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PROCYCLICALITY AND MONETARY AGGREGATES

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Procyclicality and Monetary Aggregates
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ABSTRACT

Financial intermediaries borrow in order to lend. When credit is increasing rapidly, the traditional deposit funding (core liabilities) is supplemented with other funding (non-core liabilities). We explore the hypothesis that monetary aggregates reflect the size of non-core and core liabilities and hence convey information on the stage of the financial cycle. In emerging economies with open capital markets, non-core liabilities of the banking system take the form of short-term foreign exchange liabilities, increasing the vulnerability to the outbreak of "twin crises" where a liquidity crisis is compounded by a currency crisis.

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Introduction

The financial system channels funds from savers to borrowers. Some of the funding flows directly, such as through the direct sale of marketable securities to households, but much of the credit is channeled through the banking system. Far from being passive entities, we were reminded again by the recent financial crisis that banks are active players in the propagation of the financial cycle.

As intermediaries who borrow in order to lend, banks must raise funding in order to lend to their customers. The most important source of funding available to the banking sector is retail deposits of household savers. However, retail deposits grow in line with the aggregate wealth of the household sector. In a boom when credit is growing very rapidly, the pool of retail deposits is not sufficient to fund the increase in bank credit. Other sources of funding must then be tapped to fund the increased bank lending. In this way, the state of the financial cycle is reflected in the composition of the liabilities of the banking sector.

In this paper, we examine to what extent monetary aggregates can serve as an indicator of the stage of the financial cycle by providing a window on the size and changing composition of banks' liabilities. Key monetary aggregates such as M2 track the size of the short-term deposit base of the domestic banking system, and hence can serve as a proxy for the claim of the household sector on the banking sector, or the intermediary sector more generally encompassing money market funds and other short-term claims held by the household sector.

Indeed, Borio and Lowe (2004) have argued that the ratio of total credit to money can serve as an informative signal of the stage of the financial cycle and hence of the vulnerability of the financial system to a shock to the economy. The ratio of total credit to money serves such a role since when credit is increasing faster than money, the composition of the liabilities of the banking system is shifting away from deposit funding toward non-deposit funds to finance the growth of lending.

In this way, monetary aggregates open a window on the possibility of macroprudential policy that take cues from the money stock. Central banks that continue to give some attention to monetary aggregates have emphasized the financial stability properties of monetary aggregates for this reason. For instance, the European Central Bank (ECB) has shifted in recent years to interpreting their monetary pillar increasingly as a financial stability pillar.

However, monetary aggregates are not always well-suited for macroprudential policy. Traditional classifications of monetary aggregates focus on the transactions role of money as a medium of exchange. As such, the criterion is based on how close to cash – how "money-like" – a particular financial claim is. Demand deposits are the archetypal money measure, since such liabilities of the banking sector can be quickly transferred from one person to another. Savings deposits are less money-like, and hence figure broader notions of money, such as M2, but even here they fall outside the M2 measure if

the depositor faces restrictions on easy access to the funds. In this way, the traditional hierarchy of monetary aggregates goes from cash to the very liquid claims such as demand deposits going out to more illiquid claims on the banking sector such as term savings deposits. The criterion is how easily such claims can be used to settle transactions.

However, for financial stability purposes, the distinction between core- and non-core liabilities of the banking sector is not always captured by the ease of settlement of transactions. Overnight repurchase agreements (repos) between financial institutions are claims that are short-term and highly liquid. However, the financial crisis of 2008 demonstrated through the near-failure of Bear Stearns and the bankruptcy of Lehman Brothers that repos can be highly destabilizing when the collateral requirements on the repos rise through higher imposition of higher margins charged by creditors, setting off a spiral of distress in the financial system as a whole (Adrian and Shin (2007), Morris and Shin (2009), Brunnermeier and Pedersen (2009), Gorton (2009, 2010)).

An important dimension that is not addressed in the traditional hierarchy of monetary aggregates is *who holds the claims*. The same claim can have very different financial stability implications if they are held by different entities. The cash deposits of a leveraged hedge fund at its prime broker are similar to demand deposits of household savers in the banking system in terms of how liquid the claim is. However, they have very different systemic implications. At the other end of the spectrum in terms of liquidity, a covered bond issued by a bank is an extremely illiquid, and long-term claim that is not money-like. However, a covered bond held by long-term investors such as a pension fund is similar to retail deposits in that the funding provided to the banking sector is more "sticky" – i.e. stable – than a mortgage backed security or a collateralized debt obligation (CDO) held by a securities firm.

The relevant distinction between core- and non-core liabilities can be seen as having to do with whether the claim is held by the ultimate domestic creditors (the domestic household sector). Repos and other claims held by banks on other banks can be regarded as non-core liabilities which are more volatile.

For countries with open capital markets, the role of international capital flows plays a particularly important role in financial stability, and hence on macroprudential policy. During a boom when bank assets are growing rapidly, the funding required outstrips the growth of the domestic deposit base, and is often met by capital flows from the international banks and is reflected in the growth of short-term foreign currency-denominated liabilities of the domestic banking system. As such, short-term foreign currency-denominated bank liabilities can also be seen as the volatile non-core liabilities of the banking sector.

The non-core liabilities of the banking sector provide a window on the willingness of the banking sector to increase exposures. As such, the relative size of the non-core liabilities can be conjectured to reflect the stage of the financial cycle and the degree of vulnerability to setbacks.

Our task in this paper is to examine the empirical properties of non-core liabilities of the Korean banking sector and to examine the link between the relative size of non-core liabilities and stage of the financial cycle. To anticipate our results, we find that non-core liabilities (defined as the sum of foreign exchange liabilities of the banking sector and wholesale bank funding) have undergone substantial changes over the financial cycle and trace out dramatic patterns over the two financial crises in recent years – the 1997 Asian financial crisis and the 2008 crisis following the bankruptcy of Lehman Brothers. Moreover, we demonstrate that our measure of non-core liabilities is closely related to market measures of the capacity to take on risk, such as key credit spreads and other market indicators.

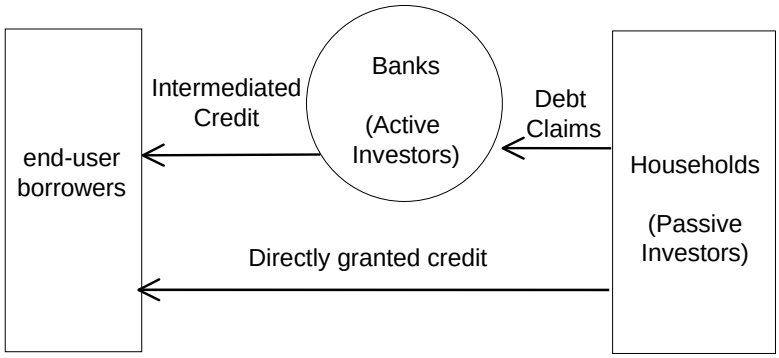
The plan of our paper is as follows. We begin by outlining the conceptual and accounting frameworks that can help us navigate the distinctions between core and non-core liabilities. We then move on to more concrete definitions, especially for the case of Korea. We outline the empirical properties of our non-core liabilities measure and show that it has close affinities with market-based signals of risk-taking. We conclude with some implications of our results for the financial regulatory reform debate.

Balance Sheet Capacity and Risk Premia

We begin with a brief overview of the rationale for focusing attention on the liabilities of the banking sector.

Figure 1 depicts a stylized credit system, which channels savings from *ultimate creditors* – the household sector and financial institutions such as mutual funds and pension funds that lend on behalf of the households – to the *ultimate borrowers*, such as non-financial firms or young households who wish to borrow to buy a house.

Figure 1: Stylized Financial System



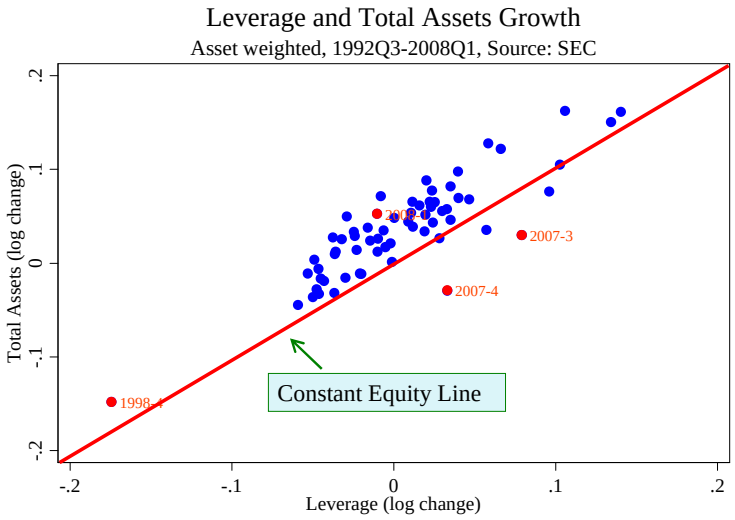
The lending can be channeled through two routes. Credit could be granted directly. For example, households buy corporate bonds and equity issued by non-financial firms directly. Alternatively, the credit can be granted indirectly through the financial intermediary sector, which borrows from the household sector in order to lend to the ultimate borrowers.

In world where the Modigliani and Miller (MM) theorems hold, we can separate the decision on the size of the balance sheet (selection of the projects to take on) from the financing of the projects (composition of liabilities in terms of debt and equity). In textbook discussions of balance sheets, the set of positive net present value (NPV) projects is taken as given. In such a setting, the size of the balance sheet would be fixed, and determined exogenously. The remaining focus is on the liabilities side of the balance sheet, in determining the relative mix of equity and debt. Even when the conditions for the MM theorems do not hold, the textbook discussion starts with the assets of the firm as given, in order to focus on the financing decision alone.

However, the distinguishing feature of banking sector assets is that they fluctuate over the financial cycle. Credit increases rapidly during the boom but increases less rapidly (or even decreases) during the downturn. Some of the variation in the size of banking assets could be accounted for by the fluctuations in the size of the pool of positive NPV projects, but some part of the fluctuations in banking sector assets may be due to shifts in the banks' willingness to take on risky positions over the cycle.

Figure 2, taken from Adrian and Shin (2010), shows the scatter chart of the weighted average of the quarterly change in assets against the quarterly change in leverage of the (then) five stand-alone US investment banks.[3] Leverage is the ratio of total assets to equity.

Figure 2. Leverage Growth and Asset Growth of US Investment Banks (Source SEC; Adrian and Shin (2010))



The first striking feature is that leverage is procyclical in the sense that leverage is high when balance sheets are large, while leverage is low when balance sheets are small. This is the opposite relationship to that for household balance sheets, whose leverage is high when balance sheets are *small*. For instance, if a household owns a house that is financed

[3] Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley

by a mortgage, leverage falls when the house price increases, since the equity of the household is increasing at a much faster rate than assets.

The horizontal axis in Figure measures the (quarterly) change in leverage, as measured by the change in log assets minus the change in log equity. The vertical axis measures the change in log assets. Hence, the 45-degree line indicates the set of points where equity is unchanged. Above the 45-degree line equity is increasing, while below the 45-degree line, equity is decreasing. Any straight line with slope equal to 1 indicates constant growth of equity, with the intercept giving the growth rate of equity. Formally, we have:

$$\text{Asset growth} = \log A(t+1) - \log A(t)$$

$$\text{Leverage growth} = \log A(t+1) - \log A(t) - (\log E(t+1) - \log E(t))$$

The 45% line therefore represents the set of points where

$$\log E(t+1) - \log E(t) = 0$$

and so represents the constant equity line. Any straight line with slope 1 in Figure 2 represents the set of points where equity is growing at a constant rate, where the growth rate is given by the intercept.

In Figure 2 the slope of the scatter chart is close to 1, implying that we can describe equity as increasing at a constant rate on average. Thus, unlike the textbook discussion of the Modigliani-Miller theorem, it is *equity* that seems to play the role of the exogenous variable and total assets (the size of the balance sheet) is the endogenous variable that is determined by the willingness of banks to take on risky exposure. Although the illustration in Figure 2 is taken from US investment banks, a similar picture holds for other intermediaries, albeit in less stark form.[4]

There is a useful perspective on this feature that comes from the risk management policies of financial intermediaries. Banks aim to keep enough equity capital to meet its overall value at risk (VaR). If we denote by V the value at risk per dollar of assets, and A is total assets, then equity capital E must satisfy $E = V \times A$, implying that leverage L satisfies

$$L = A/E = 1/V$$

If value at risk is low in expansions and high in contractions, leverage is high in expansions and low in contractions – leverage is procyclical. Total assets are determined once the leverage of the firm is applied to the given equity.

The above discussion suggests that there is a well-defined notion of *balance sheet capacity* for financial intermediaries that depends on (i) the size of its capital base (its equity) and (ii) the amount of lending that can be supported by each unit of capital. Total assets are then determined by the multiplication of the two.

[4] Shin and Shin (2010) exhibit similar evidence for Korean banks.

Balance sheet capacity increases during a boom, since the greater profitability of the banks adds to the capital base. In addition, measured risks are low during a boom, implying that the banks' willingness to lend for each unit of capital is also high.

A high balance sheet capacity translates into a higher supply of credit. In the stylized credit system depicted in Figure 1, the greater supply of credit by the banking sector means that the size of the banking sector becomes large relative to the total credit system. An increased supply of loans may also imply a narrowing of risk spreads and/or the lowering of lending standards (see Adrian and Shin (2010) and Shin (2010) for a more formal development of the argument).

When boom turns to bust, the balance sheet capacity of the banking sector shrinks for two reasons. First, loan losses lower bank capital, while the greater measured risks lower the lending that is available for each unit of capital. When the downturn is severe, the lower balance sheet capacity may result in a credit crunch. Central bank intervention in the financial market such as the direct purchase of risky assets is one way to make up for the shortfall in private sector balance sheet capacity.

An Accounting Framework

So far, we have considered the banking sector in terms of an aggregate balance sheet, but we now turn to a basic accounting framework for claims between banks in order to introduce our discussion of core and non-core liabilities.

The domestic financial system consists of ultimate borrowers (domestic firms and households) and ultimate creditors (domestic households). The domestic banking sector channels funds from ultimate creditors to ultimate borrowers. There is also a foreign creditor sector who stands ready to supply funds to the domestic banking sector.

Suppose there are n banks in the domestic banking system. The term "bank" should be interpreted widely, to include securities firms and other intermediaries. We denote the banks by an index that takes values in the set $\{1, 2, \ldots, n\}$.

The domestic household creditor sector is given the index $n+1$. The foreign creditor sector is given the index $n+2$.

Bank i has two types of assets. First, there are loans to end-users such as corporates or households. Denote the loans by bank i to such end users as y_i. Next, there are the claims against other financial institutions. Call these the "interbank" assets, although the term covers all claims on other intermediaries. The total interbank assets held by bank i are

$$\sum_{j=1}^{n} x_j \pi_{ji}$$

where x_j is the total debt of bank *j* and π_{ji} is the share of bank *j*'s debt held by bank *i*. Note that $\pi_{i,n+1}$ is the proportion of the bank's liabilities held by the domestic creditor sector (e.g. in the form of deposits), while $\pi_{i,n+2}$ is the proportion of the bank's liabilities held by foreign creditors (e.g. in the form of short-term foreign currency-denominated debt)

Since "banks" *n*+1 and n+2 are not leveraged, we have $x_{n+1} = x_{n+2} = 0$. The balance sheet identity of bank *i* is given by

$$y_i + \sum_{j=1}^{n} x_j \pi_{ji} = e_i + x_i$$

The left-hand side is the total assets of the bank. The right-hand side is the sum of equity and debt. Letting $x = \begin{bmatrix} x_1 & \cdots & x_n \end{bmatrix}$ and $y = \begin{bmatrix} y_1 & \cdots & y_n \end{bmatrix}$, we can write in vector notation the balance sheet identities of all banks as

$$y + x\Pi = e + x$$

where Π is the matrix whose (i, j)th entry is π_{ij}. Solving for *y*,

$$y = e + x(I - \Pi)$$

Define leverage as the ratio of total assets to equity, given by

$$\frac{a_i}{e_i} = \lambda_i$$

Then defining Λ as the diagonal matrix with λ_i along the diagonal,

$$y = e + e(\Lambda - I)(I - \Pi)$$

where Π is the matrix of interbank liabilities. By post-multiplying the above equation by the unit vector

$$u = \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix}$$

We can sum up the rows of the vector equation above, and we have the following balance sheet identity.

$$\sum_i y_i = \sum_i e_i + \sum_i e_i z_i (\lambda_i - 1)$$

where is given by the *i* th row of $(I - \Pi)u$. Here, z_i has the interpretation of the proportion of the bank's liabilities that come from outside the banking sector – i.e. the proportion of funding that comes either from the ultimate domestic creditors (e.g. deposits) or the foreign sector (e.g. foreign-currency denominated banking sector liabilities).

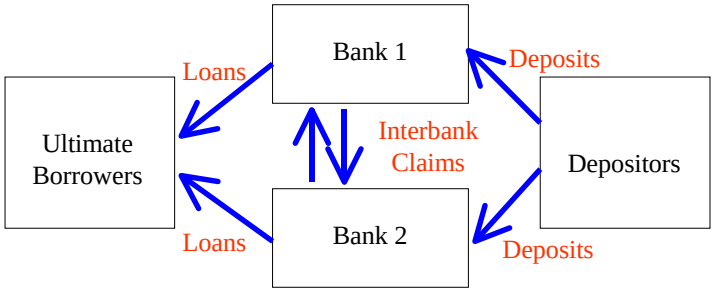
Therefore, we can re-write the aggregate balance sheet identity in the following way.

Total Credit = Total Equity of Banking Sector
+ Liabilities to Non-bank Domestic Creditors
+ Liabilities to Foreign Creditors

The accounting framework outlined above helps us to understand the connection between (i) the procyclicality of the banking system, (ii) systemic risk spillovers, and (iii) the stock of non-core liabilities of the banking system. Let us define the core liabilities of a bank as its liabilities to the non-bank domestic creditors (such as through deposits). Then, the non-core liabilities of a bank is either (i) a liability to another bank, or (ii) a liability to a foreign creditor.

In a boom when credit is growing very rapidly, the growth of bank balance sheets outstrips the growth in the pool of retail deposits. As a result, the growth of bank lending results in greater lending and borrowing between the intermediaries themselves, or results in the sucking in of foreign debt.

First, consider the simple case where there is no foreign creditor sector. The following figure depicts a stylized financial system with two banks – Bank 1 and Bank 2. Both banks draw on retail deposits to lend to ultimate borrowers. They can also hold claims against each other, if they so choose.



Imagine a boom where the assets of both banks double in size, but the pool of retail deposits stays fixed. Then, the proportion of banking sector liabilities in the form of

retail deposits must fall. In other words, rapidly expanding bank assets is mirrored by the increased cross-claims across banks. The growth in bank assets and increased systemic risk are two sides of the same coin. The relationship between banking sector assets and increased cross-exposure across banks holds more generally in the accounting identity derived above. On the assumption that the total domestic deposit claims of the banking sector is constant, if the leverage of all banks increases, then the proportion of liabilities that are due to domestic non-bank creditors must fall. In this way, the cross-claims across banks must increase.

More generally, in the presence of a foreign creditor sector, the increase in bank lending will result both in increased cross-lending between banks, but also will result in the sucking in of foreign debt.

In this way, there are close conceptual links between procyclicality, systemic risk spillovers and the stock of non-core liabilities of the banking system. The stage of the financial cycle is reflected in the composition of the liabilities of the banking sector. In a boom, we have the conjunction of three features:

- Total lending increases rapidly
- Non-core (especially foreign currency) liabilities increase as a proportion of total liabilities
- Systemic risk increases through greater cross-holdings between intermediaries

Two features distinguish non-core liabilities. First, non-core liabilities include claims held by intermediaries on other intermediaries. Second, they include liabilities to foreign creditors. Short-term foreign currency liabilities of the banks have both features. Even for liabilities to domestic creditors, if the creditor is another intermediary, the claim tends to be short-term. The distinction between core and non-core liabilities becomes meaningful once there are differences in the empirical properties of the two types of liabilities.

In what follows, we will argue that core liabilities are more stable (or "sticky") than non-core liabilities. Non-core liabilities vary more over the cycle and are a form of funding that is used most during financial booms. Therefore, the composition of the liabilities gives useful information on the stage of the financial cycle.

To the extent that our ultimate interest is in reading the stage of the financial cycle, an alternative route would have been to examine the asset side of the balance sheet. One approach might be to look at the ratio of total assets to GDP. However, the liabilities side of the balance sheet conveys additional useful information on the stickiness of funding, and hence the vulnerability to a liquidity crisis. In this way, the focus moves away from simply looking at the declining quality of bank assets and future default towards the likelihood of financial crises that are driven by the withdrawal of funding. For the Korean context, the latter perspective is very important in the light of the events of the 1997 Asian financial crisis, as well as the more recent 2008 crisis triggered after the bankruptcy of Lehman Brothers.

Defining Non-core liabilities.

As a preliminary discussion, we outline some issues in defining non-core liabilities of the banking sector.

Banks are intermediaries who borrow in order to lend, and hence they must raise funding. The most important source of funding available to a bank is retail deposits of household savers. However, retail deposits grow in line with the aggregate wealth of the household sector. In a boom when credit is growing very rapidly, the pool of retail deposits is not sufficient to fund the increase in bank credit. Other sources of funding must then be tapped to fund the increased bank lending.

Figure 3: Northern Rock's Liabilities (1998 – 2007)

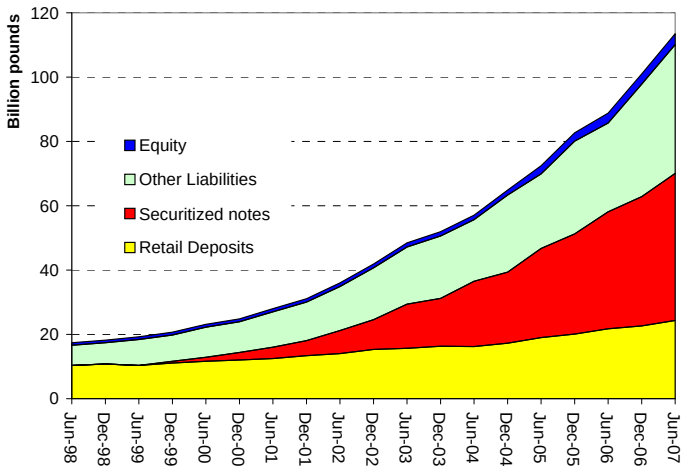


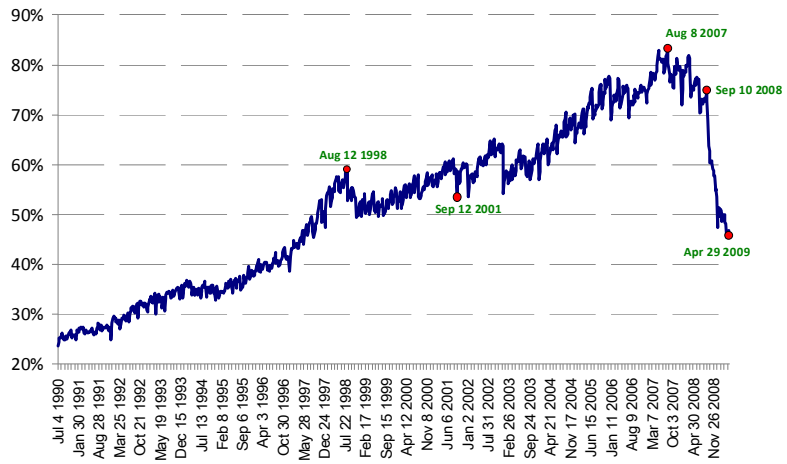
Figure 3 taken from Shin (2009) shows the composition of the liabilities of Northern Rock, the UK bank whose failure in 2007 heralded the global financial crisis. In the nine years from 1998 to 2007, Northern Rock's lending increased 6.5 times. This increase in lending far outstripped the funds raised through retail deposits (in yellow), with the rest of the funding gap being made up with wholesale funding (in red and light blue).

Although Northern Rock was an outlier in terms of the aggressive use of wholesale funding to increase lending, Northern Rock's case illustrates the general lesson that during a credit boom, the rapid increase in bank lending outstrips the core deposit funding available to a bank. As the boom progresses, the bank resorts to alternative, non-core liabilities to finance its lending. Therefore, the proportion of non-core liabilities of banks serves 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 larger is the proportion of non-core liabilities, the greater is the boom, and hence the greater is the vulnerability to a setback.

In the case of Northern Rock, there was also a run by its depositors. However, it is important to bear in mind the sequence of events that led up to the run by its depositors. The drying up of short-term funding for Northern Rock started on August 9th 2007, which led Northern Rock to seek liquidity support from the Bank of England. The depositor run happened in mid-September of 2007 once the liquidity shortage began to be reported widely in the media. The Northern Rock episode illustrates that even "sticky" liabilities such as retail deposits may become unstable once the problems with an institution becomes sufficiently serious.

Figure 4 plots data from the United States, and is taken from Adrian and Shin (2009). It charts the stock of repurchase agreements of US primary dealers[5] plus the stock of financial commercial paper expressed as a proportion of the M2 money stock.

Figure 4. Repos and Financial CP as Proportion of M2
(Source: US Federal Reserve)



M2 consists of retail deposits and holdings in money market mutual funds, and thus can be regarded as retail depositors' claim on the broader banking system. It is apparent from Figure 2 that as recently as the early 1990s, repos and financial CP were only a quarter of the size of M2. However, the ratio rose rapidly and reached over 80% by August 2007, only to collapse with the onset of the financial crisis.

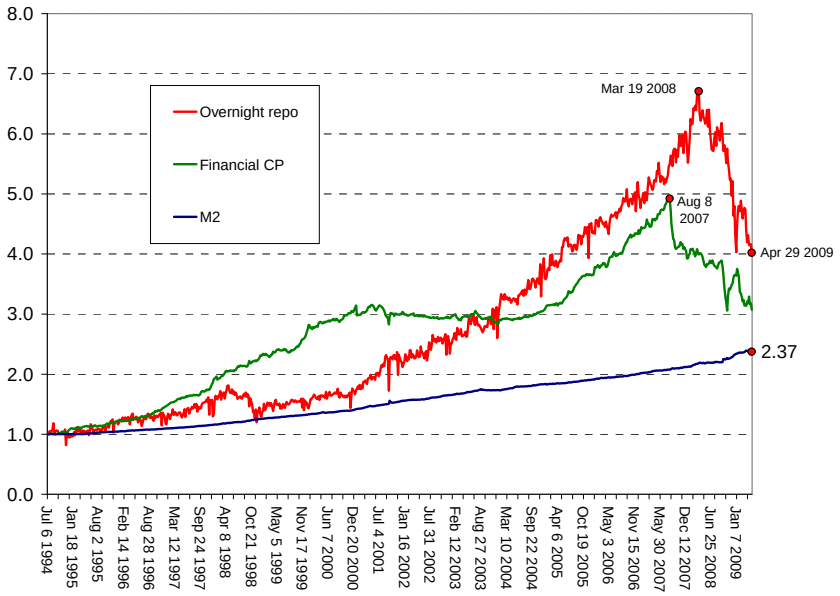
The growth in non-core liabilities is often accompanied by the shortening of maturity of the liabilities. Figure 5 plots three series: the size of the *overnight* repo stock, the total stock of financial commercial paper and M2, all normalized to equal 1 on July 6th, 1994.

We see that the stock of M2 grew by a factor of 2.4 since 1994, but the stock of overnight repos grew almost seven-fold up to March 2008, before collapsing with the onset of the

[5] US primary dealers are US banks and securities firms that have a daily trading relationship with the Federal Reserve, and which are permitted to bid at the auctions of US Treasury securities.

Bear Stearns crisis in 2008. Indeed, the use of overnight repos became so prevalent among US investment banks that, at its peak, the five Wall Street investment banks were rolling over a quarter of their balance sheets every night.

Figure 5. Overnight Repos and M2 (weekly data)
(Normalized to 1 on July 6th 1994. Source: Federal Reserve)



The increased use of short-maturity liabilities can be seen as the mirror image of the increased proportion of non-core liabilities in the banking system.

Figure 6: Short Intermediation Chain

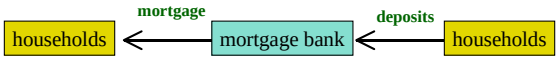
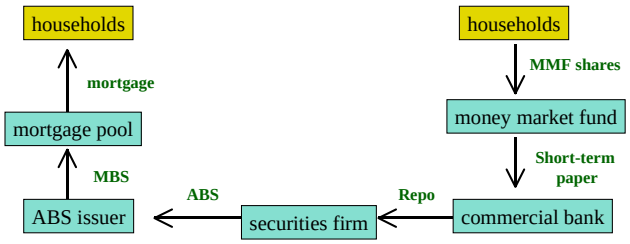


Figure 6 depicts a traditional deposit-taking bank that collects deposits and holds mortgage assets against household borrowers. All banking sector liabilities are core liabilities in such a system. However, greater use of non-core liabilities is associated with lengthening intermediation chains, as illustrated in Figure 7.

In this illustration, the mortgage asset is held in a mortgage pool, a passive firm whose sole role is to hold mortgage assets and issue liabilities (mortgage-backed securities, MBSs) against those assets. The mortgage-backed securities might then be owned by an asset-backed security (ABS) issuer who pools and tranches the MBSs into another layer of claims, such as collateralized debt obligations (CDOs). Then, a securities firm might hold CDOs on their own books for their yield, but finances such assets by collateralized borrowing through repurchase agreements (repos) with a larger commercial bank. In

turn, the commercial bank would fund its lending to the securities firm by issuing short term liabilities, such as financial commercial paper. Money market mutual funds would be natural buyers of such short-term paper, and ultimately the money market fund would complete the circle, since household savers would own shares to these funds.

Figure 7: Long Intermediation Chain



The illustration in Figure 7 is a simple example of potentially much more complex and intertwined relationships. What is noticeable from the institutions involved in Figure 5 is that they were precisely those institutions that were at the sharp end of the financial crisis of 2007 and 2008. Subprime mortgages cropped up in this chain, and the failure of Bear Stearns and Lehman Brothers owed to problems in the smooth function of this chain.

At each stage of the intermediation chain, the funding interest rate must be lower than the asset interest rate. As the intermediation chain becomes longer, more short-term funding must be used to support the chain, as short-term funding tends to be the cheapest. In this way, the growth of non-core liabilities and the increased use of short-term debt are all consequences of the rapid growth of bank assets during a boom.

The discussion so far suggests that the definition of core and non-core liabilities should focus on whether the liability is to an ultimate domestic creditor. In particular, we should distinguish between:

1. Liability due to an ultimate domestic creditor

2. Liability due to an intermediary

3. Liability due to a foreign creditor

The principle would be that we classify (1) as a core liability and (2) and (3) as non-core liabilities. In practice, the classification is not so clear-cut. For instance, the claims held by domestic non-financial firms are not easy to classify. For a small and medium sized enterprise with an owner-manager, the bank deposits of that firm could be seen as household deposits. However, the firm could be a major firm with access to market finance, who can issue bonds and then deposit the proceeds of the bond sale in the banking system. This is what happened in Japan in the 1980s, for instance. This latter case should not be counted as a core liability, since the creditor firm is acting like an intermediary who borrows in the financial markets to lend to the banks.

There are other ambiguities that are presented by items such as trust liabilities of the banking sector. Much of the trust liabilities are to non-financial corporates and face many of the definitional hurdles.

As a practical matter, it may be better to have a more graduated distinction between core and non-core liabilities, allowing an intermediate category to take account of such ambiguities.

The following table is a two-way classification that takes account of the traditional concern with the liquidity of monetary aggregates together with the question of whether the liabilities are core- or non-core. While acknowledging that some differences of views could lead to alternative classifications, we use the distinction to examine the case of Korea.

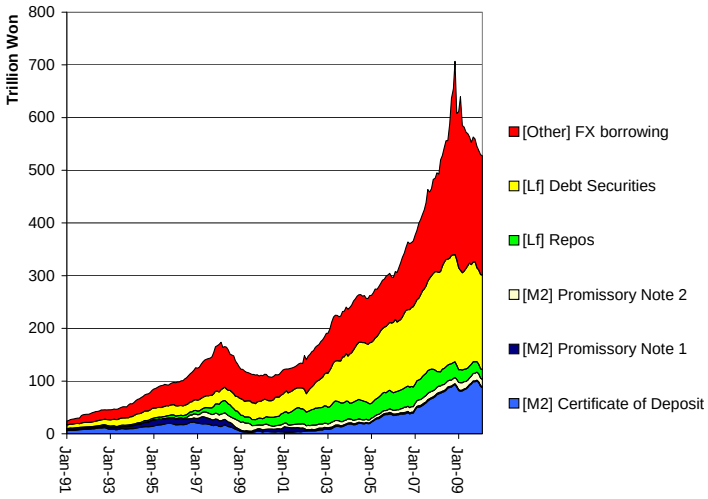
For Korea, we define non-core liabilities as the sum of (i) bank liabilities to foreign creditors (ii) bank debt securities, (iii) promissory notes (iv) repos and (v) certificates of deposit. The inclusion of CDs is motivated by the fact that CDs are often held by financial institutions engaged in the carry trade, who use CDs as an alternative to holding Korean government securities in their carry trade. However, we recognize that we are missing some demand from domestic depositors who hold CDs as a higher-yielding substitute for bank deposits.

	Core liability	Intermediate	Non-core liability
Highly liquid	Cash Demand deposits (households)	Demand deposits (non-financial corporate)	Repos Call loans Short-term FX bank debt
Intermediate	Time deposit & CDs (households)	Time deposit & CDs (non-financial corporate)	Time deposit & CDs (banks & securities firms)
Illiquid	Trust accounts (households) Covered bonds (households)	Trust accounts (non-financial corporate)	Long-term bank debt securities (banks & securities firms) ABS & MBS

Non-core Liabilities for Korea

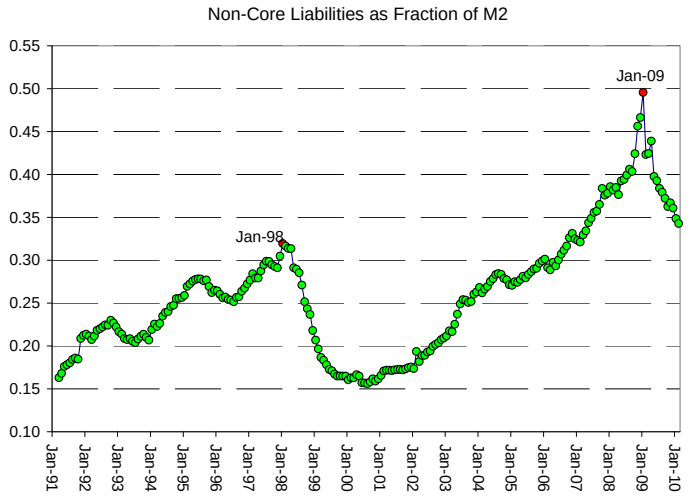
The chart for the non-core liabilities in Korea is given in Figure 8. In an open emerging economy, rapid increases in non-core liabilities of the banking sector shows up as capital inflows through the increased FX liabilities of the banking sector. The segment in red shows the bank liabilities to foreign creditors.

Figure 8. Non-Core Liabilities of Korean Banking Sector



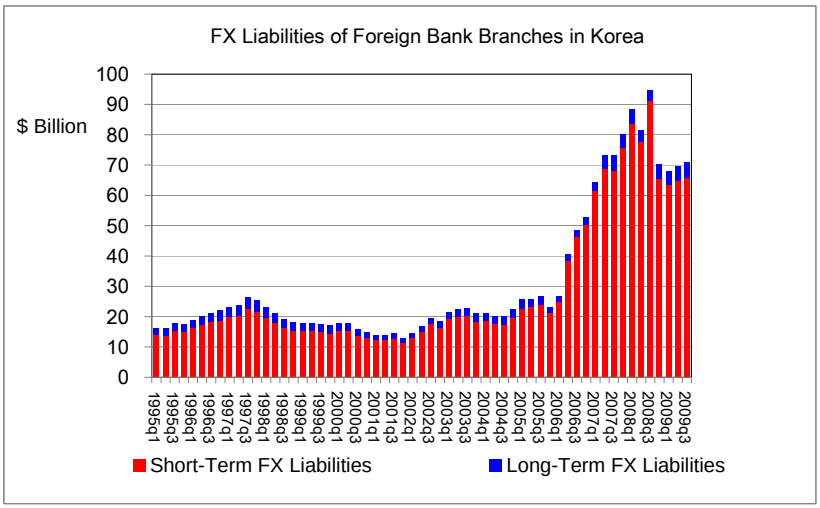
We see that the first peak on non-core liabilities comes during the 1997 financial crisis. After a lull in the early 2000s, non-core liabilities increase rapidly up to the 2008 financial crisis. Figure 7 plots the non-core liabilities of the Korean banking sector as a fraction of M2. We see that there has been substantial variation in the weight on non-core liabilities over the years, ranging from around 15% to a peak of 50% during the crisis of 2008.

Figure 9. Non-core liabilities as a proportion of M2



From 2005 to mid-2008, the foreign currency liabilities of Korean banks and foreign bank branches in Korea increased rapidly, before falling rapidly with the onset of the financial crisis after the Lehman Brothers bankruptcy.

Figure 10. Foreign currency liabilities of foreign bank branches in Korea (Source: Bank of Korea)



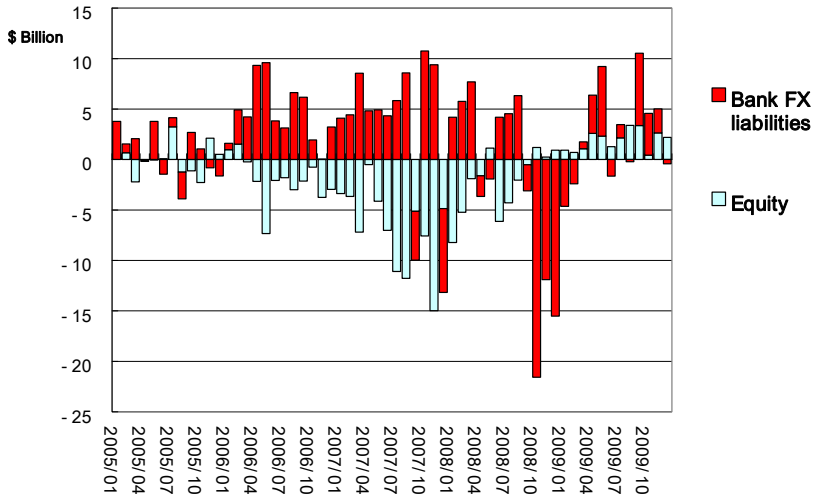
Foreign bank branches in Korea played an important role in channeling foreign currency funding to local borrowers. Figure 10 plots the foreign currency liabilities of the foreign bank branches in Korea. Foreign bank branches raise funding either from their headquarters through the interoffice account or by borrowing unsecured in the interbank market. They then enter the FX swap market in Korea, selling dollars to buy Korean won

on the spot market and simultaneously buying dollars in the forward market. Before the swap matures, foreign banks hold Korean government bonds, Bank of Korea bonds and other fixed income instruments denominated in Won to engage in the "carry trade" of lending at the higher Korean interest rate by borrowing at the lower dollar or yen interest rate.

Although local banks also held dollar assets, such assets were claims on Korean firms, and hence not usable to meet maturing dollar liabilities. Non-financial firms in Korea had dollar receivables, such as the receivables of the shipbuilders, but they were long-term dollar receivables. By hedging the exchange rate risk in these long-term dollar receivables, the non-financial companies could transfer to the banking sector the long-term dollar claims, but the banks then would engage in maturity transformation by borrowing short in dollars. In this way, although the currency mismatch could be eliminated, there was still a maturity mismatch.

Capital flows associated with foreign currency liabilities of the banking sector played a key role in the crisis of 2008. Figure 9 shows the capital inflows and outflows for two sectors – the equity sector and the banking sector.

Figure 11. Net Capital Flows of Equity and Banking Sector (Billion Dollars) (Source: Bank of Korea)



We see that the equity sector actually saw *net inflows* during the crisis in the autumn of 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 investors who sold their holdings of foreign equity.

Equity outflows also have two mitigating factors. During a crisis, stock prices fall and there is a steep depreciation of the domestic currency. For both reasons, foreign investors suffer a "double whammy" if they withdraw from the stock market. Provided that the

exchange rate is allowed to adjust, equity outflows are not the main culprit in the draining of foreign currency reserves.

However, the banking sector is different. First, foreign currency liabilities of the banks have a face value that must be met in full, and the face value is in foreign currency. For both reasons, the deleveraging of the banking sector is associated with precipitous capital outflows. Second, deleveraging sets off amplifying effects through price changes. Unlike long-term investors, such as pension funds and life insurance companies, leveraged institutions are vulnerable to erosion of their capital, and hence engage in substantial adjustments of their assets even to small shocks. The feedback loop generated by such reactions to price changes amplifies shocks.

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, there was an outflow of 21.6 billion dollars in October, 11.9 billion dollars in November and 15.5 billion dollars in December. In these three months, the outflow from the banking sector was 49 billion dollars, which 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.

Deleveraging by banks and the associated amplification effects figured prominently in emerging economy financial crises. As such, policies to moderate volatile capital flows must be linked with banking sector regulation.

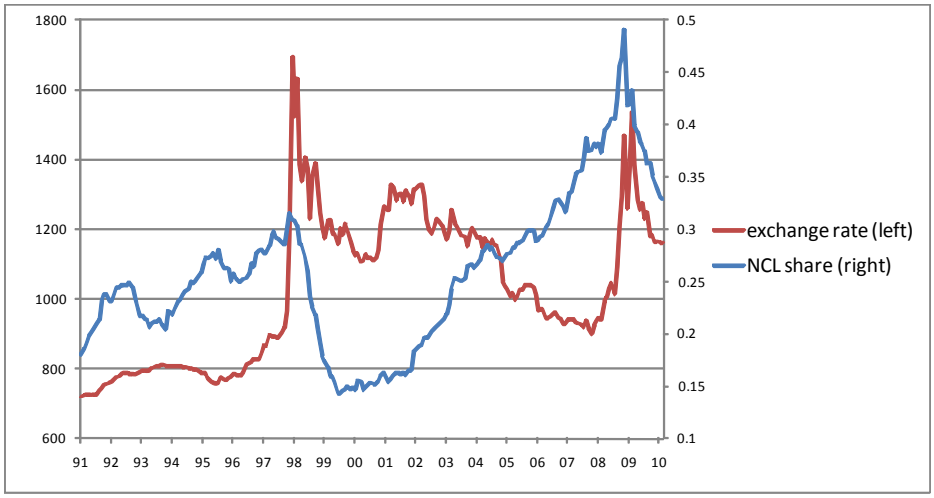
Although there are common threads between the crises of 1997 and 2008, there are also notable differences. In 1997, the currency mismatch was on bank balance sheets resulting from lending to the borrowing by large non-financial corporations (the *chaebol*) in Korea. In contrast, in 2008, the mismatch arose from the selling of long-dated dollar receivables of the shipbuilders and other exporting firms. The banks, who bought the long-dated dollars as forward contracts would then hedge the currency exposure by taking on short-term dollar-denominated debt. The large volume of dollar forward contracts sold by exporting firms accounted for a substantial portion of the increase in short-term foreign currency denominated liabilities of the banking system.

Exchange Rate Movements

For open economies such as Korea, changes in non-core liabilities can be expected to be closely related to the movement of the exchange rate since, as emphasized before, sudden changes in capital flows are primarily associated with changes in non-core liabilities of the banking sector. Figure 10 illustrates the exchange rate of the Korean won against the US dollar and the fraction of non-core liabilities of the Korean banking to M2. Before the Asian crisis in 1997, the Korean government intervened heavily in the foreign exchange market and the exchange rate was quite stable. However, after the Asian crisis, the Korean government officially adopted a floating exchange rate, and the exchange rate

has been more or less allowed to move freely and determined by the market forces since then.

Figure 10. Non-Core Liabilities and the Exchange Rate of Korea



In the graph,we can clearly see that the two peaks of the fraction of the non-core liabilities were followed immediately by the two exchange rate crises in 1997 and 2008. After the crises, as the exchange rate stabilized, the fraction of the non-core liabilities also decreased. However, if we let the crisis and after-crisis adjustment periods aside, the exchange rate and the fraction of the non-core liabilities generally moved in the opposite directions. Especially during the period of January 2001 to September 2008, while the exchange rate mostly appreciated, the fraction of the non-core liabilities almost always increased. The simple correlation coefficient between the two is -0.76 during that period. This is because, since increases in non-core liabilities reflected capital inflows through foreign borrowings of the banking sector, they put pressure on the Korean won to appreciate.[6]

Forecasting Exchange Rate Growth

Recently Adrian, Etula and Shin (2009) present evidence that the short-term credit aggregates of US financial intermediaries such as repurchase agreements (Repos) or commercial paper (CP) forecast exchange rate growth for a number of countries. Since repos and CP can provide a window on funding liquidity, the "risk appetite" of dollar funded intermediaries is closely linked to fluctuations of such short US dollar credit aggregates. In particular, when the US dollar funding liquidity is high, the risk premium

[6] As emphasized by Adrian, Etula and Shin (2009), this negative contemporaneous correlation between the exchange rate and the fraction of non-core liabilities plays a crucial role in the next subsection in forecasting the future exchange rate changes.

required on risky holdings of foreign currency is low, implying a depreciation of such risky currency. In other words, US dollar funding increases are expected to be followed by subsequent appreciation of the dollar. They call this empirical regularity a funding liquidity channel and provide a theoretical foundation for this by using an intertemporal equilibrium pricing model.

We apply the same logic to forecasting the Korean won exchange rate. Since a major source of non-core liabilities is foreign borrowings, increases in non-core liabilities are expected to reflect high risk appetite of foreign intermediaries and hence can be used to forecast the exchange rate. In Table 1 we report the regression results. The baseline specification with and without the lagged dependent variable is displayed in columns (1)-(2). We see that the monthly growth rate of non-core liabilities last month has explanatory power for the current exchange rate growth: higher growth of non-core liabilities last month is followed by depreciation of the Korean Won this month. This finding is robust to variation in the regression specification (columns (3)-(5)) where other control variables are included such as the one-month lags of the monthly growth rate of industrial production, the monthly growth rate of stock index and the interest rate difference between Korea and the U.S. The estimated coefficients of the lagged growth rate of non-core liabilities are stable across different specifications with statistical significance at the 5% level except for in column (5) where it is significant at the 10% level. The estimated coefficients are also economically significant, suggesting that a one standard deviation increase in the growth rate of non-core liabilities forecasts a roughly 0.8% depreciation of the exchange rate.

Table 1. Forecasting Monthly Exchange Rate Growth of the Korean Won against the US Dollar

Dependent Variable: Monthly Exchange Rate Growth	[1]	[2]	[3]	[4]	[5]
Exchange rate Growth (-1)		0.007	-0.007	0.003	-0.038
		[0.071]	[0.081]	[0.080]	[0.084]
Non-core Liabilities Growth (-1)	0.213**	0.209**	0.260**	0.263**	0.241*
	[0.092]	[0.099]	[0.124]	[0.123]	[0.123]
Interest Rate Difference (-1)			0.003	-0.037	-0.05
			[0.090]	[0.090]	[0.090]
Industrial Production Growth (-1)				-0.340**	-0.324**
				[0.140]	[0.140]
Stock Index Growth (-1)					-0.069*
					[0.040]
Constant	-0.001	-0.001	-0.001	0.002	0.003
	[0.003]	[0.003]	[0.005]	[0.005]	[0.005]
Observations	229	229	182	182	182
Adjusted R-squared	0.019	0.014	0.011	0.037	0.048

Note: The dependent variable is the monthly growth of the Korean Won exchange rate against the US dollar. Forecasting variables are the one-month lags of the exchange rate growth, the monthly growth rate of non-core liabilities, the interest rate difference between Korea and the US, the monthly growth rate of industrial production and the monthly growth rate of stock index. We use the end of month value for all

monthly variables. We use the policy interest rates for the interest rate and the KOSPI for the stock index. The values in parenthesis are standard errors. * and ** denote statistical significance at the 10% and 5% levels respectively.

In spite of the encouraging empirical evidence from the regressions, we should also be mindful of the potentially non-linear effects associated with the build-up to a crisis and its subsequent outbreak. During tranquil times, the capital inflows associated with greater foreign currency denominated bank liabilities is more likely to be associated with an *appreciation* of the Korean Won. However, conditional on high levels of foreign currency denominated liabilities, the probability of a crisis outbreak is high. In this respect, a more thorough investigation of the empirical evidence will need to disentangle the dynamics during tranquil periods from the dynamics around the time of crises.

Explaining Credit Spreads

We can also apply the same idea of the risk appetite to forecasting the credit spread.[7] While Adrian, Etula and Shin (2009) focus on the asset side of the financial intermediaries, we now switch our attention to the cost of the liabilities. Since a high risk appetite of the financial intermediaries implies that they are willing to borrow even at a higher interest rate, we expect the credit spread for debt securities issued by financial intermediaries to increase as the non-core liabilities of them increase. We can investigate if this implication of the same theory holds by relying on the same type regression but replacing the exchange rate growth with the credit spread.[8]

We report the regression results in Table 2. The credit spread is defined as the difference between the three-year yield on the debt securities issued by (Korean) AAA-rated commercial banks and the government bond yield of the same maturity. An increase in the credit spread is interpreted that commercial banks are willing to borrow with higher interest premiums, reflecting a higher risk appetite.

We find that the increase in the growth rate of the non-core liabilities last month increases the credit spread this month. This evidence is quite strong as the estimated coefficients of the one-month lag of the credit spread are highly significant at the 1% level in all columns except in column (1). In contrast, all other control variables are not statistically significant even at the 10% level, indicating that only the growth rate of the non-core liabilities has explanatory power for the future credit risk.

[7] Since the risk appetite is related to the future return or cost, we are more interested in the impact of increased risk appetite on the future credit spread.

[8] Since the dependent variable is not the growth rate, but the level of credit spread, we also used the non-core liabilities as a fraction of M2 instead of the growth rate of the non-core liabilities.

Table2. Forecasting Credit Spread of Korean Commercial Banks

Dependent Variable: Credit Spread	[1]	[2]	[3]	[4]	[5]
Credit Spread (-1)		0.948***	0.952***	0.956***	0.960***
		[0.036]	[0.038]	[0.039]	[0.040]
Non-core Liabilities Fraction (-1)	-0.003	0.029***	0.030***	0.029***	0.030***
	[0.013]	[0.005]	[0.005]	[0.005]	[0.006]
Interest Rate Difference (-1)			-0.004	-0.003	-0.003
			[0.011]	[0.011]	[0.011]
Industrial Production Growth (-1)				0.003	0.003
				[0.006]	[0.006]
Stock Index Growth (-1)					0.001
					[0.002]
Constant	0.006***	0	0	0	0
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	130	129	129	129	129
Adjusted R-squared	0.0073	0.8444	0.8433	0.8423	0.8415

Note: The dependent variable is the credit spread in Korea. Forecasting variables are the one-month lags of the credit spread, the monthly growth rate of non-core liabilities, the interest rate difference between Korea and the US, the monthly growth rate of industrial production and the monthly growth rate of stock index. We use the end of month value for all variables except for the credit spread for which we use the monthly average. The credit spread is defined as the difference between the three-year yield on the government bond and that on the bonds issued by (Korean) AAA-rated commercial banks. The values in parenthesis are standard errors. **** denotes statistical significance at the 1% level.

Role of Monetary Aggregates

In a hypothetical world where deposit-taking banks are the only financial intermediaries, and their liabilities (deposits) can be identified with a broad definition of "money", then the money stock would be a good indicator of the aggregate size of the balance sheets of leveraged institutions. To this extent, the growth of the money stock would play a useful role in signaling changes in the size of the aggregate balance sheet of the leveraged sector.

However, it is clear that we cannot readily identify money with the aggregate size of the liabilities of leveraged institutions. This is so for two reasons.

- Many of the leveraged institutions (investment banks, hedge funds, off-balance sheet-vehicles and others) do not conform to the textbook ideal of the deposit-funded bank. Hence, their liabilities are not counted as "money".

- Even for mainly deposit-funded banks, not all items of liabilities qualify as money. In particular, the liabilities of banks to foreign creditors need to be considered.

The first bullet point is important for financial systems such as that in the United States that rely on securitization and capital markets, rather than traditional banking. Perhaps we could speculate that the divergent empirical results for the United States and some

European countries on the role of money in financial cycles can be attributed to the fact that the capital markets play a much bigger role in the former.

The second bullet point is also important, especially when we consider the components of a bank's liabilities that fluctuate over time. The recent run on the U.K. mortgage bank Northern Rock shows how even very previously conventional deposit-funded mortgage banks may come to rely more heavily on market funding rather than deposits. Thus, the money supply as conventionally defined will fail to capture the size of the aggregate balance sheet of even the conventional banking sector, let alone the non-bank financial institutions that have an impact on the financial cycle.

If the financial system is dominated by deposit-taking banks, so that the aggregate liabilities of the financial system as a whole are well-captured by the stock of deposits, then excess liquidity corresponds to excessive growth of the money stock. Deposits fall under conventional broad notions of money, such as M2. However, the ideal of a financial system dominated by deposit-funded bank may have never existed in its purest form, and is becoming less relevant over time. Certainly, empirical evidence from the U.S. since the 1980s detects very little role for the money stock in explaining macroeconomic fluctuations (see, for example, Friedman 1988).

If the financial system is organized around the capital market, conventional measures of money represent only a small proportion of aggregate size of the leveraged sector. Nor is the quantity of deposits the most volatile component of the total aggregate liabilities of the financial system. In such a world, money is less useful for macroprudential policy. The rapid move toward a market-based financial system in recent years has accelerated the trend toward greater reliance on non-traditional, non-deposit based funding, toward greater use of the interbank bank market, the market for commercial paper, and asset-backed securities (itself sub-divided in many categories). Most of all, for an open financial system such as Korea's, the foreign liabilities of the banking sector emerges as an important balance sheet aggregate.

Link with Reform of Bank Regulation

The global financial crisis exposed weaknesses in the existing regime for bank capital regulation. The recognition of these flaws set in train a major upheaval of bank capital regulation through the G20 process. The Financial Stability Board (FSB) and the Basel Committee are examining two key strands in the proposed reform, which are:

- Capital requirements that vary over the financial cycle

- Capital surcharge for systemically important financial institutions (SIFIs)

Additionally, the G20 has mandated the IMF to examine financial sector burden sharing whereby the costs of government intervention during the financial crisis can be imposed on the financial industry itself.

So far, these initiatives have been conducted largely independently of each other in spite of the close conceptual affinities between them. There is a danger that each initiative is developed in isolation, to be piled on top of each other at the implementation stage in cumulative fashion. Such an outcome would be unfortunate, since the resulting regime will suffer from conceptual inconsistencies. There is also the danger that the cumulative application of the new charges will result in double- or triple-taxation of the same activities.

We have seen above that there are intimate connections between:

- Procyclicality
- Systemic risk spillovers, and
- Stock of non-core liabilities of the banking system.

Therefore, if systemic risk is to be taxed, it must be done in procyclical fashion. Merely slapping on a time-invariant "systemic surcharge" is not sufficient. By the same token, a procyclical capital requirement can, by itself, serve as a tax on systemic risk spillovers. A levy on non-core liabilities has a similar effect to both, but is easier to implement.

Concluding Remarks

The non-core liabilities of the banking sector can be regarded as a measure both of the stage of the financial cycle, and of the vulnerability to systemic risk spillovers. In addition, in an open emerging economy, the stock of foreign currency liabilities of the banking sector is an indicator of excess liquidity and of the vulnerability to capital outflows driven by deleveraging.

For these reasons, the non-core liabilities of the banking sector is an especially useful measure for macroprudential policy. Further research should be directed in two directions. First, there is a need for better-designed monetary aggregates that addresses the issues of financial stability, rather than the traditional preoccupations that have motivated the definition of traditional monetary aggregates. Secondly, there is greater need for further analytical work on the relationship between non-core liabilities and financial stability.

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