by the BIS locational statistics (Table 7A). The link between the leverage of the banking sector and measured risks is addressed by using the Chicago Board Options Exchange (CBOE) Volatility Index (*VIX*) of implied volatility in S&P 500 stock index option prices. As explained above, the *VIX* Index is generally considered the barometer of investor sentiment and market volatility, but for our purposes, the more specific justification is the close link between the *VIX* index and measures of bank Value-at-Risk, so that banking

sector leverage is closely tied empirically to the VIX index (Adrian and Shin (2010, 2012)). In addition to the VIX in log level, we also include the quarterly log difference of the VIX (denoted by ΔVIX), as one of the variables predicted by the theory.

We also include several control variables - both global and local - as possible determinants of capital flows. We include the log real exchange rate (RER), where RER is computed as the log of nominal exchange rate*(US CPI/local CPI). The nominal exchange rate is in units of national currency per U.S. Dollar (from the IMF’s IFS database). The quarterly growth in the global money supply ($\Delta\text{Money stock}$) is calculated as the quarterly log difference of the sum of the M2 stock in the US, Eurozone and Japan and M4 in the UK (from the IFS). GDP growth is the country percentage change in GDP from the previous year (from the WEO). Debt to GDP is the government gross debt as percentage of the GDP (from WEO). We also investigated the real lending rate (RLR) to assess the role of interest rates in affecting capital flows, where RLR was defined as the nominal lending rate adjusted by inflation, and the nominal lending rate is the bank rate (from the IFS, lines 60p and lines 60pns). However, the results for RLR proved insignificant and is not reported below. The sample period spans from the first quarter of 1996 (the first date covered in Table 7A of the BIS locational data) to the latest data at the time of writing, which is the first quarter of 2012.

3.2 Panel Regression

Our empirical investigation is based on the benchmark panel regressions for banking sector capital flows where both local and global factors appear as explanatory variables. The benchmark panel regression has the form

$$\begin{aligned} \Delta L_{c,t} = & \beta_0 + \beta_1 \cdot \Delta\text{Interoffice}_{t-1} + \beta_2 \text{VIX}_{t-1} \\ & + \beta_3 \Delta\text{VIX}_t + \text{controls}_{c,t} + e_{c,t} \end{aligned} \tag{2}$$

Here, $\Delta L_{c,t}$ is banking sector capital inflow into country c in period t , as given by the quarterly log difference in the external claims of BIS reporting country banks on country c between quarters t and $t - 1$; VIX_{t-1} is the log of end-quarter VIX index lagged by one quarter; $\Delta\text{Interoffice}_{t-1}$

is the growth in interoffice assets of foreign banks in the US from the quarter before given by the quarterly log difference and lagged by one quarter. The variable $\Delta\text{Interoffice}_{t-1}$ and the variables involving the VIX index are interpreted as reflecting the global factors in influencing capital flows, as explained above.

For a particular country c , the residuals from the panel regression (2) reflect the amount of capital flows into that country that is left unexplained by the coefficients on the explanatory variables in (2), which were obtained to fit the full sample of countries. Our strategy is then to ask whether the residual from this regression reveal any additional sensitivity of country c to global factors over and above the estimates that are designed to fit the whole sample of countries. If a country is particularly sensitive to global conditions, we should expect the residuals for that country in the panel regression to be correlated with the global factors themselves.

We operationalize this idea of examining incremental country-specific sensitivities by running an augmented panel regression with country interaction terms designed to capture the incremental impact of global factors on a particular country. In particular, our augmented panel regressions have the following specifications.

$$\begin{aligned}\Delta L_{c,t} = & \beta_0 + \beta_1 \cdot \Delta\text{Interoffice}_{t-1} + \beta_2 \text{VIX}_{t-1} \\ & + \beta_3 \cdot \Delta\text{Interoffice}_{t-1} \cdot \text{Country}_c \\ & + \beta_4 \cdot \Delta\text{Interoffice}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t + \text{controls}_{c,t} + e_{c,t}\end{aligned}\quad (3)$$

$$\begin{aligned}\Delta L_{c,t} = & \beta_0 + \beta_1 \cdot \Delta\text{Interoffice}_{t-1} + \beta_2 \text{VIX}_{t-1} \\ & + \beta_5 \cdot \text{VIX}_{t-1} \cdot \text{Country}_c \\ & + \beta_6 \cdot \text{VIX}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t + \text{controls}_{c,t} + e_{c,t}\end{aligned}\quad (4)$$

These panel regressions are on quarterly data with country fixed effects and clustered standard errors at the country level. Country_c is a dummy equal to 1 for country c and 0 otherwise and Post 2010_t is a dummy equal to 1 from the second quarter of 2010 onwards

and 0 otherwise. The coefficient β_1 in equation (3) is designed to measure the impact of $\Delta\text{interoffice}$ on capital flows for the full sample countries. However, the coefficient β_3 on the interaction term $\Delta\text{Interoffice}_{t-1} \cdot \text{Country}_c$ is designed to extract the additional impact of the $\Delta\text{interoffice}$ variable on country c that is being missed when the impact of $\Delta\text{Interoffice}$ is gauged for the whole sample of countries. Furthermore, the coefficient β_4 on the interaction term $\Delta\text{Interoffice}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t$ gives the incremental sensitivity of country c to $\Delta\text{Interoffice}$ for the period after June 2010. The sum $\beta_1 + \beta_3$ is interpreted as the total impact of $\Delta\text{Interoffice}$ on capital flows in country c before 2010, whereas the sum $\beta_1 + \beta_3 + \beta_4$ gives the total effect of $\Delta\text{Interoffice}$ in country c after June 2010.

There is an analogous set of interactions terms associated with the impact of VIX. The term $\beta_5 \text{VIX}_{t-1} \cdot \text{Country}_c$ gives the excess sensitivity of country c to VIX relative to other countries before the second quarter of 2010, and the interaction term $\beta_6 \text{VIX}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t$ gives the incremental effect of VIX for country c after the second quarter of 2010. The sum $\beta_2 + \beta_5$ gives the total effect of VIX on capital flows in country c before 2010, and the sum $\beta_2 + \beta_5 + \beta_6$ gives the total effect of VIX in country c after 2010. Other controls are as described in the data section.

3.3 Impact of Macroprudential Policy on Capital Flows into Korea

We now examine the results of our panel regressions. We assess the impact of macroprudential policies introduced in Korea by examining evidence of changes in the incremental sensitivity for Korea to $\Delta\text{Interoffice}$ and VIX after June 2010. We take advantage of the panel structure by adjusting for country-specific effects through country fixed effects and explanatory variables used to control for country-specific factors affecting capital flows.

The results for the determinants of banking sector capital flows into Korea are presented in Table 2, which are organized so as to highlight the incremental effect for Korea, further decomposed into the period before and after June 2010. Columns (1) and (2) are the benchmark regressions without any interaction terms for Korea. The VIX index in levels and log differences as well as the $\Delta\text{Interoffice}$ variables are highly significant and of the predicted sign. The

Table 2. **Impact of Macroprudential Policy on Capital Flows into Korea.** This table summarizes panel regressions where Korea enters with an interaction country dummy with growth in interoffice and with VIX. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

	1	2	3	4	5	6
Δ Interoffice	0.0104*** [0.000]	0.0076*** [0.002]	0.0074*** [0.003]	0.0074*** [0.003]	0.0075*** [0.002]	0.0076*** [0.002]
Δ Interoffice*Korea			0.0107*** [0.000]	0.0195*** [0.000]		
Δ Interoffice*Korea*Post 2010				-0.0314*** [0.000]		
VIX	-0.0629*** [0.000]	-0.0498*** [0.000]	-0.0498*** [0.000]	-0.0499*** [0.000]	-0.0485*** [0.000]	-0.0485*** [0.000]
VIX *Korea					-0.0621*** [0.000]	-0.0631*** [0.000]
VIX *Korea*Post 2010						0.0026* [0.071]
Δ VIX	-0.0214*** [0.001]	-0.0211*** [0.001]	-0.0212*** [0.001]	-0.0211*** [0.001]	-0.0212*** [0.001]	-0.0212*** [0.001]
RER	-0.0481*** [0.000]	-0.0549*** [0.000]	-0.0547*** [0.000]	-0.0547*** [0.000]	-0.0539*** [0.000]	-0.0539*** [0.000]
Δ Money stock		0.7617*** [0.000]	0.7618*** [0.000]	0.7620*** [0.000]	0.7628*** [0.000]	0.7627*** [0.000]
GDP Growth		0.3008*** [0.000]	0.3002*** [0.000]	0.3001*** [0.000]	0.3013*** [0.000]	0.3012*** [0.000]
Debt to GDP		-0.0806** [0.015]	-0.0805** [0.015]	-0.0806** [0.015]	-0.0813** [0.014]	-0.0814** [0.014]
Constant	0.2962*** [0.000]	0.2729*** [0.000]	0.2728*** [0.000]	0.2731*** [0.000]	0.2720*** [0.000]	0.2720*** [0.000]
Observations	3,120	2,892	2,892	2,892	2,892	2,892
R-squared	0.057	0.146	0.146	0.146	0.147	0.147
Number of countries	48	48	48	48	48	48

significance of $\Delta\text{Interoffice}$ indicates that the activities of global banks (mainly European banks, as shown in Shin (2012)) are correlated with the capital inflows into our sample of countries. In this context, fluctuations in the VIX index (both in the level as well as its quarterly log difference) are associated with shifts in the leverage of the banking sector and hence the capital flows through the banking sector.

In addition to the VIX and $\Delta\text{Interoffice}$, we see that the log real exchange rate (RER) is highly significant with a negative coefficient across all the specifications, indicating that capital inflows are associated with an appreciation of the recipient country currency. Column (2) shows that the inclusion of additional control variables, all of which have the expected sign, does not alter the significance of the VIX and the Interoffice variables. The R^2 jumps from 5.7% to 14.6% when going from column 1 to column 2.

Columns (3) to (6) report the incremental impact of global factors on Korea. Column (3) shows that the interaction term $\Delta\text{Interoffice}*\text{Korea}$ is positive and significant, indicating that Korea is more sensitive to the $\Delta\text{Interoffice}$ global factor compared to other countries in the sample. This is perhaps not a surprise given Korea's susceptibility to the crises in 1997 and 2008 as well as the received market wisdom of the sensitivity of Korea to shocks in external financial conditions.

However, Column (4) shows that the relatively greater sensitivity of Korea to the $\Delta\text{Interoffice}$ factor is greatly alleviated after June 2010. We see this from the fact that the coefficient on the interaction term $\Delta\text{Interoffice}*\text{Korea}*\text{Post 2010}$ is negative and highly significant (with the p-value being zero to three decimal places). It is notable that the decline in Korea's sensitivity after June 2010 is not only statistically significant, but it is also economically significant. The sum of the coefficients on the two interaction terms $\Delta\text{Interoffice}*\text{Korea}$ and $\Delta\text{Interoffice}*\text{Korea}*\text{Post 2010}$ is actually *negative*, given by $0.0195 - 0.0314 = -0.119$. In other words, although Korea was more sensitive to $\Delta\text{Interoffice}$ compared to other countries in the sample before June 2010, it has become less sensitive to $\Delta\text{Interoffice}$ compared to other countries after June 2010 (F-test = 16.56, p-value = 0.0002). This indicates that after June 2010, the introduction of the macroprudential policies has not only reduced the channeling of global banking funds into

capital flows in Korea, but actually made Korea less sensitive to fluctuations in global funding with respect to the other countries.

The analogous result for the incremental sensitivity of Korea to the VIX index is broadly consistent, as we see from columns (5) and (6). In particular, we see from column (6) that capital flows to Korea became less sensitive to the VIX index. However, this result is only significant with a p-value of 7%, and the economic magnitude is not large. Overall, we interpret our findings as providing evidence that the newly introduced macroprudential policies in Korea moderated the sensitivity of capital flows to external financial conditions.

Evidence of change in incremental sensitivity cannot be taken as conclusive proof of the effect of the macroprudential policy, since the experiment is simply to look before and after June 2010. However, we will complement our incremental sensitivity analysis for Korea by comparing the results for Korea with those of other countries in the region, as well as examining evidence for any structural breaks in the way that the global variables impact capital flows.

4 Robustness Checks

4.1 Evidence from Other Countries in Asia.

As a further check on the empirical findings for Korea, we examine the incremental impact of the global variables $\Delta\text{Interoffice}$ and VIX on other countries in the region, so that we may place the results on Korea into context. Through this exercise, we may ascertain the extent to which the results for Korea are shared by other Asian countries, and hence give clues on any regional variations in our sample.

We therefore run exactly analogous sets of panel regressions (3) and (4) for each of the following countries: Australia, Indonesia, Malaysia, Philippines, Thailand and Vietnam. The choice of Australia follows from the fact that Australia is similar to Korea in the openness of its banking sector to the use of wholesale funding. Australia also has a similar sized economy to Korea and the Australian dollar has some of the same attributes as the Korean won as a barometer of the risk-taking behavior in global capital markets. The other countries (Indonesia,

Malaysia, Philippines, Thailand and Vietnam) are chosen as they are collectively known as the “Big 5 ASEAN” countries and share some similarities to Korea in terms of openness to similar regional forces.

The full panel regression results from (3) and (4) for each of the six countries is reported in full in the Appendix. Here, we merely report the summary results on the coefficients $\{\beta_i\}$ from which we can gauge the incremental sensitivity of each country to the global factors $\Delta Interoffice$ and VIX . Table 3 reports the coefficient estimates $\{\beta_i\}$ from panel regressions (3) and (4) run separately for each country. The coefficient estimates β_1 and β_2 from the separate regressions continue remaining significant, with β_1 positive and β_2 negative as before.

The evidence on $\Delta Interoffice$ is striking. In contrast to the countries examined in Table 3, Korea is the only country for which the incremental effect of $\Delta Interoffice$ is negative and significant after 2010 (β_4). The incremental effect of $\Delta Interoffice$ after 2010 (β_4) is positive for all countries in Table 3, which indicates that unlike Korea, these Asian countries became *more sensitive* to fluctuations in global bank funding conditions after the second quarter of 2010.

The evidence on VIX for the various countries is mixed. Only Malaysia, Philippines and Thailand have a pattern similar to Korea, with an incremental positive effect after 2010. In contrast, the negative effect of VIX is further amplified in Australia and Vietnam, for which β_6 is negative and significant, and it is unchanged for Indonesia (β_6 is insignificant).

Taken together, the evidence suggests that there has been a markedly lower sensitivity to global funding on capital flows in Korea, even when all other comparable countries in the region saw the opposite effect - toward an increased sensitivity to global factors in the determination of capital flows. Our results are suggestive that the introduction of macroprudential policies in Korea served to mitigate the notorious sensitivity of Korea to external financial conditions.

4.2 Testing for Structural Change

Although the empirical findings so far indicate that Korea’s experience differs from other comparable countries in Asia in its diminished sensitivity to global factors driving capital flows, we need to show additionally that there were no systematic forces operating globally that changed

Table 3. **Individual country sensitivity analysis.** This table summarizes separate panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The separate panel regressions are reported in full in the Appendix. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for Q1:1996-Q1:2012.

Individual countries regressions coefficients derived from separate panel regressions					
β_3	Δ Interoffice*Australia	-0.0261*** [0.000]	β_5	VIX*Australia	0.0059 [0.257]
β_4	Δ Interoffice*Australia*Post 2010	0.0598*** [0.000]	β_6	VIX*Australia*Post 2010	-0.0052*** [0.010]
β_3	Δ Interoffice*Indonesia	-0.0098*** [0.001]	β_5	VIX *Indonesia	0.0185*** [0.004]
β_4	Δ Interoffice*Indonesia*Post 2010	0.0046** [0.029]	β_6	VIX*Indonesia*Post 2010	0.0034 [0.234]
β_3	Δ Interoffice*Malaysia	0.0001 [0.951]	β_5	VIX*Malaysia	-0.0114* [0.062]
β_4	Δ Interoffice*Malaysia*Post 2010	0.0091*** [0.000]	β_6	VIX*Malaysia*Post 2010	0.0100*** [0.000]
β_3	Δ Interoffice*Philippines	-0.0103*** [0.000]	β_5	VIX*Philippines	-0.0004 [0.933]
β_4	Δ Interoffice*Philippines*Post 2010	0.0271*** [0.000]	β_6	VIX*Philippines*Post 2010	0.0098*** [0.000]
β_3	Δ Interoffice*Thailand	-0.0302*** [0.000]	β_5	VIX*Thailand	-0.004 [0.547]
β_4	Δ Interoffice*Thailand*Post 2010	0.0567*** [0.000]	β_6	VIX*Thailand*Post 2010	0.0281*** [0.000]
β_3	Δ Interoffice*Vietnam	-0.0112*** [0.000]	β_5	VIX*Vietnam	-0.0198*** [0.000]
β_4	Δ Interoffice*Vietnam*Post 2010	0.0306*** [0.000]	β_6	VIX*Vietnam*Post 2010	-0.0031* [0.059]

Table 4. **Testing for Structural Change in 2010.** This table summarizes panel regressions where post 2010 dummy interacts with growth in interoffice and with VIX. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

	1	2	3	4
Δ interoffice	0.0105*** [0.000]	0.0043 [0.146]	0.0033 [0.250]	0.0050* [0.092]
Δ interoffice*Post 2010		0.0120* [0.054]	0.0084 [0.169]	0.0119* [0.056]
VIX	-0.0649*** [0.000]	-0.0583*** [0.000]	-0.0458*** [0.000]	-0.0499*** [0.000]
VIX*Post 2010		-0.0073** [0.030]	-0.0061** [0.028]	-0.0071** [0.035]
Δ VIX	-0.0217*** [0.001]	-0.0226*** [0.000]	-0.0218*** [0.001]	
RER	-0.0483*** [0.000]	-0.0583*** [0.000]	-0.0681*** [0.000]	-0.0596*** [0.000]
Δ Money Stock			0.7576*** [0.000]	
GDP Growth			0.3100*** [0.000]	
Debt to GDP			-0.0670** [0.038]	
Constant	0.2981*** [0.000]	0.3038*** [0.000]	0.2778*** [0.000]	0.2800*** [0.000]
Observations	3,120	3,120	2,892	3,120
R-squared	0.061	0.065	0.151	0.062
Number of countries	48	48	48	48

the fundamental relationship between global factors and capital flows. Therefore, we examine a set of panel regressions that tests for structural changes globally around June 2010. Table 4 reports the results of panel regressions that include interaction terms between the global factors (Δ Interoffice and VIX) with a time dummy for the period after June 2010.

Column (1) of Table 4 is our benchmark regression without time interaction terms. Starting from this benchmark regression, column (2) includes interaction terms between the global factors, Δ Interoffice and VIX with a time dummy for the period after June 2010. The interaction term Δ interoffice*Post 2010 has a coefficient which is positive, and marginally significant,

indicating that the global factor $\Delta\text{Interoffice}$ was not weaker after June 2010 (in fact, it was marginally stronger). However, $\Delta\text{Interoffice}$ itself becomes insignificant in column (2) when the time interaction term is included. In column (2), the global factor VIX remains negative and highly significant, as is the interaction term VIX*Post 2010 . Thus, there is no evidence that the VIX global factor has weakened after 2010 (in fact, the evidence points to the opposite, and the VIX has had a bigger impact post 2010). The remaining columns (3) and (4) are variations on the earlier columns.

The main message of the results from Table 4 is that there is no evidence that the global factors driving capital flows had weakened in the period after June 2010. Indeed, the evidence points to the opposite - that the impact of global factors in driving capital flows had become stronger. These findings suggest that the increased sensitivity of Australia, and other Asian countries other than Korea examined above is representative of global trends as a whole. Given such a backdrop, the conspicuous drop in the sensitivity of capital flows into Korea is all the more notable.

5 Directions for Further Research

The evidence in our paper suggests that the driving force behind banking sector capital flows is the leverage cycle of the banking sector, through the interaction of the supply and demand of wholesale bank funding. Our findings reinforce the argument in Borio and Disyatat (2011), Obstfeld (2012a, 2012b) and Gourinchas and Obstfeld (2012) on the importance of *gross* capital flows between countries in determining financial conditions, especially the gross flows intermediated by the banking sector.

Bank capital flows have also been pivotal in the European financial crisis. The credit boom in countries such as Ireland and Spain were financed primarily by capital flows through the banking sector (see Allen, Beck, Carletti, Lane, Schoenmaker and Wagner (2011) and Lane and Pels (2011)). Therefore, the mechanisms outlined here on the link between capital flows and leverage are relevant in understanding the European crisis, also.

Our findings highlight the role of financial intermediaries in driving fluctuations in risk premiums and financial conditions, especially in connection with the growing use of wholesale bank funding.

The procyclicality of banking sector capital flows poses challenges in setting policy and regulatory responses. The cross-border spillovers associated with banking sector flows highlights the importance of international coordination in banking regulation and in monetary policy, but such coordination is not straightforward to design or implement, even when the interests of the relevant countries are congruent. Moreover, even when coordination is globally optimal, it still may generate tensions with national governance.

In the absence of effective international coordination, a second best approach (that takes the spillovers as given) would be appropriate in designing a framework to mitigate the risks of cross-border flows at the national level. The recent report by the Committee on International Economic Policy Reform (CIEPR (2012)) describes the considerations that are relevant in setting policy on capital flows in a second best world. The macroprudential policies introduced in Korea in 2010 can be viewed in this context. The preliminary findings reported in our paper indicate that the measures in Korea have had some impact in reducing the sensitivity to global factors driving capital flows. The results provide useful lessons for the design and implementation of similar measures elsewhere.

Appendix

In this appendix, we report the full results of the panel regressions with country interaction dummies, run separately for each of the following six countries: Australia, Indonesia, Malaysia, Philippines, Thailand and Vietnam. The panel regressions are specified in the same way as in the body of the paper. They are:

$$\begin{aligned}\Delta L_{c,t} = & \beta_0 + \beta_1 \cdot \Delta \text{Interoffice}_{t-1} + \beta_2 \text{VIX}_{t-1} \\ & + \beta_3 \cdot \Delta \text{Interoffice}_{t-1} \cdot \text{Country}_c \\ & + \beta_4 \cdot \Delta \text{Interoffice}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t + \text{controls}_{c,t} + e_{c,t}\end{aligned}\quad (5)$$

$$\begin{aligned}\Delta L_{c,t} = & \beta_0 + \beta_1 \cdot \Delta \text{Interoffice}_{t-1} + \beta_2 \text{VIX}_{t-1} \\ & + \beta_5 \cdot \text{VIX}_{t-1} \cdot \text{Country}_c \\ & + \beta_6 \cdot \text{VIX}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t + \text{controls}_{c,t} + e_{c,t}\end{aligned}\quad (6)$$

The interaction term $\beta_3 \Delta \text{Interoffice}_{t-1} \cdot \text{Country}_c$ gives the incremental sensitivity of country c to $\Delta \text{Interoffice}$ relative to other countries before the second quarter of 2010. Similarly, the interaction term $\beta_4 \Delta \text{Interoffice}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t$ gives the incremental sensitivity of country c to $\Delta \text{Interoffice}$ for the period after the second quarter of 2010. The sum $\beta_1 + \beta_3$ gives the total effect of $\Delta \text{Interoffice}$ on capital flows in country c before 2010, whereas the sum $\beta_1 + \beta_3 + \beta_4$ gives the total effect of $\Delta \text{Interoffice}$ in country c after June 2010.

The term $\beta_5 \text{VIX}_{t-1} \cdot \text{Country}_c$ gives the excess sensitivity of country c to VIX relative to other countries before the second quarter of 2010, and the interaction term $\beta_6 \text{VIX}_{t-1} \cdot \text{Country}_c \cdot \text{Post 2010}_t$ gives the incremental effect of VIX for country c after the second quarter of 2010. The sum $\beta_2 + \beta_5$ gives the total effect of VIX on capital flows in country c before 2010, and the sum $\beta_2 + \beta_5 + \beta_6$ gives the total effect of VIX in country c after 2010. Other controls are as described in the data section.

Table 5. **Individual country sensitivity analysis: Australia.** This table summarizes panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

AUSTRALIA	-1	-2	-3	-4
Δ Interoffice	0.0078*** [0.002]	0.0078*** [0.002]	0.0076*** [0.002]	0.0076*** [0.002]
Δ Interoffice *Country	-0.0094*** [0.000]	-0.0261*** [0.000]		
Δ Interoffice*Country*Post 2010		0.0598*** [0.000]		
VIX	-0.0498*** [0.000]	-0.0495*** [0.000]	-0.0499*** [0.000]	-0.0498*** [0.000]
VIX *Country			0.0038 [0.473]	0.0059 [0.257]
VIX *Country*Post 2010				-0.0052*** [0.010]
Δ VIX	-0.0212*** [0.001]	-0.0212*** [0.001]	-0.0211*** [0.001]	-0.0211*** [0.001]
RER	-0.0547*** [0.000]	-0.0554*** [0.000]	-0.0549*** [0.000]	-0.0555*** [0.000]
Δ Money stock	0.7619*** [0.000]	0.7610*** [0.000]	0.7617*** [0.000]	0.7615*** [0.000]
GDP Growth	0.3005*** [0.000]	0.3018*** [0.000]	0.3007*** [0.000]	0.3016*** [0.000]
Debt to GDP	-0.0807** [0.015]	-0.0804** [0.015]	-0.0806** [0.015]	-0.0803** [0.015]
Constant	0.2728*** [0.000]	0.2729*** [0.000]	0.2729*** [0.000]	0.2734*** [0.000]
Observations	2,892	2,892	2,892	2,892
R-squared	0.146	0.147	0.146	0.146
Number of countries	48	48	48	48

Table 6. **Individual country sensitivity analysis: Indonesia.** This table summarizes panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

INDONESIA	-1	-2	-3	-4
Δ Interoffice	0.0078*** [0.002]	0.0078*** [0.002]	0.0076*** [0.002]	0.0076*** [0.002]
Δ Interoffice *Country	-0.0085*** [0.006]	-0.0098*** [0.001]		
Δ Interoffice*Country*Post 2010		0.0046** [0.029]		
VIX	-0.0498*** [0.000]	-0.0498*** [0.000]	-0.0502*** [0.000]	-0.0502*** [0.000]
VIX *Country			0.0203*** [0.001]	0.0185*** [0.004]
VIX *Country*Post 2010				0.0034 [0.234]
Δ VIX	-0.0211*** [0.001]	-0.0211*** [0.001]	-0.0212*** [0.001]	-0.0212*** [0.001]
RER	-0.0549*** [0.000]	-0.0549*** [0.000]	-0.0548*** [0.000]	-0.0546*** [0.000]
Δ Money stock	0.7617*** [0.000]	0.7617*** [0.000]	0.7621*** [0.000]	0.7621*** [0.000]
GDP Growth	0.3006*** [0.000]	0.3006*** [0.000]	0.3004*** [0.000]	0.3003*** [0.000]
Debt to GDP	-0.0801** [0.015]	-0.0801** [0.016]	-0.0806** [0.015]	-0.0803** [0.016]
Constant	0.2728*** [0.000]	0.2728*** [0.000]	0.2730*** [0.000]	0.2727*** [0.000]
Observations	2,892	2,892	2,892	2,892
R-squared	0.146	0.146	0.146	0.146
Number of countries	48	48	48	48

Table 7. **Individual country sensitivity analysis: Malaysia.** This table summarizes panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

MALAYSIA	-1	-2	-3	-4
Δ Interoffice	0.0075*** [0.002]	0.0076*** [0.002]	0.0076*** [0.002]	0.0077*** [0.002]
Δ Interoffice *Country	0.0027 [0.223]	0.0001 [0.951]		
Δ Interoffice*Country*Post 2010		0.0091*** [0.000]		
VIX	-0.0498*** [0.000]	-0.0497*** [0.000]	-0.0496*** [0.000]	-0.0497*** [0.000]
VIX *Country			-0.0072 [0.231]	-0.0114* [0.062]
VIX *Country*Post 2010				0.0100*** [0.000]
Δ VIX	-0.0212*** [0.001]	-0.0212*** [0.001]	-0.0212*** [0.001]	-0.0211*** [0.001]
RER	-0.0549*** [0.000]	-0.0549*** [0.000]	-0.0549*** [0.000]	-0.0544*** [0.000]
Δ Money stock	0.7617*** [0.000]	0.7616*** [0.000]	0.7618*** [0.000]	0.7617*** [0.000]
GDP Growth	0.3009*** [0.000]	0.3010*** [0.000]	0.3006*** [0.000]	0.2989*** [0.000]
Debt to GDP	-0.0805** [0.015]	-0.0805** [0.015]	-0.0806** [0.015]	-0.0811** [0.014]
Constant	0.2729*** [0.000]	0.2728*** [0.000]	0.2730*** [0.000]	0.2730*** [0.000]
Observations	2,892	2,892	2,892	2,892
R-squared	0.146	0.146	0.146	0.146
Number of countries	48	48	48	48

Table 8. **Individual country sensitivity analysis: Philippines.** This table summarizes panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

PHILIPPINES	-1	-2	-3	-4
Δ Interoffice	0.0077*** [0.002]	0.0077*** [0.002]	0.0076*** [0.002]	0.0077*** [0.002]
Δ Interoffice *Country	-0.0027 [0.275]	-0.0103*** [0.000]		
Δ Interoffice*Country*Post 2010		0.0271*** [0.000]		
VIX	-0.0498*** [0.000]	-0.0497*** [0.000]	-0.0499*** [0.000]	-0.0499*** [0.000]
VIX *Country			0.0036 [0.447]	-0.0004 [0.933]
VIX *Country*Post 2010				0.0098*** [0.000]
Δ VIX	-0.0211*** [0.001]	-0.0212*** [0.001]	-0.0211*** [0.001]	-0.0211*** [0.001]
RER	-0.0549*** [0.000]	-0.0549*** [0.000]	-0.0548*** [0.000]	-0.0546*** [0.000]
Δ Money stock	0.7617*** [0.000]	0.7615*** [0.000]	0.7617*** [0.000]	0.7616*** [0.000]
GDP Growth	0.3008*** [0.000]	0.3007*** [0.000]	0.3007*** [0.000]	0.3004*** [0.000]
Debt to GDP	-0.0805** [0.015]	-0.0806** [0.015]	-0.0805** [0.015]	-0.0801** [0.015]
Constant	0.2729*** [0.000]	0.2729*** [0.000]	0.2729*** [0.000]	0.2725*** [0.000]
Observations	2,892	2,892	2,892	2,892
R-squared	0.146	0.146	0.146	0.146
Number of countries	48	48	48	48

Table 9. **Individual country sensitivity analysis: Thailand.** This table summarizes panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

THAILAND	-1	-2	-3	-4
Δ Interoffice	0.0079*** [0.002]	0.0079*** [0.002]	0.0076*** [0.002]	0.0078*** [0.002]
Δ Interoffice *Country	-0.0143*** [0.000]	-0.0302*** [0.000]		
Δ Interoffice*Country*Post 2010		0.0567*** [0.000]		
VIX	-0.0498*** [0.000]	-0.0496*** [0.000]	-0.0499*** [0.000]	-0.0501*** [0.000]
VIX *Country			0.0075 [0.255]	-0.004 [0.547]
VIX *Country*Post 2010				0.0281*** [0.000]
Δ VIX	-0.0211*** [0.001]	-0.0212*** [0.001]	-0.0211*** [0.001]	-0.0211*** [0.001]
RER	-0.0550*** [0.000]	-0.0552*** [0.000]	-0.0549*** [0.000]	-0.0534*** [0.000]
Δ Money stock	0.7617*** [0.000]	0.7612*** [0.000]	0.7617*** [0.000]	0.7618*** [0.000]
GDP Growth	0.3010*** [0.000]	0.3013*** [0.000]	0.3009*** [0.000]	0.2970*** [0.000]
Debt to GDP	-0.0802** [0.015]	-0.0801** [0.015]	-0.0806** [0.015]	-0.0805** [0.015]
Constant	0.2729*** [0.000]	0.2726*** [0.000]	0.2729*** [0.000]	0.2719*** [0.000]
Observations	2,892	2,892	2,892	2,892
R-squared	0.146	0.147	0.146	0.148
Number of countries	48	48	48	48

Table 10. **Individual country sensitivity analysis: Vietnam.** This table summarizes panel regressions run for each country with an interaction country dummy with VIX or interoffice asset growth. The dependent variable is the quarterly log difference of BIS reporting bank external loans (BIS Table 7A). See text for explanation of methodology. p-values are reported in parantheses. Standard errors are clustered at the country level. Data are for 1996Q1-2012Q1.

VIETNAM	-1	-2	-3	-4
Δ Interoffice	0.0077*** [0.002]	0.0077*** [0.002]	0.0076*** [0.002]	0.0076*** [0.002]
Δ Interoffice *Country	-0.0024 [0.291]	-0.0112*** [0.000]		
Δ Interoffice*Country*Post 2010		0.0306*** [0.000]		
VIX	-0.0498*** [0.000]	-0.0496*** [0.000]	-0.0493*** [0.000]	-0.0493*** [0.000]
VIX *Country			-0.0214*** [0.000]	-0.0198*** [0.000]
VIX *Country*Post 2010				-0.0031* [0.059]
Δ VIX	-0.0212*** [0.001]	-0.0211*** [0.001]	-0.0211*** [0.001]	-0.0211*** [0.001]
RER	-0.0548*** [0.000]	-0.0552*** [0.000]	-0.0552*** [0.000]	-0.0554*** [0.000]
Δ Money stock	0.7617*** [0.000]	0.7610*** [0.000]	0.7612*** [0.000]	0.7610*** [0.000]
GDP Growth	0.3005*** [0.000]	0.3019*** [0.000]	0.3019*** [0.000]	0.3026*** [0.000]
Debt to GDP	-0.0806** [0.015]	-0.0805** [0.015]	-0.0805** [0.015]	-0.0804** [0.015]
Constant	0.2730*** [0.000]	0.2729*** [0.000]	0.2730*** [0.000]	0.2730*** [0.000]
Observations	2,892	2,892	2,892	2,892
R-squared	0.146	0.146	0.146	0.146
Number of countries	48	48	48	48

References

- Adrian, Tobias and Hyun Song Shin (2010) “Liquidity and Leverage,” *Journal of Financial Intermediation*, 19, 418-437
- Adrian, Tobias and Hyun Song Shin (2012) “Procyclical Leverage and Value-at-Risk” Federal Reserve Bank of New York Staff Report 338,
http://www.newyorkfed.org/research/staff_reports/sr338.html
- Baba, Naohiko, Robert N. McCauley and Srichander Ramaswamy (2009) “US Dollar Money Market Funds and Non-US Banks” *BIS Quarterly Review*, March 2009, 65-81.
- Bank for International Settlements (2010) “Funding patterns and liquidity management of internationally active banks” CGFS Papers 39, Committee on the Global Financial System,
<http://www.bis.org/publ/cgfs39.pdf>
- Bank for International Settlements (2011) “Global liquidity – concept, measurement and policy implications” CGFS Papers 45, Committee on the Global Financial System
<http://www.bis.org/publ/cgfs45.pdf>
- Borio, Claudio and Piti Disyatat (2011) “Global imbalances and the financial crisis: Link or no link?” BIS Working Papers No 346 <http://www.bis.org/publ/work346.pdf>
- Brunnermeier, Markus and Lasse Pedersen (2009) “Market Liquidity and Funding Liquidity,” *Review of Financial Studies*, 22, 2201-2238.
- Brunnermeier, Markus and Yuliy Sannikov (2011) “The I-Theory of Money” working paper, Princeton University
- Calvo, Guillermo A., Leonardo Leiderman, and Carmen Reinhart, “Capital Flows to Developing Countries in the 1990s: Causes and Effects,” *Journal of Economic Perspectives*, 10, Spring 1996, 123-139.
- Cetorelli, Nicola and Linda S. Goldberg (2009) “Banking Globalization and Monetary Transmission” Forthcoming in *Journal of Finance*.
- Cetorelli, Nicola and Linda S. Goldberg (2010) “Global Banks and International Shock Transmission: Evidence from the Crisis”, Federal Reserve Bank of New York Staff Report #446.
- Claessens Stijn, Neeltje Van Horen, Tugba Gurcanlar and Joaquin Mercado Sapiain (2008) “Foreign Bank Presence in Developing Countries 1995-2006: Data and Trends” working paper,
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1107295

Committee on International Economic Policy Reform (2012) *Banks and Cross-Border Capital Flows: Policy Challenges and Regulatory Responses*, policy report, September 2012

Danielsson, Jon, Hyun Song Shin and Jean-Pierre Zigrand (2012) “Procyclical Leverage and Endogenous Risk” working paper

Forbes, Kristin J. and Francis E. Warnock (2011) “Capital Flow Waves: Surges, Stops, Flight and Retrenchment” working paper, MIT Sloan School and University of Virginia.

Gourinchas, Pierre-Olivier and Maurice Obstfeld (2012) ”Stories of the Twentieth Century for the Twenty-First,” *American Economic Journal: Macroeconomics*, 4(1), 226-65.

Hahm, Joon-Ho, Hyun Song Shin and Kwanho Shin (2011) “Non-Core Bank Liabilities and Financial Vulnerability” working paper.

Lane, Philip and Gian Maria Milesi-Ferretti (2007). ”The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004” *Journal of International Economics*, 73, 223-250.

Lane, Philip and Barbara Pels (2011) ”Current Account Balances in Europe.” working paper, Trinity College Dublin

McGuire, Patrick and Goetz von Peter (2009) “The US Dollar Shortage in Global Banking” *BIS Quarterly Review*, March 2009, Bank for International Settlements.

Obstfeld, Maurice (2012a) “Does the Current Account Still Matter?” Richard T. Ely Lecture, 2012 American Economic Association Annual Meeting in Chicago
<http://elsa.berkeley.edu/~obstfeld/Ely%20lecture.pdf>

Obstfeld, Maurice (2012a) “Financial Flows, Financial Crises, and Global Imbalances”, *Journal of International Money and Finance*, 31, 469–480

Obstfeld, Maurice (2012b) “Does the Current Account Still Matter?”, Ely Lecture, delivered at the 2012 American Economic Association meeting. forthcoming in the American Economic Review Papers and Proceedings, 2012
<http://elsa.berkeley.edu/~obstfeld/Ely%20lecture.pdf>

Reinhart, Carmen M and Kenneth S Rogoff (2009), *This Time is Different: Eight Centuries of Financial Folly*, Princeton, NJ: Princeton University Press

Schularick, Moritz and Alan M. Taylor (2012) “Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870-2008.” *American Economic Review* 102 (2012), forthcoming

Shin, Hyun Song (2010) “Non-Core Liabilities Tax as a Tool of Prudential Regulation” policy memo,
<http://www.princeton.edu/~hsshin/www/NonCoreLiabilitiesTax.pdf>

Shin, Hyun Song (2011) “Global Banking Glut and Loan Risk Premium” 2011 Mundell-Fleming Lecture, IMF Annual Research Conference,
http://www.princeton.edu/~hsshin/www/mundell_fleming_lecture.pdf

Shin, Hyun Song and Kwanho Shin (2010) “Procyclicality and Monetary Aggregates”, NBER discussion paper w16836, <http://www.nber.org/papers/w16836>.

Xiong, Wei (2001) “Convergence Trading with Wealth Effects: An Amplification Mechanism in Financial Markets”, *Journal of Financial Economics* 62, 247-292