



Impacts of Cross-border Capital Flow on China's Commercial Banks' Soundness Based on GMM of Dynamic Panel System

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Abstract. The paper measured the soundness of Chinese commercial banks based on data from 2006Q1 to 2016Q3 through building index system, and built the economic model by utilizing GMM system to demonstrate the impact and mechanism of cross-border capital flows on banks' soundness. The results show that the banking soundness increases gradually from 2006 to 2010, and remains stable after 2012. We find that the rise of overall cross-border capital net flow significantly decreases the degree of commercial banks' soundness. Both portfolio investment and other investment could impair banks' soundness, but the net flow of direct investment exerts significantly a positive effect on banks' soundness.

Keywords: Cross-border capital flows, Bank soundness, Commercial bank, GMM system, Panel study

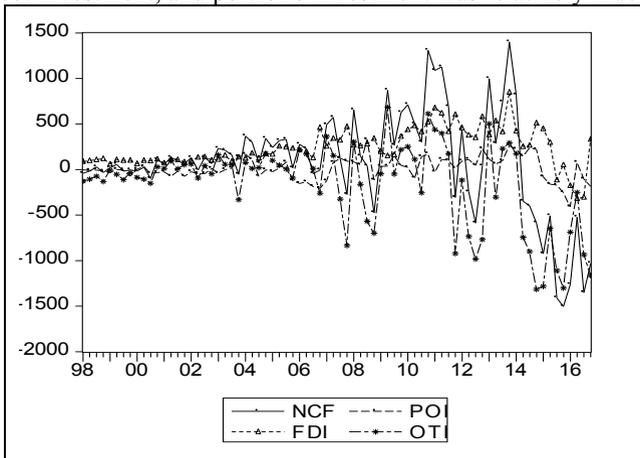
1 Introduction

Cross-border capital flows are one indicator of international financial integration or financial globalization. The theoretical explanation for financial globalization is well known. It allows capital to flow from capital-rich to capital-poor economies, where returns should be more attractive. These flows complement limited domestic saving in capital-poor countries and reduce their cost of capital, boosting investment and growth. Financial globalization may also be a buffer against shocks and carry positive externality to do with managerial and organizational expertise, or better governance of local firms. Some allowance for a slower pace of financial integration was sometimes made for developing or emerging economies, citing their weaker institutions and more limited capacity to absorb and benefit fully from the inflows of capital, but the ideal of full capital account convertibility should still serve as the golden rule that emerging economy policymakers should navigate by, even if they steer close to land initially so as to avoid the perils of the open ocean that only advanced economy ships can navigate safely.

However, the subprime crisis in the US and capital flow reversals and the banking crisis in Europe, have shaken faith that even developed economies can harness the

benefits of greater financial flows and deepening without incurring costs [1]. The advanced-countries that have been swept up first by the subprime crisis and now by the Eurozone crisis are not the stereotypical emerging economies with weak institutions. Spain, for example, ranks high on traditional yardsticks of financial development such as the ratio of commercial bank assets to GDP, or of financial integration such as cross-border liabilities as a proportion of GDP. And yet, those same measures of financial integration and development that were held up as yardsticks of progress have turned out instead to be the engines of financial distress as capital flow reversals have gathered pace in Europe. In contrast, it has been the emerging economies with what were presumed to have ‘weak’ institutions and underdeveloped financial markets that have best weathered the storm.

Since 2000, cross-border capital flows play an important role in providing financing for emerging market economies (EMEs). They facilitate investment and help to foster economic development. However, they also leave countries vulnerable to external pressures, for example changes in risk sentiment lead to capital outflows. Substantial macroeconomic research establishes a positive relationship between cross-border capital inflows, lending booms and the incidence of financial crises [2]–[4]. In 2016, China’s non-reserve financial account deficit was US\$417 billion, of which the direct investment deficit was US\$466, the securities investment deficit was US\$62.2 billion, and the other investment deficit was US\$303.5 billion. Figure 1 shows that the scale and volatility of cross-border capital flows from 1998 to 2016 have been changing sharply, especially after 2006. Other investment flows have become extremely volatile, followed by direct investment, and portfolio investment was relatively much more stable.



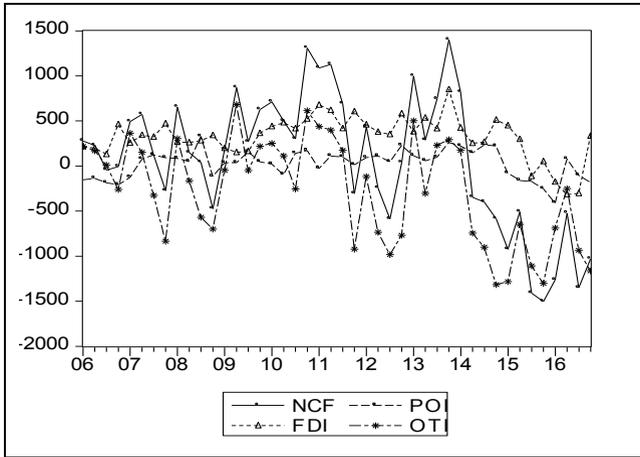


Fig. 1. Comparison of China's cross-border capital flows between two periods (1998-2016/2006-2016) (Unit: billion U.S. dollars)¹

Figure 2 shows the NPL's (non-performing loan) ratios of China's commercial banks during the period 2006-2016. After the financial regulatory reform, the NPL ratio of Chinese commercial banks has gradually declined. However, since 2014, the NPL ratios of various commercial banks have risen again. Among them, the NPL of rural commercial banks was more severe than the others. It can be seen from Figure 1 and Figure 2 that in recent years, there has been a significant increase in short-term cross-border capital flow volatility and an increase in the non-performing loan rate. Although Chinese banking industry currently did not meet the huge problem caused by sudden cessation or shortage of capital inflows, the pressure from the sharp decline in foreign exchange reserves and the appreciation of the RMB exchange rate has already appeared. These potential financial risks will directly affect the soundness of banking sector and whole financial system.

¹ Source: IMF-IFS database and SAFE

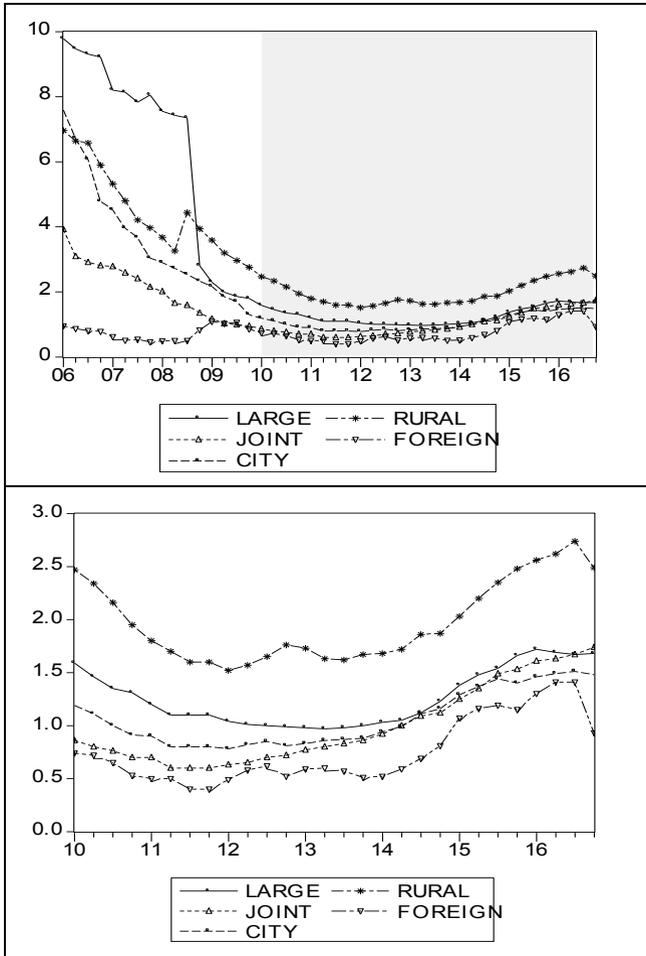


Fig. 2. Comparison of the NPL's ratios (%) of Chinese commercial banks between two periods (2006-2016/2010-2016)

Our paper aims to study the fluctuation of cross-border capital flow during 2006-2016 in China and the impact to the soundness of Chinese banking sector. The NPL's ratio in Figure 2 can only reflect one aspect of the financial soundness of commercial banks, and cannot fully explain its degree of soundness. Therefore, our paper investigates the influence and mechanism of cross-border capital flows on banks' soundness at first and then measures the soundness of commercial banks in China based on data from 2006 to 2016. Secondly, we distinguish different kinds of capital flows to study which one affect more banks' soundness in China.

2 Literature review

Before the Financial Crisis of 2008, most of the studies on the soundness of commercial banks are carried out from the operating performance of commercial banks. For example, Diamond and Dybvig developed a model which shows that bank deposit contracts can provide allocations superior to those of exchange markets, offering an explanation of how banks subject to runs can attract deposits [5]. Carl Johan Lindgren et al. investigated the linkages between macroeconomic policy and bank soundness. From a global viewpoint, they studied the major causes and consequences of banking sector problems and discussed how the banking system can be strengthened, nationally and internationally [6]. After all, the conventional view is that a modern market economy is fundamentally stable, in the sense that it is constantly equilibrium-seeking and sustaining, and that some exogenous shock is necessary for some crisis to occur. However, after the Financial Crisis of 2008, the main purpose of the conventional economic theory has been challenged by the Financial Instability Hypothesis (FIH) of Minsky [7]. Essentially, Minsky argues that stability is destabilizing, and that the internal dynamics of a system can be solely responsible for market failures [8]. The FIH maintains that the level of profits determines system behavior, as aggregate demand determines profit, and so aggregate profits equal aggregate investment plus the government deficit. To Minsky, banks act as profit-making institutions, with an incentive to increase lending, which undermines the stability of the economy. Debt plays a crucial role in determining system behavior, and so Minsky analyses three distinct income-debt relations for economic units [9].

Historically, cross-border capital flows mainly reflected transactions of goods or services with other countries. Over time, however, the financial aspect of capital flows has taken on a massively bigger significance. Capital flows have increased much faster than world GDP over the last decades. This dramatic rise coincided with the liberalization of global capital markets and corresponds to the exponential rise of new financial instruments serving risk management or speculation purposes. With the beginning of the global financial crisis in 2007-08, the rise of the global financial market collapsed and financial integration in the whole world still hasn't recovered from the damage inflicted by the global financial and the euro debt crises.

In fact, over the last two decades, and especially since the recent global economic and financial crisis, the International Monetary Fund has increasingly asserted its role in the emerging framework for international financial regulation. Banking sector around the world maintains excess regulatory capital, whether to minimize capitalization costs or to mitigate risks of financial difficulties. Cross-border capital flows are the connective tissue of the international financial system and, in recent decades, they have become an enormous part of the global economy. The expansion of cross-border capital flows has coincided with the liberalization of domestic rules in advanced economies and many emerging economies, often pursuant to international agreements regarding foreign investment. However, these financial crisis in developed countries dramatically illustrated, however, that there are costs and potential risks associated with the increasing volume of capital flows. In the case of developing countries, many studies showed that heavy capital inflows can fuel asset value bubbles and exchange rate appreciation,

overwhelm regulatory and supervisory capacity, and make an economy vulnerable to capital flow reversals. Capital outflows can create downward pressure on asset values and the exchange rate and can deplete foreign reserves [10]–[12]. Sula and Willett investigated whether some types of capital flows are more likely to reverse than others during currency crises and confirmed that direct investment is the most stable category, but find that contrary to much popular analysis, private loans on average are as reversible as portfolio flows [13]. Park et al. found that capital flows during quantitative easing (QE) and the symptoms of those capital flows such as high inflation, credit expansion, and the deterioration of the current-account balance accounted for much of the destabilizing effect of a QE taper tantrum. Sula revealed that a surge in capital inflows significantly increases the probability of a sudden stop and a surge accompanied by a high current account deficit or an appreciated real exchange rate is more likely to be associated with a sudden stop [14]. Cyganczuk et al analyzed the capital structure of the 10 biggest Brazilian banks in terms of total assets, comparing their current structures - with only subordinated debts - with the structure proposed in Basel III, composed solely of contingent convertibles [15].

All these studies concluded that the volatility of cross-border capital could increase the instability of the banking system and the probability of financial crisis. In addition, they showed that different types of cross-border capital flows (direct investment, securities investment, other investments) have different effects on bank soundness or financial stability, but few studies analyzed their impact to different types of commercial banks in China. Therefore, our paper focuses on this point to supplement related research in this area.

3 Measuring soundness of Commercial Banks

Our paper aims to construct and calculate the Bank Soundness Index (BSI) of different types of commercial banks to measure their financial soundness. Bank soundness is a concept commonly used to denote, for example, an ability to withstand adverse events. Nevertheless, its usage is typically imprecise and gives rise to questions regarding its definition, measurement, and prediction. A sound banking system may be defined as one in which most banks (those accounting for most of the system's assets and liabilities) are solvent and are likely to remain so. Solvency is reflected in the positive net worth of a bank, as measured by the difference between the assets and liabilities (excluding capital and reserves) in its balance sheet [6]. Using current solvency as a proxy for the soundness of a banking system abstracts from important measurement and projection issues.

Table 1. Financial Soundness Index of Depository Institutions

Financial Soundness Indicators of Depository Institutions	Core-indicator
Capital adequacy	Regulatory capital/risk-weighted assets

Asset quality	Regulatory Tier 1 capital/risk-weighted assets
Earnings	(NPL-reserves)/capital, NPL/total loans, etc.
Liquidity	ROA, ROE, income from spreads/total income
Sensitivity to market risk	Non-interest expenses/total income

The bank's own risk resistance ability can be measured by synthesizing the above indicators of the bank to construct a soundness index. This method is applicable to any country due to the unified indicators. Generally, the formula for constructing a bank soundness index (BSI) is as follows:

$$BSI_{it} = \frac{1}{k} \sum_{j=1}^k \left(\frac{x_{j,it} - u_{j,it}}{\sigma_{j,it}} \right) \quad i = 1, 2, \dots, n \quad (1)$$

$$t = 1, 2, \dots, T$$

BSI_{it} represents the soundness index of the i^{th} commercial bank or the i^{th} type of commercial bank in period t ; $x_{j,it}$ represents the specific value (or reciprocal) of the j^{th} core

index of the i^{th} commercial bank or the i^{th} type of commercial bank in period t ; $u_{j,it}$ represents the average value of the j^{th} core indicator (or inverse) of the i^{th} commercial

bank or the i^{th} type of commercial bank during the sample period; $\sigma_{j,it}$ represents the standard deviation of the j^{th} core indicator (or inverse) of the i^{th} commercial bank or the i^{th} type of commercial bank during the sample period. In order to estimate the soundness of commercial banks, some indicators are positive indicators that increase soundness (such as capital adequacy ratio and liquidity), and some are negative indicators that

weaken soundness (such as non-performing asset ratio). Therefore, if $x_{j,it}$, $u_{j,it}$, $\sigma_{j,it}$ correspond to a negative indicator, then we use their reciprocal value or the mean and standard deviation of the reciprocal value. The final result calculated according to the above formula will fluctuate around 0. If it is greater than 0, the bank's soundness is higher than the average level, and vice versa. Then we choose two most important core indicators for measuring of BSI. While capital adequacy ratio is chosen as the representative positive indicator, the negative indicator is non-performing loan ratio for measuring capital quality so as to estimate the soundness of commercial banks in China from 2006 to 2016.

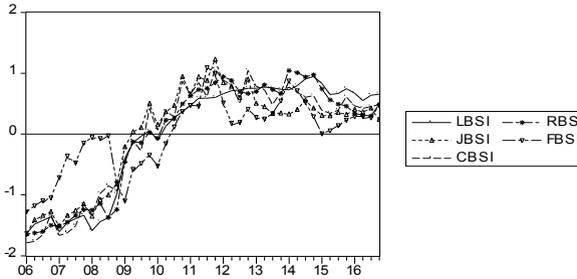


Fig. 3. The BSI of China's commercial banks by types² from 2006Q1 to 2016Q3

The results in Figure 3 show that the evolution of BSI in different types of commercial banks are quite consistent. Because of the impact of the US subprime crisis on some domestic foreign trade companies, the overall BSI for commercial banks were lower than the average level before 2010. The debt solvency of these banks was badly affected by the increase of their non-performing loan ratio, and the capital adequacy ratio continually decreased in the following years, so the soundness index was lower than the average level. By the end of 2010, all Chinese commercial banks' capital adequacy ratios were higher than 8% and their non-performing loans declined. Since 2014, however, BSI has declined again with an increase of NPL ratio. Local large commercial banks' soundness has experienced smaller fluctuation than the small and medium-sized banks. Meanwhile, foreign banks have been also suffering from the Financial Crisis in 2007-08 with the lower BSI. During the same period, the soundness of rural commercial banks was lower than that of large commercial banks and joint-stock commercial banks, and their ability to resist risks was much weaker than other types of commercial banks. This is related to factors such as their own asset scale and business operations.

4 Econometric Analysis

4.1 The Empirical Model

In order to effectively analyze the relationship between cross-border capital flows and the soundness of commercial banks, this paper selects dynamic panel data. Because the random error term may have heteroscedasticity or autocorrelation, we use the generalized moment estimation method (GMM) to examine the lag effect of the explained variable on itself, thereby reducing the bias and obtaining a consistent estimator. Based on the model of Sula [13], this paper constructs a model to test the influence of cross-border capital flow and its decomposition factors on the soundness of China's commercial banks as follows:

² LBSI, JBSI, CBSI, RBSI, FBSI respectively represent the bank soundness index (BSI) for large commercial banks, joint-stock commercial banks, urban commercial banks, rural commercial banks, and foreign banks.

$$BSI_{it} = \alpha_i + \beta \left(\frac{flow}{GDP}\right)_{i,t-1} + \gamma X_{i,t-1} + \varepsilon_{i,t-1} \tag{2}$$

$\left(\frac{flow}{GDP}\right)_{it}$ is the independent variable. In specific analysis, it can be the normalized value of the proportion of cross-border net capital flows to GDP, or it can be the normalized value of the proportion of direct investment, securities investment, and other investment net flows to GDP. $X_{it} = \{asset_{it}, GGDP_{it}, GM2_{it}, CPI_{it}, REER_{it}\}$ are the selected control variables. All explanatory variables use data with one period lagging behind to avoid endogeneity problems.

4.2 Data and Summary Statistics

The data mainly comes from the WIND database, and some commercial bank data are obtained from the annual reports published by China Banking Regulatory Commission and the State Administration of Foreign Exchange. The sample time span is from the 2006Q1 to the 2016Q4. The types of commercial banks refer to large commercial banks, joint-stock commercial banks, urban commercial banks, rural commercial banks, and foreign banks. The dependent variable is BSI for various types of commercial banks. The independent variable is the net cross-border capital flow. Meanwhile, we distinguished three major types of cross-border capital flows: direct investment flows, portfolio investment flows, and other investment flows. The data comes from the Balance of Payments Statement of the State Administration of Foreign Exchange (SAFE). In addition, some other major factors affecting the soundness of commercial banks are also considered as control variables, such as bank asset size, economic growth rate, M2 year-on-year growth rate, inflation rate, and real effective exchange rate index.

4.3 Results

1) Descriptive statistics.

Table 2. Commercial banks' NPL ratio, capital adequacy (CA) ratio and BSI

	Mean	S.D	Max	Min	Obs
NPL ratio (%)					
Large commercial bank	3.15	3.12	0.97	9.78	44
Joint-stock commercial bank	1.40	0.80	0.60	3.92	44
Urban Commercial Bank	1.99	1.67	0.78	7.59	44
Rural commercial bank	2.90	1.51	1.52	6.96	44
Foreign bank	0.75	0.28	0.40	1.41	44
CA (%)					
Large commercial bank	11.95	1.69	14.50	9.00	44

Joint-stock commercial bank	10.26	1.04	11.95	8.50	44
Urban Commercial Bank	11.10	1.11	12.59	9.00	44
Rural commercial bank	11.08	2.20	13.81	7.60	44
Foreign bank	14.62	2.57	19.45	11.00	44
BSI					
Large commercial bank	0.0752	0.9448	0.9444	-1.6341	44
Joint-stock commercial bank	0.0582	0.8617	1.2236	-1.6375	44
Urban Commercial Bank	0.0724	0.9526	1.0685	-1.7867	44
Rural commercial bank	0.0790	0.9374	1.0442	-1.6478	44
Foreign bank	0.1056	0.6183	1.6014	-1.2770	44

Table 3. Descriptive statistics of different types of cross-border capital flows (Unit: 1 billion U.S. dollars)

	Mean	S.D	Max	Min
Cross-border capital flows	7.148	74.223	140.20	-150.40
Direct investment	32.259	23.58	84.90	-31.80
Portfolio investment	2.455	15.754	32.90	-40.90
Other investment	-27.405	58.001	68.30	-131.60

From 2006 to 2016, direct investment flows were the most stable and least volatile among all types of cross-border capital, while securities investment is less stable than other investments, and other investments fluctuate sharply (see Table 3).

2) The relationship between cross-border capital flow and the soundness of commercial banks.

Table 4 shows the cross-border capital inflow is negatively correlated with BSI during the period from the first quarter of 2006 to the fourth quarter of 2016. The coefficient of the relationship between two variables was negative and significant. Table 5 shows the relationship between the BSI in various types of banks and cross-border capital flows. Although there are differences in the coefficients of different types of banks, these differences are not very large. Figure 3 shows that foreign commercial banks are stable. It is also affected the most by cross-border capital flows (the largest coefficient). This is because foreign banks play an important role in the international settlement, which are quite different from rural commercial banks and urban commercial banks. The gap with large commercial banks and joint-stock banks is relatively small. On the whole, the types of commercial banks have an impact on the soundness of banks, but their impacts are not significantly different from each other.

Table 4. The relationship between BSI and cross-border capital flows

	(1)	(2)	(3)	(4)	(5)	(6)
$L \frac{cFlow}{GDP}$	-0.026*** (4.467)	-0.039*** (-4.684)	-0.013** (-2.560)	0.039*** (-4.424)	-0.019** (-2.85)	-0.017** (-1.144)
Lnasset		0.107 (0.708)	0.049 (0.418)	0.101 (0.704)	0.117 (0.817)	0.112 (0.797)
LGGDP			0.259* (2.157)	0.382* (2.367)	1.133** (3.264)	0.449* (2.492)
LGM2				-0.030 (-0.414)	-0.103 (-1.270)	-0.097 (-1.130)
LCPI					-0.368 (-1.685)	-0.382 (-1.703)
LREER						-0.006 (-0.345)
AR(1)	0.586*** (5.415)	0.693*** (6.689)	0.631*** (5.982)	0.669*** (5.833)	0.673*** (6.313)	0.666*** (6.123)
c	-0.242 (-0.2671)	-1.441 (-0.775)	-1.249 (-0.681)	-2.249 (-0.681)	-1.285 (-0.389)	-0.273 (-0.062)
R^2	0.841	0.853	0.861	0.868	0.872	0.883
F-statistic	146.37	138.27	128.74	127.78	126.73	122.23

Note: *, **, *** indicate significance levels of 10%, 5%, and 1%, respectively.

Table 5. The relationship between cross-border capital flows and BIS for different types of commercial banks

	Large commercial bank	Joint-stock commercial bank	Urban commercial bank	Rural commercial bank	Foreign bank
$L \frac{cFlow}{GDP}$	Joint-stock commercial bank	-0.029*** (-3.684)	-0.017** (-2.543)	-0.015*** (-2.424)	-0.039** (-3.858)
Lnasset	Urban Commercial Bank	0.311 (0.897)	0.278 (0.788)	0.301 (0.851)	0.259 (0.753)
LGGDP	Rural commercial bank	0.449** (2.921)	0.549*** (3.503)	0.349** (3.213)	0.249** (2.292)
LGM2	Foreign bank	-0.297** (-3.130)	-0.322*** (-4.112)	-0.495*** (-4.130)	-0.191 (-1.131)
LCPI	-0.285* (-1.903)	-0.382 (-2.703)	-0.357 (-2.584)	-0.233 (-1.707)	-0.411* (-2.001)
LREER	-0.021 (-0.448)	-0.016 (-0.442)	-0.206 (-0.845)	-0.122 (-0.521)	-0.132 (-0.447)
AR(1)	0.314* (2.123)	0.456*** (5.123)	0.513*** (5.431)	0.289* (2.149)	0.255* (2.121)
c	-0.168 (-0.091)	-0.255 (-1.001)	-0.279 (-1.162)	-0.311 (-1.345)	-0.315 (-1.367)
R^2	0.851	0.872	0.816	0.827	0.844
F-statistic	123.42	132.31	112.23	122.31	131.16

3) The relationship between different types of cross-border capital flows and the BSI of commercial banks.

In order to further examine whether the changes of different types of cross-border capital have different effects on the BSI of commercial banks, the regression analysis of how the fluctuations of different types of cross-border capital flows affect the BSI (see Table 6). During this period, FDI has affected positively on the BSI of commercial banks while portfolio investment and other investment had a negative effect. The result is in line with theoretical expectations. Direct investment is an investment activity undertaken by investors to obtain permanent management power (more than 10% ownership) of a company. Obtaining permanent rights means that there is a long-term relationship between the direct investor and the enterprise. This type of investment is a cross-border capital investment with less volatility. Generally speaking, if the macroeconomic situation of the capital receiving country is good, it will not fluctuate sharply. Although China's direct investment has a deficit in 2016, the results show that direct investment has still a positive effect on BSI. Portfolio investment refers to the inflow of equity securities, including shares, stocks, deposit receipts, and stocks directly purchased by foreign investors in the local stock market. Although this part of the investment accounts for a relatively small proportion in China, its liquidity is directly related to the degree of capital account openness in the receiving country. As China's capital account opens up, its liquidity volatility also increases. But so far, it represented still the smallest part among the three investments. In 2016, as the global risk aversion sentiment fluctuated greatly, capital outflows appeared in emerging market countries including China. Both the net outflow and net inflow of China's foreign portfolio investment increased, but the outflow rate became higher. During the same period, its volatility has a certain negative effect on the BSI. Other investments include deposits and loans, bank capital, trade credit and other projects. China's commercial banking institutions occupy a major position in the financial market. Borrowing and capital in foreign trade settlement, etc. are all through commercial bank channels, so it is greatly affected by the international and domestic external macroeconomic environment. The fluctuations in the international financial market and the changes in the economic fundamentals of the capital-receiving countries will make the investment fluctuate sharply, and other investments It accounts for a larger proportion than securities investment, and has a greater impact on the soundness of banks, and is significant at the 5% level of significance. The impact of different types of cross-border capital flows on different types of commercial banks is not significantly different (see Table 4).

Table 6. The relationship between BSI and different types of cross-border capital flows

	Direct Investment	Portfolio investment	Other investment
$L \frac{Flow}{GDP}$	0.024* (1.573)	-0.011* (-1.542)	-0.038** (-3.851)
Llnasset	0.254 (0.678)	0.279 (0.727)	0.313 (0.955)
LGGDP	0.533* (2.176)	0.648* (2.592)	0.719** (3.273)

LGM2	-0.251* (-1.031)	-0.364** (-2.130)	-0.411** (-3.120)
LCPI	-0.317** (-2.903)	-0.389** (-3.103)	-0.352** (-3.001)
LREER	-0.032 (-0.488)	-0.014 (-0.413)	-0.016 (-0.443)
AR(1)	0.614*** (4.127)	0.532*** (4.123)	0.367*** (3.431)
c	-0.145 (-0.362)	-0.168 (-0.567)	-0.229 (-0.864)
R^2	0.782	0.809	0.832
F-statistic	145.46	137.35	129.29

5 Conclusion

This study constructs Banking Soundness Index (BSI) to evaluate the soundness of China's commercial banks. In doing so, we use GMM to measure the impact of the macroeconomic and financial variables on the soundness of the banks based on data from 2006Q1 to 2016Q3. The results show that the banking soundness increases gradually from 2006 to 2010, and remains stable after 2012. The rise of overall cross-border capital net flow significantly decreases the degree of commercial banks' soundness. Among all kinds of capital flows, both portfolio investment and other investment could impair banks' soundness, but the net flow of direct investment exerts significantly a positive effect on banks' soundness.

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