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# Bank Wholesale Funding and Credit Procyclicality: Evidence from Korea

**Summary:** Credit procyclicality has recently been the focus of considerable attention, but what fuels the often excessive credit growth is rarely questioned. We investigate the relationship between the composition of banks' liabilities and their credit procyclicality. After examining the macroeconomic context where banks rely increasingly on wholesale funding (WSF), we estimate the effect of WSF on the banks' credit growth using quarterly panel data for the commercial banks of Korea from 2000 to 2011. We find that a higher sensitivity of banks' WSF to the business cycle leads to an excessive response of credit growth to the business cycle, even with a low share of WSF on bank liabilities. On the other hand, we find that overseas WSF has a more marked effect on credit procyclicality, which may additionally exacerbate the financial fragility of export-led emerging economies.

**Key words:** Credit procyclicality, Wholesale funding, Financial fragility.

**JEL:** E44, G21, G28.

The relationship between the credit cycle and the business cycle has often been a major concern for monetary authorities and economists, and it has recently received renewed attention in the wake of the global financial crisis. In particular, with less and weaker financial supervision, the procyclical pattern of credit growth has been considered a warning signal leading up to the crises (see for example, Charles Goodhart and Boris Hofmann 2008; Michael Hume and Andrew Sentence 2009). With respect to the over-sensitivity of credit growth to the business cycle, many posit that a failure to establish appropriate regulations is the main cause of this problem. The reckless deregulation of the financial sector allegedly resulted in imprudent lending competition and relaxed lending standards, typified by the sub-prime mortgage boom in the U.S. (Philip Arestis and Elias Karakitsos 2009; Ognjen Radonjić and Miodrag Zec 2010).

However, considering the bank's intrinsic role in credit creation as distinct from other financial intermediaries, it is also important to understand what fuels the bank's often-excessive credit growth. As noted by Markus K. Brunnermeier (2009) and John Geanakoplos (2010) when financial agents aim to adjust their balance sheets to hit the target leverage following an asset price growth during a boom, such adjustments contribute to a greatly amplified credit. And the bank's leverage adjustment is implemented mainly through wholesale funding (hereafter WSF). In this regard, the core question of this paper is as follows. What influences will the composi-

tion of bank liabilities have on the bank's excessive credit procyclicality and hence on macroeconomic vulnerability? This question has surprisingly been overlooked and even treated as a minor issue.

We will show that the sensitivity of WSF to the business cycle has contributed to the excessive responsiveness of credit growth to the business cycle. We present evidence by investigating the case of banks in South Korea (hereafter Korea). The rest of the paper is organized as follows. Section 1 discusses the macroeconomic context of the rise of WSF and its effects on the economy with a review of related literature. Section 2 explains the bank panel data used in our study. In Section 3, we present our empirical methodology and discuss the estimation results. Section 4 estimates the effect of overseas WSF and examines its structural grounds, which will cast light on the issues of financial fragility in similar open emerging economies. Section 5 concludes the paper and suggests policy implications.

## 1. Wholesale Funding and Financial Fragility

One of the main reasons WSF increased on the bank liabilities was the low interest rate environment since the early 2000s. With a few financial busts worldwide in the late 1990s and early 2000s, the interest rates in many developed economies began to decline noticeably and were held at record lows throughout much of the first decade of the 2000s. Within the overall low interest rate environment, competition for deposits among banks became more intense, and thus, attracting deposits became more difficult.

The declining household savings rate is another contributing factor to the decline of deposit shares in bank liabilities, though this trend is not so definitive as to be generalized across economies. However, in the case of Korea, the household savings rate fell from over 20.0% in the 1990s to 2.8% in 2010, which is even lower than the 5.7% rate in the U.S. and the 6.1% average rate of the 20 OECD countries for whom data are available (The Organisation for Economic Co-operation and Development - OECD 2011<sup>1</sup>). Though Korea's total savings rate is still higher due to high corporate and government savings, a drop in Korea's household savings rate in the 2000s has been substantial enough to impose heavy burdens on traditional bank funding. Moreover, with the penetrations of new financial agents, such as money market mutual funds and mutual funds, into deposit commodity markets, banks were forced to lose their deposit market shares and decreased the share of core deposits in their liabilities (Korkut Erturk and Gökçer Ozgur 2009). In effect, with the introduction and development of new financial instruments and the expansion of overnight loan, liability management through WSF has greatly increased in importance as a source of bank funds. In the case of U.S. negotiable certificates of deposits (CDs) and bank borrowings accounted for 47% of bank liabilities in 2008, a dramatic increase from the 2% share in 1960, while the share of checkable deposits decreased from 61% to 6% (Fredrick Mishkin 2009). Because the traditional distinctions between the bank-based and market-based systems are becoming blurred, we expect

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<sup>1</sup> The Organisation for Economic Co-operation and Development - OECD. 2011. OECD Economic Outlook. <http://stats.oecd.org>.

that banks will rely more on WSF and that the market-to-market changes will affect banks to a higher degree.

Meanwhile, a few of the studies on banking award higher marks to a wholesale financier than to a deposit account holder from a microeconomic perspective. Rocco Huang and Lev Ratnovski (2010) suggest that the “bright” side of WSF is that it enables banks to fully utilize investment opportunities regardless of the deposit supply. That is, the traditional source of deposits held in banks is bound to lag behind the expansion of lending during periods of rapid asset growth. Moreover, while wholesale financiers allow banks to adjust quickly to the changes in assets or market conditions, depositors are relatively insensitive to the bank’s misallocations of resources and are sluggish in punishing the bank by withdrawing their deposits. As a result, depositors cannot offer banks efficient incentives or strong market discipline.

Furthermore, considering the criticism that banks’ safety nets encourage moral hazard (e.g. Charles W. Calomiris 1999; Asli Demirgüç-Kunta and Enrica Detragiache 2002), WSF instruments, which are generally not covered by explicit deposit insurance, may be more efficient at monitoring banks and preventing them from taking excessive risks. Overall, following the orthodox mainstream economic doctrine that stresses the beneficial effects of financial market liberalization and touts the development of new financial instruments, those banks with a higher share of WSF, through competitive market-based liabilities management, may acquire more advanced engineering techniques, such as more efficient options for hedging risks and diversifying portfolios for revenue, which consequently contribute to higher profitability.

However, the bank’s reliance on WSF may compromise credit quality due to aggressive lending and lead to inefficient liquidations, where wholesale financiers often exit ahead of and shift significant losses onto depositors, as was observed in recent bank failures. Joonho Hahm, Hyunsong Shin, and Kwanho Shin (2011) formulate a model in which a large stock of a bank’s non-core liabilities, a concept similar to WSF in this paper except for the empirical specifics, erodes risk premium and heightens vulnerability to a crisis. Furthermore, Demirgüç-Kunta and Harry Huizinga (2010) insist that non-deposit WSF lowers the rate of return on assets, while the expected beneficial effects of risk diversification are limited only to the low levels of non-deposit funding. In actuality, the relationship between bank profitability and non-deposit funding is not conclusively established due to unavoidable endogeneity. Though this topic should be addressed in other papers, we can easily expect mixed results. That is, while the higher prime cost of non-deposit funding is surely detrimental to bank profits, this type of funding combined with non-interest income-bearing projects, such as securitization trading, enhances bank returns during asset price booms. Which of the two will have a stronger effect depends on each economy’s structure and the time span, and the complicated endogeneity issues warn against a hasty conclusion regarding causality. However, even though the profit-enhancing effect of WSF is found to be robustly significant in some samples, we cannot deny that those high profits were built up at the expense of the macroeconomic stability of the banks.

Our paper takes a critical stance toward banks’ WSF and argues that WSF, as an increasing funding source of banks, is not always welcome in view of the finan-

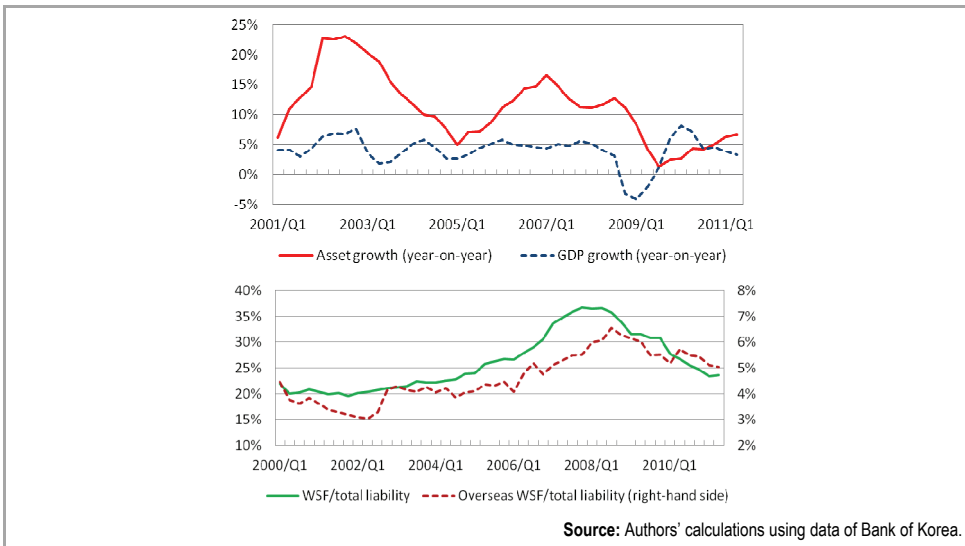
cial fragility and systemic risk associated with it. Above all, as banks turn to increased WSF, the integration of the financial system through the provision of liquidity within and among banks and other non-depository institutions is accelerated. This interconnectedness among financial institutions has been cautioned against in a vast literature (see for example Stefano Battison et al. 2009) because such a relationship expands the channels of contagion; the credit instruments which give rise to interlinkage among institutions contribute to higher systemic risk and a more fragile economy.

However, this does not imply that the low share of WSF per se guarantees bank and macroeconomic stability. The recent empirical confusion regarding the “leverage effect” suggests another point to consider when investigating the effect of WSF. While investment banks’ procyclical leverage adjustment is revealed explicitly, as in Tobias Adrian and Shin (2010), the existing literature fails to verify leverage procyclicality as banks’ (mostly commercial banks) general characteristic (see for example, Fabio Panetta et al. 2009; Angelo Baglioni et al. 2010). Given that the bank’s leverage adjustment is implemented mainly through WSF and that the shares of WSF in commercial banks’ liabilities worldwide are actually not so high as to be alarming at a glance, Demirgüç-Kunt and Huizinga (2010) shows that 61.3% of their extensive sample of 1,334 banks in 101 countries have non-deposit funding shares of less than 5%, it is not surprising that the procyclical bank leverage growth has not been pronounced in all economies. In fact, excessive credit procyclicality has been also found later in the form of foreign currency or banking crises in the emerging economies, where WSF accounts for insignificant portion of bank liabilities. Therefore, the often-missing link in the existing literature seems to lie with the qualitative rather than the quantitative features of WSF, which is in this paper, the oversensitivity of WSF to economic fluctuations. We focus not only on the share of WSF per se but on the relative dynamics between the sensitivity of WSF and bank credit to the business cycle.

In the next sections, we explore the channel through which the liability structure of banks affects their credit operation and how credit cycle expansions lead to macroeconomic vulnerability. However, the empirical evidence on this channel is scarce, with the exception of Hyungkwon Jeong (2009) and Evren Damar, Cesaire A. Meh, and Yaz Terajima (2010) who use panel data from Canadian and Korean banks, respectively. Damar, Meh, and Terajima (2010) argue that a bank’s leverage becomes more procyclical during times of increased liquidity in WSF. Jeong (2009) regresses corporate loan growth on GDP growth and its interaction term with the WSF ratio, thereby demonstrating that a bank’s reliance on WSF is partly responsible for the increase in the procyclicality of bank lending. Their findings are broadly in line with ours. However, we pay attention to the sensitivity measure of WSF as well. Whether bank credit growth responds excessively to the business cycle matters in this paper because the procyclical lending trend itself is, to a certain extent, natural in the business cycle. Additionally, we identify determinants of banks’ funding structure, accounting for endogeneity biases between the variables, which have not been sufficiently addressed in previous literature.

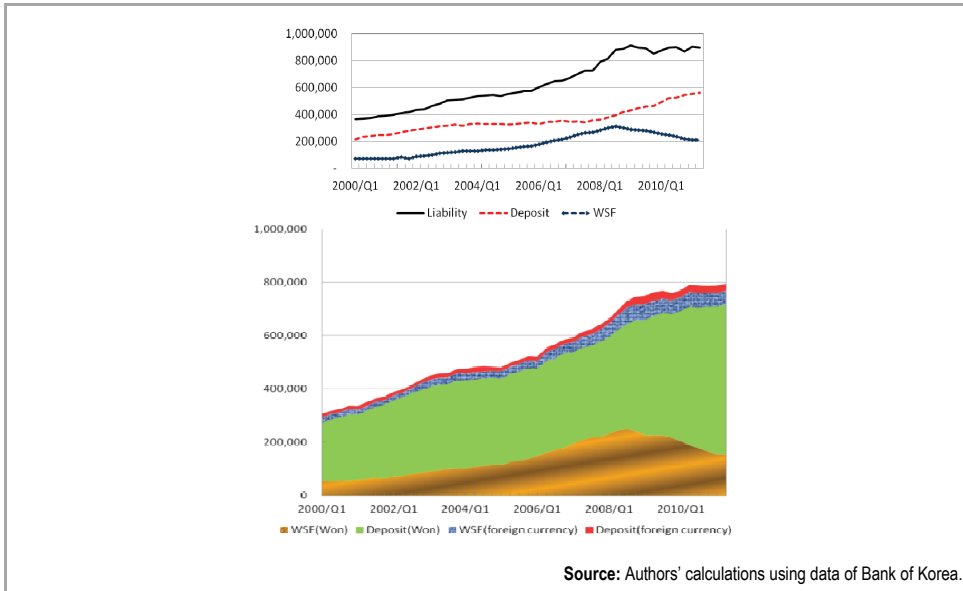
## 2. Data and Empirical Trends

For the empirical analysis, we use balance sheet data from Korean commercial banks that maintained ongoing business as of the 2nd quarter of 2011, which is available at Financial Analysis Information Retrieval System, and macro variables from the Economic Statistics System, both of which are under the supervision of the Bank of Korea. The data covers the period from the 1st quarter of 2000 to the 2nd quarter of 2011. Branches or affiliates of foreign banks and state-owned special-purpose banks are excluded from data due to the differences in legal status, accounting standards and establishment purpose. Though the role of WSF is critical for this study, the exact definition or coverage of WSF depends on the relevant literature. For the purpose of this study, we calculate WSF as the sum of inter-bank borrowing, financial bond issues, repurchase agreements and certificates of deposits, thus covering most kinds of non-deposit bank funding. In addition, WSF includes funding from overseas, such as inter-bank foreign currency borrowing or foreign currency denominated bond issue, which will be further discussed in Section 5.



**Figure 1** Bank Asset Growth, GDP Growth and Bank Liability Structure

We present representative empirical trends in the aggregate sample data. Figure 1 indicates that the average growth rate of total bank assets has generally exceeded the GDP growth rate. This indicates there has been an over-expansion of banks' leverage in the recent decade, which is consistent with the common perception. Additionally, the lower panel shows that before the onset of the financial crisis in 2008, banks' asset growth had been accompanied by an increasing reliance on WSF and that the share of overseas WSF was increasing as well. In the same vein, the abrupt shrinkage of asset expansion for banks was coincidental with a decreased reliance on both domestic and foreign WSF.



Source: Authors' calculations using data of Bank of Korea.

**Figure 2** Bank Liability Structure, on Average (in 100 mil. Won)

Notably, as Figure 2 indicates, when banks' asset expansions were deactivated by contagions from the crisis, banks' funding preferences changed, placing increased emphasis on funding via deposit rather than on WSF, which resulted in lower shares of WSF. In regard to the currency of WSF, after the financial crisis in 2008, Korean banks dramatically reduced Won (Korean currency), denominated WSF, mainly CDs and financial bonds. However, WSF from foreign creditors underwent few or minimal adjustments.

### 3. Empirical Analysis

#### 3.1 Econometric Strategy

The persistence of statistical stability along the time span should be certain enough to conduct an econometric analysis. Particularly in Korea, we cannot deny the possibility of structural changes in the economy. For example, the mass credit card defaults in 2003 almost halted the new lending in Korean banks and the aftermath of the global financial crisis in 2007-2008 was much severe in Korea. Thus, to control the time effect and to identify the dynamics of the relationship among the variables in more detail, we applied the "rolling regression" method instead of the other common techniques using a time dummy variable because, in the case of long panels, including a time dummy responding to each time spot can lead to a singularity. At each rolling regression, the time window was set as 12 quarters.

We split up the estimation process into three steps in the following order: (1) to identify the determinants of bank funding decisions, (2) to determine the extent to which and the way in which the banks' liability structure influences loan operations, and finally, (3) to grasp the potential driver of macroeconomic fluctuations. Above

all, separating the liability structure estimation from the loan behavior estimation challenges the traditional perception that the decision on how to raise funds and the decision related to loan supply are not related, that is, once a bank decides to whom and to what extent it lends, where the funds come from is irrelevant. This is reminiscent of the Modigliani-Miller theorem in a perfect capital market. If this theorem were true of banks, funding structures would have no effect on the lending decision. On the contrary, we test the validity of the myth by separately estimating the factors that affect the funding and lending behaviors of banks. Hence, separate estimations of the individual steps reveal the inner mechanism of the lending.

In the first step of estimation, we analyze the banks' liability structure determination process using specific factors of the bank and macroeconomic variables, particularly focusing on WSF. We construct an estimation model consisting of a system of three equations. The regressands of each equation are as follows: the share of WSF in the liability, the year-over-year growth rate of WSF and the normalized deviation of WSF from its trend. Actual estimations of systems are performed via Three-Stage Least Squares (3SLS) with individual fixed effects.

In the second step, we analyze the effect of banks' WSF indicators on the procyclicality of bank credit. The regressors in the equation are fitted values of the first estimation step. If the bank credit response to the real economy fluctuation is excessive, it will be a major factor in amplifying the business cycle fluctuation in the next period because it will distort the liquidity allocation process.

In the final step, while we use the panel data on individual banks until the second step, estimating the macroeconomic relationship requires placing the macro level variable, that is, the GDP deviation or GDP fluctuation, on the left-hand side of equation. This means that the regressands of the equation are the same across all the panel entities. Therefore, we would briefly provide the macroeconomic implications of bank lending behavior. Despite the shortcomings of our estimation framework, we hold to it because it has the ability to reveal the individual inner mechanisms of how bank credit works, given there are a vast number of studies on bank credit channels at the aggregate level.

### 3.2 First Step

We analyzed the bank's funding behavior focusing on WSF. The regressors of the equations are the indicators reflecting the individual bank's preference regarding WSF, such as the amount of capital, asset operation behavior, dynamics of non-performing loans, asset price dynamics, interest rate fluctuations, funding gap (the difference between operating assets and liabilities), and the dependence of other banks on WSF.

For the interest rate variables representing the relative cost of the bank's funding, we used the over-night call market interest rate variables (non-collateral), the average interest rate of loans and deposits, and the spread between the return on a 3-year treasury note and an AA-grade corporate bond. Another important variable worthy of consideration is the bank's excess capital. It is rational to expect that a bank prefers to use its excess capital above the regulatory level rather than cost-incurring outside funding; an adverse relationship between the bank's excess capital and its



reliance on WSF. Therefore, we used the banks' excess capital holdings above the regulatory level of capital recommended by the Korea Financial Supervisory Service (FSS). In Korea, banks would make great efforts to comply with FSS' criteria to manage their market reputations. For the other variables, such as the amount of bank assets, loans, and non-performing loans and asset (housing) prices, we used the growth rate of each variable. Finally, for the other variables, we used the percentage value of each variable.

Banks' WSF indicators are the three regressands in the system equations as stated above. In particular, the last one of the three, the normalized deviation of WSF from its trend is defined as  $W_{it}$  in Equation (1) for every sub-sample of the rolling regression (hereafter, a variable with a bar over it denotes its average value while  $\delta$  denotes its standard deviation).

$$W_{it} \equiv \frac{\Delta WSF_{it,t-4} - \overline{\Delta WSF_{it,t-4}}}{\delta(\Delta WSF_{it,t-4})} \quad (1)$$

We estimated the system equations using the 3SLS technique so that we exploit the advantage of seemingly unrelated regression (SURE) by controlling correlations among equations and among panel entities in a system of equations where each equation had regressors similar to those of any vector autoregression model. We did not use a common panel Generalized Method of Moments (GMM) not only because adjusting the instrumental variables to fit the model appropriately at each rolling runs the risk of undermining the consistency of our estimation process but also model specification criteria applied to test the suitability of the GMM cannot be fully satisfied to every equation and every rolling in practice.

Because any macroeconomic variable cannot be perfectly exogenous, establishing the pools of instrumental variables is of great concern. Therefore, we used the seemingly predetermined or exogenous variables, such as the lagged regressors or the banks' balance sheet variables, including the net profit indicators, which are thought to have little feedback on regressands and other macroeconomic indicators. This reflects our effort: 1) to explain the dynamics of the bank lending channel with only a limited class of regularly reported bank-specific and macroeconomic variables; and 2) to observe the inner mechanism of the bank's behavior, which relates to funding and lending in a more explicit manner.

The estimation results in the first step are upon request from the author. Since the prior purpose of the first estimation step was to obtain the fitted values to be used in the second step, significant tests for the individual coefficients of equations are little important. However, the coefficient of determination of each rolling regression showed little fluctuation though structural fluctuations seem to exist during the whole sample period. Thus, applying rolling regression proves to be the correct strategy.

### 3.3 Second Step

The second step is to estimate the procyclicality of bank credit and to identify the determinants of this process. We used the fitted values of the first step's regressands as regressors in the behavioral equation. As in the first step, the individual bank's fixed effect was considered.



The most important part of the second step is determining the regressand. As we estimate the impact of WSF on bank credit fluctuation, we define a bank credit sensitivity measure to estimate bank credit fluctuation. As noted in Section 1, it is natural to assume that the bank credit cycle is, to some degree, synchronized with the business cycle. This synchronization would not be a critical problem, however, if and only if there were moderate loan adjustments. In the case where the bank credit cycle is a critical problem, the over-responses of bank credit compared to the business; during downturns, the excessive response of credit would result in further liquidity shortages, thus aggravating the pressing economic recession. However, other common measures such as the growth rate of credit or the credit to GDP ratio can show only partially the excessive response of credit to the business cycle. Hence, we defined the measure of sensitivity of credit growth ( $\Delta\text{loan}_{it,t-4}$ ) to the business cycle,  $\theta_{it}$ , as in Equation (2). This is a variation of the concept of elasticity.

$$Z_{it} \equiv \frac{\Delta\text{loan}_{it,t-4} - \overline{\Delta\text{loan}_{it,t-4}}}{\delta(\Delta\text{loan}_{it,t-4})}, \quad X_t \equiv \frac{\Delta\text{GDP}_{t,t-4} - \overline{\Delta\text{GDP}_{t,t-4}}}{\delta(\Delta\text{GDP}_{t,t-4})}, \quad (2)$$

$$\theta_{it} \equiv \frac{Z_{it}}{X_t}.$$

As with the previous measures for credit procyclicality, we applied the same concept to the regressors. We built another variable for the WSF deviation in the same manner as the numerator of the bank credit sensitivity measure. By dividing the fitted value ( $\widehat{W}_{it}$ ) of the WSF deviation by the GDP deviation ( $X_t$ ), we built the measure of the WSF sensitivity,  $\varepsilon_{it}$ .

$$\varepsilon_{it} \equiv \frac{\widehat{W}_{it}}{X_t}. \quad (3)$$

We then estimate the following single behavioral Equation (4).

$$\theta_{it} = c + \eta_i + \alpha\theta_{it-1} + \beta_1\widehat{WSF}_{it} + \beta_2\Delta\widehat{WSF}_{it,t-4} + \beta_3\varepsilon_{it} + \beta_4X_t + \sum_{k=1}^K \gamma_k Z_{it}^k + \zeta_{it}. \quad (4)$$

The coefficients  $\beta_1$  to  $\beta_3$  are the regression coefficients of the main variables, the fitted WSF ratio ( $\widehat{WSF}_{it}$ ), the fitted WSF growth rate ( $\Delta\widehat{WSF}_{it,t-4}$ ) and the WSF sensitivity, respectively.  $X_t$  is the GDP deviation from its time trend, as defined above, and  $Z_{it}$  are the other factors including loan to asset ratio, excess capital holding, and overnight interest rate, and  $\eta_i$  denotes an individual fixed effect, and finally,  $\zeta_{it}$  denotes idiosyncratic error term. The results are presented in Table 1 (all data and detailed econometric codes using E-views are all the time available on request).

As Table 1 clearly shows, the sensitivity of WSF has a significantly positive impact on the sensitivity of bank credit to the business cycle. This result generally holds regardless of the period covered in each of the sub-samples. In other words, if a bank is over (under)-funded in the WSF market in response to the real economy

growth (decline), then bank credit would be overly sensitive as well, and it would be a common aspect of bank lending.

**Table 1** Loan Sensitivity Results

Rolling	1	2	3	4	5	6	7	8	9	10	11
Intercept	16.98	38.53	1.39	-2.77	-24.76	0.06	16.10	-6.53	-3.53	-9.36	-6.07
	8.86	16.70	6.85	4.92	17.33	6.71	61.01	4.69	5.46	8.52	5.77
	1.92	2.31	0.20	-0.56	-1.43	0.01	0.26	-1.39	-0.65	-1.10	-1.05
Loan sensitivity(-1)	-0.04	-0.23	-0.14	0.04	-0.57	0.03	-0.08	0.17	0.01	0.02	-0.05
	0.08	0.07	0.09	0.09	0.12	0.07	0.07	0.06	0.06	0.06	0.04
	-0.56	-3.10	-1.63	0.45	-4.91	0.40	-1.09	2.67	0.22	0.29	-1.27
Fitted WSF growth rate	0.04	0.01	-0.01	0.00	-0.02	-0.02	0.11	0.00	-0.01	0.08	0.03
	0.02	0.04	0.02	0.02	0.04	0.02	0.16	0.01	0.01	0.04	0.03
	1.45	0.26	-0.92	-0.21	-0.58	-1.60	0.69	-0.38	-0.68	2.01	0.98
Fitted WSF ratio	-0.11	0.32	-0.04	-0.01	-0.11	0.08	-0.09	-0.13	-0.06	-0.26	-0.05
	0.10	0.18	0.08	0.05	0.20	0.07	0.70	0.05	0.09	0.13	0.09
	-1.06	1.79	-0.48	-0.13	-0.56	1.14	-0.13	-2.66	-0.67	-2.01	-0.61
Fitted WSF sensitivity	0.61	0.64	0.14	0.02	0.67	0.64	0.39	0.56	1.20	0.87	0.35
	0.13	0.11	0.10	0.14	0.10	0.08	0.05	0.11	0.11	0.07	0.09
	4.54	5.62	1.29	0.12	6.60	8.30	7.88	5.31	11.34	12.81	4.05
Loan to asset	-0.17	-0.24	0.07	0.06	0.24	0.00	-0.64	0.13	0.11	0.28	0.10
	0.07	0.14	0.07	0.06	0.25	0.11	0.91	0.05	0.08	0.12	0.07
	-2.41	-1.73	0.91	1.02	0.96	0.03	-0.70	2.39	1.40	2.24	1.37
Excess capital	0.03	0.61	0.08	-0.21	-1.33	0.54	1.00	-0.94	-0.43	0.12	0.23
	0.34	0.63	0.28	0.14	0.64	0.34	2.78	0.18	0.20	0.32	0.22
	0.10	0.97	0.28	-1.53	-2.07	1.56	0.36	-5.15	-2.13	0.37	1.05
Call rate	-0.99	-7.50	-1.39	-0.22	3.52	-0.77	6.03	1.00	-0.39	-0.39	0.28
	1.40	2.30	0.79	0.62	2.13	0.65	6.63	0.74	0.36	0.48	0.39
	-0.70	-3.26	-1.77	-0.36	1.65	-1.18	0.91	1.36	-1.09	-0.81	0.73
GDP deviation	-0.20	1.49	-0.69	0.28	0.39	-0.31	2.43	-1.10	0.48	-0.43	-0.42
	0.27	0.44	0.20	0.16	0.76	0.31	3.30	0.94	0.40	0.46	0.29
	-0.76	3.37	-3.51	1.77	0.52	-1.03	0.74	-1.17	1.18	-0.94	-1.46

**Notes:** The first row of each variable is for its coefficient, the second row is for its standard error, and the third row is for t-statistics. The shaded areas indicate the case of t-statistics exceeding 2 in the absolute value ( $p < 0.05$ ). Same marking rule applies hereafter.

**Source:** Authors' estimations.

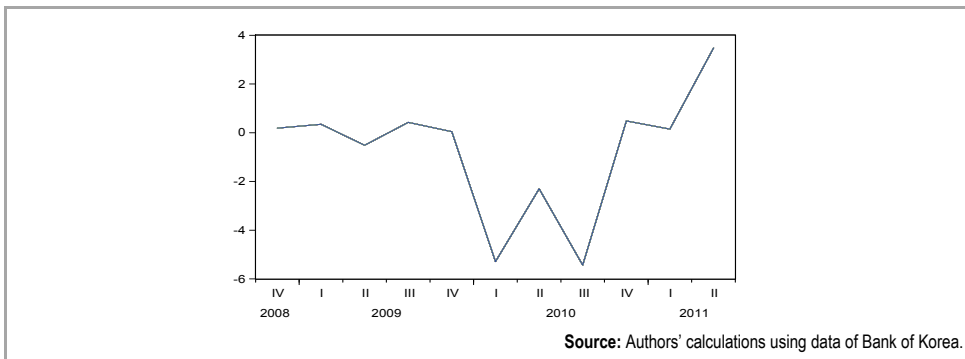
On the other hand, two other major variables, the WSF ratio and the WSF growth rate, seem to have little impact on the sensitivity of bank credit. There is no doubt that these variables may have explanatory power with respect to the loan volume. In our framework, however, procyclicality of bank credit is defined in relative terms as the fluctuation between the credit volume and the GDP. There is a chance that the volume and the growth rate variables of WSF contribute to the quantity of bank credit rather than to the relative dynamics. The result suggests that the oversensitive lending tendency may occur even when banks have relatively low shares of WSF, and in this respect, monitoring relative WSF sensitivity is of more importance.

We conjecture that it can be attributed to two factors linked to each other. One is the role of expectation about the future. Oversensitive borrowing is spurred by the expectation of higher future profits during a boom, which fosters financial fragility (Hyman Minsky 2008). In particular, Korea's higher financial openness with such "boom euphoria" allowed banks to borrow from WSF markets more easily and more frequently. The other factor is the specific regulatory environment in Korea. In the

aftermath of the Asian crisis in 1997-1998, the loan-deposit ratio has been supervised strongly and banks were mandated to follow the capital standards assigned by the Korea Financial Supervisory Service, whose criteria have often been higher than the Basel Committee guidance and standards. Therefore, under the long-time practices of the government-interventionist financial system, Korean banks have tried to find their way to make profits without increasing the share of WSF significantly. However, banks' oversensitive borrowing from the WSF market was somewhat outside the regulatory scope, which led to the excessive credit fluctuation and hence macroeconomic fragility.

Meanwhile, the results from the most recent sub-sample beginning in the 3rd quarter of 2008 are noteworthy. Although the direct effect of the intervention of the monetary authority was found to be insignificant at the second step, the overnight interest rate was estimated to have a significant positive effect on WSF deviation at the first step regression. It suggests the existence of an indirect channel of the monetary policy. That is, reducing the policy rate would reduce the WSF deviation and thus make WSF sensitivity less volatile. Hence, a monetary authority could have prevented the further economic downturn caused by the reduction in bank lending by reducing the overnight interest rate.

To add briefly to the third step, as noted in Section 4.1, it would be unreasonable to estimate and compare the macro level variables, which are identical at every panel entity, with the variables representing the individual specific characteristics of panel entities. Rather, we describe briefly the macroeconomic implication of oversensitivity of bank credit incurred by over-sensitivity to WSF. Figure 3 shows the normalized trend deviation of the GDP to the average loan deviation since the onset of the global financial crisis. Notably, the real economy has reacted sensitively to bank credit fluctuations, although it works indirectly in our study.



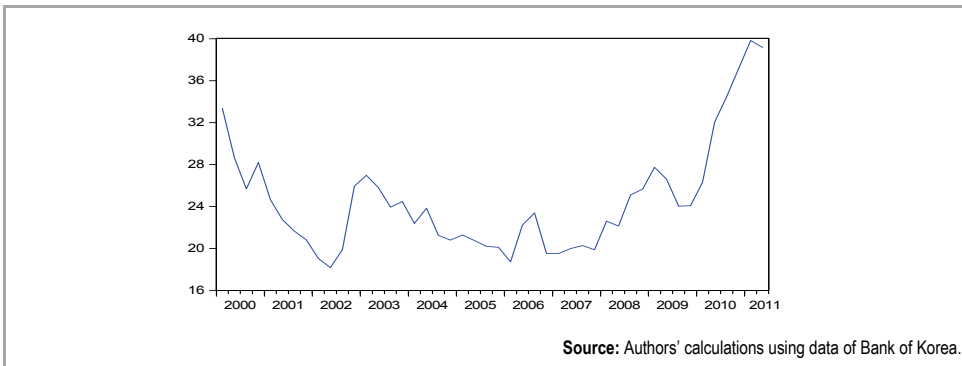
**Figure 3** GDP Deviation to Aggregate Loan Deviation

#### 4. Overseas Wholesale Funding

We found that WSF could affect the sensitivity of bank lending, and this, in turn, could result in further business cycle fluctuations. It is probable that whether the funds are from domestic or foreign creditors makes a difference with respect to their

impact and channel on credit procyclicality. Given that countries such as Korea have suffered from the volatile flows of foreign capital, analysis of overseas WSF's own impact could provide further macroeconomic implications.

The majority of foreign currency inflows and outflows are from institutional trade because domestic commercial banks are one of the major borrowers in this market. In Korea, overseas WSF, here defined as the sum of inter-bank foreign currency borrowings and foreign currency denominated financial bonds, has remained constant at its maximum, that is, slightly below 40% of the domestic currency denominated WSF as shown in Figure 4. While its absolute and relative volumes are still smaller than the domestic, it is noteworthy that the relative volume of overseas WSF has increased, although this increase partially reflects a dramatic decrease in domestic currency denominated WSF.



**Figure 4** WSF Volume Comparison (%), Foreign to Domestic (on Average among Banks)

We separated the total WSF into one denominated by domestic currency and one denominated by foreign currency. The estimation framework is identical to that in the previous section. The results displayed in Table 2 indicate that the impact of overseas WSF on bank lending is more marked compared to the previous results for total WSF in Table 1 and with only domestic currency denominated WSF (the latter result is available upon request). It meets our prior expectation that overseas WSF contributes more to fluctuations in bank credits than domestic WSF does.

How does the sensitivity of external wholesale liabilities to the business cycle cause bank credit procyclicality even though the volume of overseas WSF is relatively small? In Korea, the borrowing of foreign currency is much more significant than the issue of foreign currency denominated financial bonds, suggesting that the overseas WSF has not been a long-term stable funding source for Korean banks. The maturity structure of the Korean banking sector's WSF from overseas is concentrated with short-term maturity. Bank of Korea (2010) finds that, for Korean domestic banks as of the end of 2009, more than 50% of their total overseas funding have the maturity of less than 1 year.

This feature is due to the distorted industrial structure of Korea, the heavy reliance on large export firms, such as Chaebol conglomerates in the shipbuilding, automobile and semiconductor industries. As the Korean domestic currency is not

widely accepted, firms have no choice but to incur massive exchange rate risk. To hedge the exchange rate risk, however, the major export firms in the world market demand to be in a short position with respect to the foreign exchange market (FX) forwards contract, en masse. This demand has been matched in turn by the domestic banks' short-term foreign currency borrowings.

**Table 2** Result on the Loan Sensitivity (Overseas WSF)

Rolling	1	2	3	4	5	6	7	8	9	10	11
Intercept	3.79	36.85	1.66	-5.45	-14.86	-2.36	26.67	1.45	-4.05	-13.05	-4.11
	9.51	15.20	6.11	4.54	17.14	7.24	72.35	5.25	6.40	8.40	5.41
	0.40	2.42	0.27	-1.20	-0.87	-0.33	0.37	0.28	-0.63	-1.55	-0.76
Loan sensitivity(-1)	0.01	-0.22	-0.12	0.03	-0.55	0.13	-0.12	0.22	0.01	0.04	-0.01
	0.08	0.07	0.08	0.08	0.11	0.08	0.08	0.06	0.07	0.06	0.04
	0.13	-2.93	-1.49	0.39	-4.83	1.68	-1.46	3.40	0.10	0.69	-0.21
Fitted WSF growth rate	0.01	0.01	0.00	0.00	-0.01	0.02	-0.05	0.00	-0.05	-0.04	-0.02
	0.01	0.01	0.01	0.01	0.03	0.02	0.09	0.01	0.02	0.02	0.01
	1.07	1.21	0.39	-0.53	-0.41	1.24	-0.57	-0.10	-2.98	-1.68	-1.28
Fitted WSF ratio	0.01	-1.17	-0.53	-0.27	0.96	-0.42	0.90	-0.03	0.31	0.28	-0.29
	0.39	0.63	0.28	0.22	0.95	0.40	4.06	0.20	0.35	0.54	0.29
	0.03	-1.86	-1.85	-1.23	1.01	-1.05	0.22	-0.15	0.89	0.51	-0.99
Fitted WSF sensitivity	0.48	0.85	0.47	0.57	0.73	1.22	0.41	0.30	0.60	0.86	0.30
	0.10	0.15	0.09	0.19	0.10	0.19	0.17	0.12	0.07	0.07	0.14
	4.98	5.87	5.05	3.06	7.15	6.28	2.40	2.48	8.18	12.41	2.18
Loan to asset	-0.06	-0.08	0.06	0.07	0.15	0.04	-0.49	0.06	0.00	0.18	0.08
	0.08	0.15	0.07	0.06	0.25	0.12	1.07	0.06	0.09	0.13	0.08
	-0.78	-0.55	0.86	1.18	0.58	0.36	-0.46	1.07	0.04	1.37	1.03
Excess capital	0.01	-0.03	-0.10	-0.30	-1.55	0.23	0.73	-0.64	-0.10	-0.29	0.03
	0.34	0.62	0.31	0.14	0.66	0.37	3.41	0.19	0.22	0.34	0.22
	0.04	-0.05	-0.33	-2.14	-2.34	0.61	0.21	-3.40	-0.45	-0.87	0.13
Call rate	0.07	-6.66	-0.91	0.66	0.72	0.12	0.38	-0.91	0.92	0.31	0.14
	1.44	2.21	0.80	0.65	2.06	0.65	7.26	0.91	0.37	0.38	0.44
	0.05	-3.02	-1.14	1.02	0.35	0.19	0.05	-1.00	2.48	0.82	0.32
GDP deviation	-0.12	1.18	-0.53	0.27	0.54	-0.29	0.44	0.97	-0.64	-0.04	-0.37
	0.27	0.44	0.18	0.14	0.72	0.34	3.88	1.19	0.44	0.38	0.24
	-0.46	2.68	-3.00	1.93	0.75	-0.87	0.11	0.82	-1.47	-0.10	-1.53

Source: Authors' estimations.

Geunyoung Kim and Young-Kyung Suh (2009) shows that, in the case of domestic banks especially, the real economic variables, such as the value of shipbuilding orders, act as a determinant of currency mismatch. Under this kind of economic condition, external liabilities, materialized as so-called the inherent risk of currency and maturity mismatch, further influence the entire economy through the direct channel of exchange rate fluctuation in the FX market, as well as through the indirect channel of bank creditworthiness and insolvency. This kind of reliance on overseas WSF and its economic importance is enforced by Korea economy's structure. And these risks in turn, directly distort an entire economy.

In Korea, during the financial crisis of 2008, foreign creditors began to withdraw the money they had lent to Korean banks, not because of the weakened economic fundamental of Korea but because of their own funding problems. This inhe-

rent currency and maturity mismatch triggered a foreign liquidity squeeze on Korean banks, and it came close to erupting into a foreign exchange crisis similar to that of the late 1990s. Confronted with overseas funding squeeze and increased default risk, banks may respond by adjusting domestic credit, which shall lead to an extended credit procyclicality. Our result shows that this indirect channel through overseas WSF market has worked more tightly on domestic banks' credit creation.

In this respect, although the share of foreign currency denominated WSF of a bank's total liabilities is insignificant in absolute volume, its impact on the real economy should not be ignored. Overseas WSF leads to a more volatile loan cycle and then a more fragile macroeconomics. And this imbalance in the financial sector is deeply intertwined with the structural contradictions of Korea economy.

## 5. Conclusion

Credit procyclicality has recently received considerable attention, while the factors that fuel the often-excessive credit growth are rarely part of the discussions. We investigated the relationship between the composition of banks' liabilities and their credit procyclicality. In our empirical study on Korean banks, a higher sensitivity of banks' WSF to the business cycle is found to have contributed to the excessive procyclicality of bank credit, thus exacerbating macroeconomic fragility.

Our discussion has regulatory policy implications (see Phillip Anthony O'Hara 2011 for the policy issues emerging from the crisis). With respect to the countercyclical measures, WSF, through which banks are able to overextend their credit growth, is an important domain that must be monitored and regulated. The regulation of a bank's WSF mechanism would contribute to financial stability through a bank credit channel. In a similar vein, much stronger regulations or harsher levies on banks' WSF liabilities, such as the "Financial Stability Contribution" proposed by the International Monetary Fund in 2010 and the "Systemic Risk-adjusted Levy" that was partially launched in Germany, should be given more serious consideration. Additionally, as this study implies, the over-lending by banks can be the result of their over-sensitive borrowing even when they have relatively low shares of WSF, which highlights the need to monitor the qualitative aspects of the funding structures of banks, such as the maturity and frequency of borrowing as well as the quantity of bank liabilities, per se.

On the other hand, the more pronounced effect of overseas WSF suggests the need for further regulatory policies. These policies are particularly needed in export-driven emerging economies with an increasing openness toward cross-border financial markets where the banks' unfettered access to foreign currency denominated liabilities can be a fatal channel through which the credit cycle is unduly amplified and external shocks are easily transmitted. Furthermore, given that the banks' rising reliance on overseas WSF is primarily due to the excess demand for foreign currency that is intrinsic to export-led economies, macro-prudential regulation should aim to contain the unbridled movements of cross-border capitals in WSF markets while the reform of the industry structure, which is over-dependent on exports, should be carried out in parallel from a long-term point of view.

It has been proposed that commercial banks' traditional reliance on deposit funding would become more difficult to sustain and banks' WSF would become more important because of the sluggishness in overall income increases, the global decline in income shares of the working class, the innovations in financial instruments, and the continuous penetrations of non-depository financial institutions into the deposit markets. Therefore, clarifying the role and the effects of the banks' WSF on the macroeconomic dynamics would be a meaningful work.



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