An Empirical Study Regards the Bank Level Systemic Risk and Wealth Management Products in China

by

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Abstraction

This paper studies the relation between the WMPs activities and the bank level systemic risk in China. Due to the motivation of regulatory arbitrage, Chinese banks have conducted shadow banking business, represented by issuing WMPs. Through panel regression, this paper has following findings: (1) Both WMPs issuance and mature contribute to the systemic risk of the issuing banks. Particularly, the effect will be enhanced when the issuing banks have a poor loan quality and strict lending restriction; (2) For small and medium size banks, the issuance of WMPs will lead to more rapid increase in its systemic risk, while for larger banks, such effect is not as significant. Besides, the concentrated WMPs mature schedule will speed up the increase of the systemic risk, especially when the market liquidity is expensive; (3) For small and medium size banks, WMPs issuance also contribute to the systemic risk increments through the decreasing of equity value. Similarly, the concentrated WMPs mature schedule will also drop the equity value when the market liquidity is expensive, which also contribute to the increase of systemic risk; (4) when the market liquidity is expensive, the concentrated WMPs mature schedule will increase the volatility of the issuing bank's stock price, which lead to a increase in its systemic risk. Overall, the WMPs issued by the commercial banks generate significant risk exposure for the issuing banks. Hence, more close monitoring system and strict regulations should be introduced to keep the stability of the banking and financial system. Meanwhile, the banking reformation and interest rate liberalization are still the key to reduce the incentive to conduct regulatory arbitrage in China.

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Contents

I. Introduction

Since 2008 financial crisis, more and more attention has been put on the systemic risk brought by the shadow banking sector, especially the shadow banking activities which involve the commercial banks. Many researchers have studied the economic behavior of this new credit intermediation, however, only a few researches have been focused on the emerging shadow banking sector in China. Since China is the world's second-largest economy, it is very important to understand the risk embedded in its financial system. This paper will study one of the most important shadows banking activities in China, which is the bank issued Wealth Management Products (WMPs). This paper uses SRISK, developed by Volatility Institution, as the bank level systemic risk measure. Through panel regression, this paper will analysis the effect of the WMPs issuance and mature on the bank level systemic risk change and what exactly are the causes of the systemic risk increments.

II. Literature Review and Background

1. Wealth Management Products

With the most recent reference to the definition given by Financial Stability Board (FSB) in Global Shadow Banking Monitoring Report 2015, Shadow banking can be described as any credit intermediation involving entities and activities fully or partially outside the regular banking system (FSB 1). According to the narrow estimation[1] by the FSB, the total assets size of the global shadow banking sector has reached $36 trillion in 2014, which is equivalent

[1] The narrow measure is based on the method that classified shadow banking activity and entities by "economic function" and calculate the risk raised by each function. More specifically, there are five economic functions, management of collective investment vehicles, loan provision, intermediation of market activity, facilitation of credit creation, securitization-based credit intermediation.

to 59% of global GDP(FSB 2). While shadow banking sector has become a main component of the global financial system, it has also brought tremendous challenges for the regulators. Due to its complexity and obsceneness by nature, it is very hard to monitor the risk exposure of the shadow banking activity, and it will be more challenge to implement effective risk control in time. In order to better measure and control the risk of the shadow banking sector, started in 2013, FSB has established Policy Framework and shadow banking information-sharing exercise. These new frameworks aimed at building a more transparent database for researchers and policymaker to study the related the topics like the economic influence and economic behavior of the shadow banking sector. However, by now, most advanced research related to shadow banking has been focused on the developed markets, while most studies in China are still focusing on the structure of the shadow banking sector. Actually, the shadow banking sector in the emerging markets, especially in China, has undergone rapid development throughout the years. According to the FSB measure, in 2014, shadow banking sector in China has the second highest annual growth rate in the world, nearly 40%, and China has also contributed most to the growth of global shadow banking assets. Though the shadow banking in the developing market is much more straightforward compared to the developed market, it is still worthwhile to study because it carries many unique features and behavior. Besides, being a major player in the global financial market, China has the responsibility to keep its financial system stable. Therefore, understand the potential risks regards the new credit intermediation is of great moment for Chinese regulator.

Before studying China's shadow banking, it is important to understand the nature of it. Described by many research, the shadow banking in China is oriented from “regulatory arbitrage”. In other words, the emerge of the shadow banking sector in China was either caused or catalyzed by the banking regulations. With decades of rapid economic growth and the opening of the financial market, the demand for lending has reached an all-time high. However, due to the cautiousness of Chinese regulator, the regulated banks has been imposed with strict leading regulations. For instance, the ceiling of the loan-to-deposited ratio (LDR) for Chinese bank is 75%, while most U.S. banks have an LDR for more than 90%. Besides, People's Bank of China (PBOC) used to pose strict control on the leading interest rate. With the LDR and interest rate constraints, the commercial banks in China are not willing to lend credit to the private enterprise due to the high risk and low return. This creates an incentive for the emerge of non-bank credit intermediation. And since China has a bank centered economic system, Chinese banks are still highly involved in the non-bank credit intermediation. In order to circumvent the banking regulation, the shadow banking activities in the regulated banks usually are conducted through unconsolidated liabilities. Through issuing non-guaranteed products, commercial banks collect funds from the public. Then due to the regulations, commercial banks cannot invest the funds on their behalf, hence the commercial banks usually lend these fund to the third party like trust companies. The third party then re-lend the money to the companies or invested in specific project. Such business model is very successful because it meets the needs for all parties. On the banks' side, conducting off-balance sheet lending can greatly increase its profitability, while the such

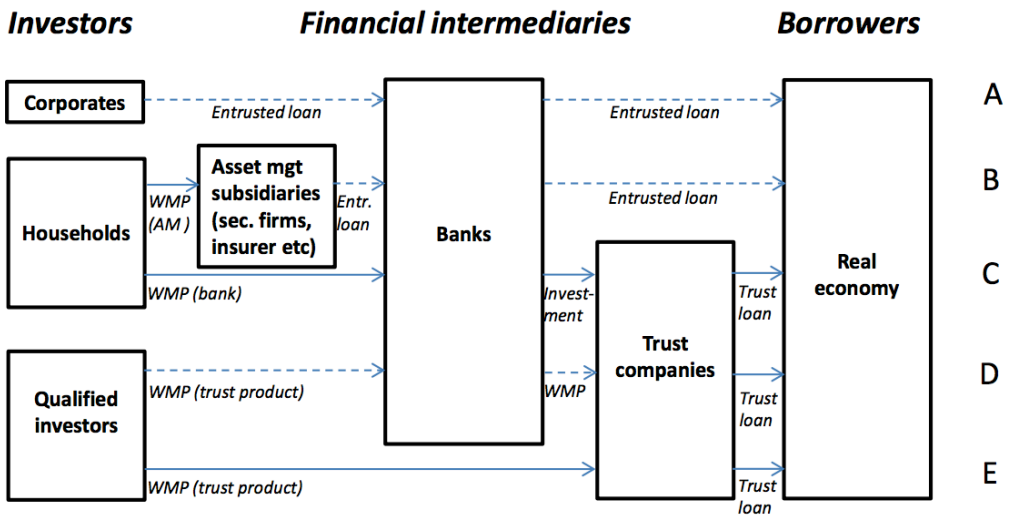
lending could circumvent the formal lending process so that they no longer need to be bothered by the interest rate control from the PBOC. On the borrower's, because of the cautiousness of the commercial banks, it is very hard for non-state owned enterprises to borrow money through formal lending process. Therefore, they are willing to pay a higher price to borrow from non-bank credit intermediation in order to fund their business. On the investors' side, the shadow banking products usually enjoys a higher return compared to the banks' deposit rate. Also, investor in China perceive the WMPs issued by commercial banks to be as safe as the bank deposit because they believe all banks are supported by the central government. Hence, investors in China are also willing to purchase such products. Therefore, the high demands from the banks, borrowers, and investor give rise to this new forms of credit intermediation, "shadow banking insides the regulated banks".

Due to the huge market demand, the market size of WMPs has grown very fast. Especially since 2010, with the attempt to sustain the high economic growth rate, Chinese government loose regulations on the non-bank credit lending activities. According to Wei Jiang's paper, the Future of Shadow Banking in China, in 2014, China's shadow banking asset to GDP ratio has reached 65% and among these, almost two-thirds of shadow banking in China is characterized as bank loans in disguise (Jiang 5). In her paper, Jiang said the total size of WMPs balance has reached RMB 15 trillion, which is 25% of Chinese GDP and 13.2% of bank's deposit. However, what is the risk of WMPs? Will the issuing banks suffer from the close interconnection with the shadow banking sector? If yes, then what exactly is attributor of the risk exposures of the regulated banks? Investigating these questions is critical because

China’s economic structure is highly depend on its banking system. If the banking system go down, it will for sure damage the whole economy in China, and even leads to another global financial crisis.

Fortunately, started from 2013, the rapid growth of the shadow banking sector has prompted the Chinese regulator to put more pressure on the information disclosure, also regulator's effort in the data collection regards shadow banking sector made more detailed quantitative study available. In 2015, under the information sharing system, FSB published a peer review report of China. In the third part of that report, FSB specifically focused on the non-bank credit intermediation in China. This report could serve as a great guidebook to understand the structure of shadow banking sector in China. Said in the report, "One distinguishing characteristic of non-bank credit intermediation in China is that the banking sector is closely involved in several aspects of the intermediation chain" (FSB 30). Based on the data provided by PBOC, the non-bank credit loan has taken up around 20% of total social financing over the period 2012-2014 (FSB 28). And if we look deeper into the non-bank credit loan, it is not hard to find that WMPs play a critical role in it. Among five credit intermediation chains described by FSB, four of them have WMPs serve as the way to collect funds from the public. (See Figure 1) Therefore, the scale of WMPs can be regarded as an indicator of the overall activity level of the China's shadow banking sector.

Figure 1



Source：Peer Review Report of China, FSB

After knowing the structure of Chinese shadow banking system, it is important to understand the economic behavior of it. A recent paper In the Shadow of Banks: Wealth Management Products and Issuing Banks' Risk in China, by Acharya, Qian and Yang, is the first research paper that quantitatively analyzes the economic behavior of the WMPs activities in China. In the paper, they first examine the relationship between the product characteristics and the characteristics of the issuing banks. They found following relations: firstly, the scale of WMPs issuance is greater for banks with more lending restriction, especially when the market liquidity is low; secondly, the expected yields[2] for the WMPs are positively related to the risk of issuing banks. Their findings prove the "regulatory arbitrage" natural of Chinese shadow banking system. Moreover, they use Shibor ask spread[3] as the indicator for the rollover risk faced by banks. They found that the Shibor ask spread is higher for the banks with more WMPs mature. Based on that findings, they conclude that due to the

[2] The expected yield is given by the banks at the instruction of the WMPs. Though they are not guaranteed by banks, investors usually think this is a yield promised by the bank.
[3] Shibor ask spread is calculated as the bank's ask price mines the final Shibor price

timing difference among the different WMPs maturities, the issuing bank will face rollover risk. However, Shibor ask price by each bank may not necessary be an exact representation of bank's liquidity condition. Firstly, the Shibor ask spread will greatly be influenced by banks' expectation on PBOC's future policy. In other words, if the commercial banks believe the PBOC will have a tightened monetary policy, then they will bid up the Shibor price even when they are not actually facing liquidity problem. Secondly, if the future WMPs mature schedule is concentrated, the issuing banks are more likely increase their interbank borrowing in advance. Also, the banks will borrow through loans with different maturity in order to decrease the overall cost. Therefore, it will be very rare for a bank to suddenly bid up one Shibor price. Finally, the bank with the most liquidity issue may not be the bank who bid highest for the interbank loan. Based on the game theory, unless the situation is very emergent, it is not likely for a bank to bid significantly higher than other banks because it may cause market to panic. Though the Shibor ask spread may not be a good indicator, this paper does provide deep insights of the rollover risk faced by the issuing banks and the overall economic behavior of the WMPs.

2. Systemic Risk Measure

According to Banking and Currency Crises and Systemic Risk: Lessons from recent events by Kaufman, systemic risk refers to the risk or probability of the breakdown in an entire system and is evidenced by correlation among most or all the parts (Kaufman 14). Measuring systemic risk correctly and in time is essential for monitoring the risk exposure of the financial system. However, measuring systemic risk is a challenging task. One reason is

the interconnection among financial institutions. Because of the interconnection, systemic risk cannot be measured by one firm's health condition along. Many institutions and researchers have devoted into creating a better systemic risk measurement. This paper primarily uses the systemic risk measure developed by Acharya, Engle, and Richardson. This approach of measuring systemic risk is called SRISK. The monthly SRISK data is available on the V-lab website[4] for Volatility Institute at New York University Stern School of Business. The developing of SRISK is a long process and many researchers have contributed to that. This section cited research results from following papers: Measuring Systemic Risk, by Acharya, Pedersen, Philippon, and Richardson; Capital Shortfall: A New Approach to Ranking and Regulating Systemic Risks[5].

SRISK is the expected capital shortfall of a firm under a financial crisis scenario. In other words, SRISK measure how much capital injection is needed for a firm to keep solvent under the assumed crisis scenario. More specifically, SRISK is calculated by the equation (1). The first line of the equation (1) define the SRISK of firm i at time t as the expected capital shortfall under the crisis scenario (Acharya 4). The second line of equation (1) shows that the expected capital shortfall can be calculated by the net capital, which is the prudential capital ratio (k) times the total asset, minus the expected equality value loss. And the third line of equation (1) further defines the expected equality value loss as the Long Run Marginal Expected Shortfall (LRMES) times as the total equity of the firm. There are different ways to calculate LRMES. One method called MES with simulation. This method first uses the

[4] https://vlab.stern.nyu.edu/
[5] For more detailed calculation process of *SRISK,* please refer to the paper listed in the reference page

GJR-GARCH and DCC model to estimate asymmetric volatility and correlation. Then apply the bivariate daily time series model developed by Brownlees and Engle, to simulate many times into the next six months to see the firm's return on the condition that market index falls by 40% in the simulation. The other method is Dynamic MES without simulation. The formula to calculate the MES is shown in equation (2). Here, d is market index drop under the crisis scenario, the default setting is 40%. And for the international firms, beta is calculated as the dynamic conditional beta.[6]

$$SRISK_{i,t} = E_{t-1}(Capital\ Shortfall_i | Crisis) \quad (1)$$

$$= E\big((k(Debt + Equity) - Equity)\big|Crisis\big)$$

$$= k\big(Debt_{i,t}\big) - (1-k)(1 - LRMES_{i,t})Equity_{i,t}$$

$$\text{LRMES} = 1 - \exp(\log(1 - \text{d}) * \text{beta}) \quad (2)$$

The change of SRISK can be broken down into three components, which is a useful way to see which factors contribute most to the change of SRISK. Based on the equation (1), it is not hard to get the change of SRISK, which is shown in equation (3). Note that there are three components is this equation: change of debts(ΔDebt), change of equity (ΔEquity) and change of risk (ΔRisk). ΔDebt captures the effect of the changes in total debt amount. One thing needs to be mentioned is that SRISK is calculated based on the balance sheet, which means since non-principal guaranteed WMPs are off-balance sheet, ΔDebt will not be directly influenced by the WMPs issuance. ΔEquity captures the effect of the changes in the market

[6]For more information on how to calculate dynamic conditional beta, please refer to https://vlab.stern.nyu.edu/doc/17?topic=mdls

capitalization of the firm, which main influenced by the change of stock price. The ΔRisk capture the effect of the changes in LRMES, and ann increase in firm's stock variance and correlation may lead to a positive ΔRisk.

$$\Delta\text{SRISK} = \text{k} * d\text{Debt} - (1 - \text{k}) * (1 - \text{LRMES})d\text{Equity} + (1 - \text{k})\text{Equity} * d\text{LRMES} \quad (3)$$

- $\Delta\text{Debt} = \text{k} * d\text{Debt}$
- $\Delta\text{Equity} = -(1 - \text{k}) * (1 - \text{LRMES})d\text{Equity}$
- $\Delta\text{Risk} = (1 - \text{k})\text{Equity} * d\text{LRMES}$

III. Data and Summary Statistics

1. Data

This paper focus on the nine banks in China includes top 4 biggest state-owned banks, Bank of China, Industrial and Commercial Bank of China, China Construction Bank and Bank of Communication. The selection of these nine banks is due to many reasons. The first reason for many small banks are not included is that many small banks never or very rarely show positive SRISK. Since for the analysis of this research, positive SRISK has more practical meaning, many small banks are not selected. The second reason fort many local banks, like Bank of Beijing, Bank of Ningbo and Bank of Nanjing, not be included is because they have very poor WMPs data quality. Lots of sales data and mature data are missing or not disclosed. The third reason for some banks, like the Agricultural bank of China and Ping An Bank, are not selected is because they are either listed just recently or they are not listed on the Shanghai Stock Exchange. In order to keep consistency in the stock price analysis, these banks are not included. There are other particular reasons for few bank are not included. For

instance, the Industrial Bank is not suited for this study because the majority of their WMPs are not closed, which means there is no maturity for one WMPs. It is true that involve more banks can increase the sample diversity, but since the 9 banks included in the sample took up a majority market share of WMPs and account for a large percentage of SRISK[7], it is safe to say the sample can reflect the reality.

The sample period is from January 2011 to December 2014 and the WMPs data are observed on the weekly basis. The reason for selecting this sample period is because before 2011, the WMPs market is relatively small, and it is since 2011, WMPs market has experienced rapid growth. Besides, the reason for not include 2015 is that since 2015, most bank stops discloses detailed information on WMPs sales and mature. In order to keep consistency in data quality, 2015 are cut from the sample period.

The WMPs issuance and mature data are calculated based on one assumption. Due to the lack of daily WMP sales and mature data, this paper calculates the average sales amount per WMPs. WIND recorded each WMPs issued every day and their maturity. Using VBA program, we automatically get the total number of WMPs issue and mature for each day. However, for most WMPs, WIND does not provide how much RMB have been sold for each WMPs. But for the majority of the model, RMB amount of WMPs data is needed. Thus, we made following assumption: for each bank, the RMB sales for each WMPs at every quarter is equal to the quarterly total WMPs sales divided by the total number of WMPs sold in that quarter[8]. Therefore, due to this assumption, the sales of WMPs will have a linear relation with

[7] According to the data on V-lab, in April 7 2017, the nine banks in the sample took up 74.18% of total SRISK in China
[8] For some banks it is semi-annual because for quarterly report they do not disclose WMPs sales data

the number of WMPs sold within one-quarter. We admitted that this assumption is not ideal, but we believe this assumption will not change the effect significantly because after comparing the calculated data with the actual sales data we have, the difference is acceptable.

NPL ratio and LDR are recorded on the quarterly or semi-annual basis and the data is also collected from WIND. This paper uses the market capitalization to represent the bank's equity. The market capitalization data are collected from Bloomberg on a daily basis. The Shibor price data are collect on daily basis from the official website of Shibor. SRISK, daily variance, and correlation are provided by V-lab on the daily basis. Through all models in this research, we assume the dollar to RMB exchange rate is fixed at seven.

2. Summary Statistics

Table 1 shows the summary statistics for all the data used in this research, and we have separate the top 4 bank and other small and medium size banks since they are significantly different in size and many other features. The first column is the summary statistics for the entire sample, the second column is for top 4 banks and the third column is for the rest small and medium size banks. There is 1872 observations in the entire sample, 832 observations for the group include only top 4 banks and 1040 observations for the group with small and medium size banks. For the equity size, the top 4 banks are nearly 7 times larger than the rest of banks. The top 4 banks also issue significant more WMPs compare to the rest of banks. Note that the WMPs issuance and mature data for top 4 banks have a higher standard deviation compared to the sample with smaller banks, which may indicate to a higher rollover risk faced by the issuing banks. This paper use one-year deposit rate (cannot withdraw) as the

risk-free rate. The small and medium bank overall generate higher stock return compared to the top 4 banks. Also, the small and medium bank has a high standard deviation in the stock return relative to the top 4 banks, which indicate a higher stock volatility.

The SRISK for top 4 banks are almost 4 times higher than the SRISK for the small and medium size banks. However, this is majorly caused by the gigantic size of the top 4 banks. Over the sample period, the top 4 banks experienced a positive ΔRisk, while the small and medium size bank has a negative in ΔRisk. This means for the top 4 banks, the contribution of volatility increase over the sample periods. Also, top 4 banks have a higher LRMES compared to the rest of banks, which means their stock price should drop greater under the financial crisis scenario. Small and medium size banks have a higher stock daily variance, while top 4 banks have a higher correlation with the market index. The leverage ratio is around 15, and the small and medium size banks leverage a bit more than the top 4 banks.

Summary Statistics				
		N=1872 n=9 T=208	N=832 n=4 T=208	N=1040 n=5 T=208
Variables			Top4	SM Bank
Equity	Mean	81,911.49	148,146.70	28,923.35
(Million USD)	Std.Dev	75,008.41	67,861.81	11,171.71
	Min	8,278.42	39,321.12	8,278.42
	Max	262,591.80	262,591.80	62,452.52
WMPs Issuance	Mean	151.02	234.12	84.54
(Weekly,Million USD)	Std.Dev	141.32	149.00	90.85
	Min	0.00	0.00	0.00
	Max	1,082.98	1,082.98	690.48
WMPs Mature	Mean	142.63	222.40	78.82
(Weekly,Million USD)	Std.Dev	192.39	251.89	80.58
	Min	0.00	0.00	0.00
	Max	3,678.99	3,678.99	576.42
Risk Free Rate	Mean	3.01	3.01	3.01
(%)	Std.Dev	0.08	0.08	0.08
	Min	2.75	2.75	2.75
	Max	3.25	3.25	3.25
Market Return	Mean	0.09	0.09	0.09
(Weekly,%)	Std.Dev	2.41	2.41	2.41
	Min	-5.19	-5.19	-5.19
	Max	9.53	9.53	9.53
Stock Return	Mean	0.34	0.26	0.45
(Weekly,%)	Std.Dev	3.47	2.86	4.14
	Min	-11.56	-9.49	-11.56
	Max	24.45	21.28	24.45
NPL Ratio	Mean	0.86	0.98	0.76
(%)	Std.Dev	0.19	0.08	0.20
	Min	0.40	0.81	0.40
	Max	1.39	1.17	1.39

LDR	Mean	70.44	68.89	71.68
(%)	Std.Dev	3.78	4.37	2.64
	Min	60.99	60.99	65.31
	Max	79.17	78.39	79.17
Shibor O/N	Mean	3.01	3.01	3.01
(%)	Std.Dev	0.93	0.93	0.93
	Min	1.68	1.68	1.68
	Max	6.96	6.96	6.96
SRISK	Mean	27,806.42	46,548.56	12,812.70
(Million USD)	Std.Dev	28,045.66	32,469.20	8,179.39
	Min	-43,520.95	-43,520.95	-7,576.94
	Max	111,675.30	111,675.30	35,329.02
ΔRisk	Mean	6.73	17.09	-1.56
(Weekly,Million USD)	Std.Dev	2,482.29	3,697.08	404.62
	Min	-17,199.45	-17,199.45	-4,157.76
	Max	19,233.98	19,233.98	2,455.50
LRMES	Mean	0.28	0.32	0.25
(%)	Std.Dev	0.11	0.11	0.09
	Min	0.11	0.11	0.12
	Max	0.59	0.59	0.50
Daily Variance	Mean	0.03	0.03	0.04
(%)	Std.Dev	0.03	0.03	0.03
	Min	0.00	0.00	0.01
	Max	0.23	0.21	0.23
Correlation	Mean	0.20	0.23	0.18
	Std.Dev	0.06	0.07	0.05
	Min	0.02	0.02	0.04
	Max	0.40	0.40	0.33
Leverage Ratio	Mean	15.13	14.05	15.99
	Std.Dev	3.67	3.04	3.90
	Min	7.67	7.72	7.67
	Max	26.82	21.67	26.82

List of Sample Bank
Industrial and Commercial Bank of China
China Construction Bank
Bank of China
Bank of Communications
China CITIC Bank
China Merchants Bank
Shanghai Pudong Development Bank
Hua Xia Bank
China Minsheng Bank

IV. Empirical Methods

This research paper uses panel regression for Chinese banks in order to see the relation between the shadow banking activities and bank level systemic risk. More specifically, through focusing on the scale of WMPs issuance and mature, this paper is trying to answer following questions: how do the WMPs activities influence the SRISK? how do the WMPs activities affect the change of SRISK? how does the risk brought by WMPs activities attribute to the three components of ΔSRISK? Based on the answers to all three questions, this paper aims at providing constructive insights on monitoring the risk exposure of the issuing banks.

1. Influence of WMPs on SRISK

This paper first interested in how the issuance and mature of WMPs affect the bank level systemic risk. Based on the findings from previous research, a bank with higher NPL ratio are more likely to issue WMPs with higher expected yield. Our hypothesis is that the WMPs issued by such bank could involve a more risky transaction. Thus, we believe NPL is also a factor that influences the effect of WMPs on the issuing banks' systemic risk. Besides, since

the banks with more strict LDR are usually facing the problem of low profitability, they are more willing to involve in the risky WMPs transaction in order to increase their profit. Hence, the hypothesis is that LDR is another factor that enhances the effect of WMPs on the issuing banks' systemic risk. We expected the banks with more WMP issuance and mature to have a higher systemic risk. Also, the positive effect of WMPs issuance and mature on SRISK should be enhanced for the bank with lower LDR and higher NPL ratio. The empirical models are:

$$SRISK_{bt} = WMPissue_{bt} + LDR_{bt} + LDR_{bt} * WMPissue_{bt} + \varepsilon_{bt} \quad (1)$$

$$SRISK_{bt} = F.WMPdue_{bt} + LDR_{bt} + LDR_{bt} * WMPdue_{bt} + \varepsilon_{bt} \quad (2)$$

$$SRISK_{bt} = WMPissue_{bt} + NPLR_{bt} + NPLR_{bt} * WMPissue_{bt} + \varepsilon_{bt} \quad (2)$$

$$SRISK_{bt} = F.WMPdue_{bt} + NPLR_{bt} + NPLR_{bt} * WMPdue_{bt} + \varepsilon_{bt} \quad (4)$$

The dependent variable SRISK is the issuing bank's SRISK divided by banks' market capitalization. Variable WMPissue and WMPdue are the weekly WMPs issuance and mature dollar amount divided by the banks' market capitalization. LDR and NPLR are recorded at the end of each quarter and keep same within a quarter We expect the coefficient of WMPissue and WMPdue to be significantly positive. Also, the interaction of LDR should be significantly negative and the interaction of NPLR should be significantly positive.

2. Influence of WMPs on the Change of SRISK

This paper also investigated how WMPs activities affect the change of systemic risk. The hypothesis is that the banks with more WMPs activities will experience a more rapid growth

in the SRISK. The reason for WMPs issuance to be a factor is that though WMPs will generate profit for the issuing banks, but such profit will be realized only if the project that the banks invested generate enough profit. Hence, the profit of WMPs issuance is not sure until the ned of the project, but the principles and interest will immediately become the liability of the issuing bank. Besides, issuing WMPs could be an alternative way for the banks to raise short-term fund when they need liquidity. However, the cost issuing should also be higher under such circumstance. In general, in order to issue a large volume of WMPs in short time, banks would need to raise the expected yield to attract the investor. And the high issuing cost creates an incentive for banks to invest in the risky but profitable project, which will increase the banks' systemic risk.

The reason for WMPs mature to be a factor is that the issuing banks tend to schedule a large amount of WMPs mature at the same day. This seems to to be counterintuitive, but it actually is due to the "regulatory arbitrage". The WMPs mature amount will be extreme higher in the end of each month, especially the end of each quarter. The reason is because most investors are not likely to withdraw their principal and interest immediately after the products have matured. Therefore, the money left in the banks account automatically become a deposit in issuing banks' balance sheet. And the reason for choosing the end of each month is because PBOC will check banks' LDR at that day, and an increase in deposit can lower the LDR to meet PBOC's requirement. However, such concentrated WMPs mature schedule creates an enormous amount of risk exposure for the issuing bank. Particularly, if the interbank loan becomes expensive at these days, the issuing banks would need to borrow at a

very high cost in order to repay their products, or if the cost is too high, the banks have to default on their products. Note that though most WMPs are not principle guaranteed, it not necessary means bank can choice to default on their products frequently. The reason is that the default of one product would decrease the banks' creditability, which has a more serious chain effect. Also, the default of WMPs could let PBOC and CBRC put more strict restrictions on banks' business. Therefore, the WMPs mature amount should have a positive impact on the increase of the systemic risk of the issuing banks, especially when the market liquidity is expensive.In this research, we use the change of Shibor overnight price as the indicator of market liquidity condition. The risk-free rate has been subtracted from the Shibor overnight price in order to avoid the influence of the interest rate cycle. The empirical models are:

$$\Delta SRISK_{bt} = WMPissue_{bt} + \Delta Shibor_t + \Delta Shibor_t * WMPissue_{bt} + \varepsilon_{bt} \quad (5)$$

$$\Delta SRISK_{bt} = F.WMPdue_{bt} + \Delta Shibor_t + \Delta Shibor_t * WMPdue_{bt} + \varepsilon_{bt} \quad (6)$$

The dependent variable ΔSRISK is calculated as the SRISK divided by equity minus the SRISK divided by equity on the previous Friday. The ΔShibor is calculated as the Friday's Shibor overnight price minus the last Friday's price. We expected the coefficients of WMPissue and WMPdue to be significantly positive. And the interaction terms should also have a positive coefficient. Also, the entire sample is divided into subgroups based on the range of ΔShibor. Then, for each subgroup, Model (5) and (6) are estimated without the interaction terms.

3. Risk Attribution of WMPs

The last question this paper aims to answer is what is the attribution of the risk exposure brought by the WMPs activities. Remember that the change of SRISK can be broke down into three component, ΔDebt, ΔEquity, and ΔRisk. The ΔDebt is directly influenced by the change of debt amount on bank's balance sheet at the end of each day. Since the majority of WMPs issued by banks are not principal guaranteed, they will not be recorded on the balance sheet. Thus, the WMPs will not directly contribute to the ΔDebt. However, since the bank is not likely to default frequently on its WMPs, it is reasonable to conclude that there is an implicit guarantee on the principle for all WMPs issued by these banks. If taken the implicit guarantee into the consideration, then the issuing of WMPs will have a significant impact with the ΔDebt. At the end of this paper this impact will be discussed.

The ΔEquity is directly influenced by the change of the bank's stock price. If the stock price goes up, it will increase the equity value and decrease the SRISK, vice versa. Thus, this paper is going to examine how the issuance of WMPs and mature influence the stock return. The relation is expected to be significantly negative. Besides, because the large state-own banks are believed to be safer compared to rest of bank based on the market perception, the issuing of WMPs should have a weaker impact on their stock price. The entire sample is divided into two subgroups based on their size. The negative impact of WMPs issuance on the stock return should be more strong for the small and medium size banks relative to the top 4 banks.

Moreover, this paper also examines the influence of WMPs mature on the stock price. The reason for WMPs mature to affect the stock price is that investor also sees the WMPs mature schedule of the issuing banks. If the interbank market is tightened and there is a huge amount of WMPs going to mature in the near future, investors will for sure regard this as a bad news so that the issuing banks' stock price will drop. Hence, the WMPs mature will change the stock return and the change of Shibor price should also enhance the effect of WMPs mature. And because the investor knows the WMPs mature schedule beforehand, they will use today's liquidity condition to judge the risk of the WMPs mature in the near future. Therefore, the impact of WMPs should have a lead in the time series. The empirical models are:

$$Stock\_return_{bt} = WMPissue_{bt} + Market\_return_t + \varepsilon_{bt} \quad (7)$$

$$Stock\_return_{bt} = WMPissue_{bt} + Market\_return_t + WMPissue_{bt} * D1 + \varepsilon_{bt} \quad (8)$$

$$Stock\_return_{bt} = F.WMPdue_{bt} + Market\_return_t + \Delta Shibor_t + \varepsilon_{bt} \quad (9)$$

The dependent variable Stock_return is calculated as the weekly stock return minus the risk-free rate. The Market_rerurn are calculated as the weekly return for the Shanghai Composite Index. Both returns have been adjusted for dividend, right issue, and stock split. The entire sample is divided into two subgroups, top 4 banks and rest small and medium size bank. The WMPissue uses the number of WMP issued within a week instead of the dollar amount of WMP issued. The reason for use the number is the sales figure are not available to the market at the moment when the WMPs are issued. Investors can only get access to the

number of WMP issuance through the record from CBRC. Thus, the number of WMPS issuance should be a better factor in this model. In Model (7), the coefficient for WMPissue is expected to be negative, and such relation should be stronger for the group includes small and medium size bank. Also in order to further prove the finding, the Model (8) uses bank size as the dummy variable to estimate the results. The dummy variable for top 4 banks is 1 and 0 for rest of banks. We expect the WMPissue has a negative coefficient and dummy term has a positive coefficient. For Model (9), the coefficient for WMPdue should be significantly negative for the group with the large Shibor price increase.

The ΔRisk is linearly related to the change of LRMES. Since this paper uses dynamic MES without simulation, the ΔRisk should positively influence by the beta of the bank. And based on the formula for calculating the dynamic beta, the beta are dependent on two factor: variance and correlation. The hypothesis that the WMP mature will have a positive impact on the bank's stock daily variance. Also, because the market knows exactly the schedule for WMPs mature, the influence of WMPs mature should have a lead in the time series. Besides, like other models, the market liquidity condition should also influence the stock daily variance. This is because when the market liquidity is expensive, the market would be more worry about the potential default on the WMPs that going to mature in near future. The empirical model is:

$$dRisk_{bt} = F.WMPdue_{bt} + \Delta Shibor_t + \Delta Shibor * F.WMPdue_{bt} + \varepsilon_{bt} \quad (11)$$

$$Variance_{bt} = F.WMPdue_{bt} + \Delta Shibor_t + \Delta Shibor * F.WMPdue_{bt} + \varepsilon_{bt} \quad (12)$$

The dependent variable *d*Risk is divided by the equity of the bank. For each model, the entire sample is divided into subgroup based on the range of ΔShibor. Under the situations with a large increase in Shibor overnight price, all coefficient for WMPdue and the interaction term are expected to be significantly positive.

V. Empirical Results

1. Effect of WMPs on SRISK

This section shows the effect of WMPs issuance and matures on SRISK using Model (1) to (4). The results for the Model (1) and (3) are shown in the panel A of Table 1. The results for the Model (2) and (4) are shown in the panel B of Table 1. For both two panels, the group (1) has WMPs issuance/mature as the independent variable, while group (2) and group(3) add NPL ratio and LDR as the independent variable. Group (4) and (5) add the interaction terms. Panel A focuses on the effect of WMPs issuance. As what expected, the WMPs issuance has a significant positive coefficient, which means the more WMPs products the bank issued, higher the SRISK the issuing bank has. The interaction term between NPL ratio and WMPs issuance also has a positive coefficient, but it is not significant. The interaction term between LDR and WMPs issuance has a significant negative coefficient, which is consistent with the hypothesis. This negative coefficient means the effect of WMPs issuance on SRISK is stronger for the banks with more strict lending constraint.

Panel B studies the effect of WMPs mature. For all groups, WMPs mature has a significant positive effect on the SRISK. The interaction term between WMPs mature and NPLR has a significant positive coefficient, which means when the issuing banks have a poor

loan quality, the WMPs mature will bring more systemic risks. The other interaction term between WMPs mature and LDR has a significant negative coefficient, which means when LDR is low, the mature of WMPs will bring the more systemic risk of the issuing banks. It means that the WMPs mature for banks with stricter lending constraint will cause a higher increase in the systemic risk. All the coefficients are consistent with the hypothesis.

Table 1

Panel A:How does WMPs Issuance affect SRISK

Dep Var:SRISK/equity	(1)	(2)	(3)	(4)	(5)
WMPs Issuance/equity	14.28821***	12.78724***	14.45351***	12.77905***	15.48841***
	(1.7804)	(1.80379)	(1.783538)	(1.815579)	(1.866433)
NPL Ratio		11.46812***		11.34986***	
		(2.624663)		(2.635429)	
LDR			0.1958734		0.2079956*
			(0.1358337)		(0.1432812)
NPLR*WMPs Issuance				0.0001044	
				(0.0002043)	
LDR*WMPs Issuance					-0.0000862*
					(0.0000462)
Constant	0.18679***	0.0845312*	0.0503478	0.0855172*	0.0448149
	(0.341118)	(0.0412163)	(0.1005787)	(.0412707)	(0.1005469)
Time Fixed Effect	YES	YES	YES	YES	YES
Bank Fixed Effect	YES	YES	YES	YES	YES
Observation	1872	1872	1872	1872	1872
R_squared: within	0.8074	0.8096	0.8077	0.8097	0.8081
between	0.0552	0.0597	0.0884	0.0686	0.1266
overall	0.4232	0.4254	0.4324	0.4264	0.441
Cluster	Bank	Bank	Bank	Bank	Bank

Panel B:How does WMPs Mature affect SRISK

Dep Var:SRISK/equity	(1)	(2)	(3)	(4)	(5)
WMPs Mature/equity	13.28413***	12.0461***	13.24902***	9.222239***	12.99374***
	(1.63106)	(1.64433)	(1.632216)	(2.589546)	(1.628894)
NPL Ratio		11.83647***		15.07048***	
		(2.610286)		(3.865183)	
LDR			0.0890662		0.0659811
			(0.135617)		(0.1356933)
NPLR*WMPs Mature				486.8143*	
				(259.837)	
LDR*WMPs Mature					-0.0001971*
					(0.0001489)
Constant	0.1960638***	0.0893864*	0.1341346	-0.1759169	0.1468755
	(0.0340377)	(0.0412126)	(0.1002538)	(0.1165461)	(0.1002477)
Time Fixed Effect	YES	YES	YES	YES	YES
Bank Fixed Effect	YES	YES	YES	YES	YES
Observation	1872	1872	1872	1872	1872
R_squared: within	0.8077	0.81	0.8077	0.8136	0.8094
between	0.0477	0.048	0.0691	0.0608	0.0910
overall	0.4200	0.4225	0.4244	0.4371	0.4274

2. Effect of WMPs on ΔSRISK

After knowing the effect of WMPs on SRISK, it is also useful to see the relation between WMPs and change of SRISK. This section investigates the effect of WMPs activities on ΔSRISK using Model (5) and (6). The results for Model (5) are shown in the Panel A of Table 2. Group (1) shows the results of the entire sample, however, the positive coefficient of WMPs issuance is not significant. In group (2) and (3), the entire sample is divided into subsample based on their size. In group (2), which only include top 4 banks, the coefficient of WMPs issuance is negative and not significant. But in the group (3), which include the small and medium size banks, the coefficient of WMPs issuance is a significant positive. This result is consistent with the hypothesis, it means that the WMPs issued by small and medium size bank would bring more SRISK to the issuing bank compared to the WMPs issued by the large banks. In the next section, we are going to further examine the different effect caused by the bank size.

Panel B estimates Model (6) with subgroups separated by the change range of Shibor overnight price. The coefficient of WMPs mature in the entire sample is negative but not significant. But our hypothesis states that the WMPs mature will increase issuing banks' systemic risk when the market liquidity condition is expensive. Therefore, we are more interested in the group (2) and group (3). As expected, the coefficient of WMPs mature in the group (2) and (3) is significantly positive, and the effect is stronger for the group (2), which has the largest Shibor price increase. This result means when the market liquidity is

expensive, the incoming WMPs mature will cause a more rapid increase in the systemic risk of the issuing banks.

Table 2

***Panel A:How does WMPs Issuance affect* ΔSRISK**

Dep Var: ΔSRISK/equity	(1)	(2) Top 4 Banks	(3) Small and Median Banks
WMPs Issuance/equity	0.7473742	-0.1696047	1.494676*
	(0.64374)	(0.8877543)	(0.9239129)
ΔShibor	10.98769*	-3.152645	22.39857**
	(8.570069)	(10.02135)	(11.51318)
Constant	0.0376718*	0.0274454	0.0464158**
	(0.0181275)	(0.0212246)	(0.0243377)
Time Fixed Effect	YES	YES	YES
Bank Fixed Effect	YES	YES	YES
Observation	1863	828	1,035
R_squared: within	0.5625	0.6567	0.6913
between	0.011	0.6754	0.2071
overall	0.5619	0.6567	0.6906
Cluster	Bank	Bank	Bank

Panel B:How does WMPS mature affect ΔSRISK

Dep Var:ΔSRISK	(1)	(2)	(3)	(4)
ΔShibor O/N		>0.01	(0,0.01)	<0
WMPs Mature/equity	-0.0106403	11.84936**	3.433537*	1.530325
	(0.5902225)	(5.764565)	(1.787552)	(0.3695503)
ΔShibor O/N	-15.68485***	-7.445985**	-182.4456***	-113.9541***
	(1.538567)	(2.707089)	(30.28474)	(33.61274)
Constant	0.0163427	0.0969579	0.0394487	-0.2404009***
	(0.0114358)	(0.0659746)	(0.0473203)	(0.0197176)
Time Fixed Effect	YES	YES	YES	YES
Bank Fixed Effect	YES	YES	YES	YES
Observation	1863	180	693	972
R_squared: within	0.5633	0.5863	0.5254	0.5291
between	0.0073	0.0023	0.0890	0.0367
overall	0.5631	0.5722	0.5239	0.5283
Cluster	Bank	Bank	Bank	Bank

3. Risk Attribution of WMPs

The change of SRISK can be broke down into three parts, ΔDebt, ΔEquity, and ΔRisk. Hence, it is very useful to see what is the attribution of the risk exposure brought by WMPs.

a) ΔEquity

Model (7) to (9) examines how WMPs affect the stock return. Panel A estimates Model (7) with subgroups based on bank size. The coefficient of WMPs issuance for the entire sample is significant negative, which means the issuance of WMPs will lead to a drop in the stock price. However, for the group includes large banks, the negative coefficient is not significant, while for the group with smaller banks, the negative effect of WMPs issuance is significant. These results are consistent with the hypothesis and the results indicated from the Model (5). It means that the WMPs issued by small banks are more likely to cause a drop in the stock price of the issuing bank compared to the WMPs issued by large banks. As we discussed in the previous section, this could result from the different market confidence towards the issuing banks. The perception towards the issuing banks let the market to regard the issuing of WMPs from small banks as a bad news. A further test is also designed to examine this phenomenon. Panel B estimates Model (8) using the bank size dummy variable. The interaction term between the dummy variable and WMPs issuance is significantly positive, which means being a top 4 banks will decrease the negative effect of the WMPs issuance on the stock return. This finding is consistent with the hypothesis.

Panel B shows the results from Model (9), which studies the effect of WMPs mature on the stock return. The entire sample is divided into subgroups in order to see the different effects under different market liquidity condition. The coefficient for WMPs mature is significantly negative only when the Shibor rate increase by more than one percent. This means, under the situation that the market liquidity is expensive, the stock price of the issuing bank will drop more when there is a concentrated WMPs mature schedule.

Table 3

Panel A:How does WMPs Issuance affect stock return

Dep Var: Stock return	(1)	(2)	(3)
		Top 4 Banks	Small and Median Banks
WMPs Issuance	-0.0000368*	-1.92e-06	-0.0001268**
	(0.2713212)	(0.0000141)	(0.0000434)
Market Return	1.381962***	1.246314***	1.489028***
	(0.3018167)	(0.3248778)	(0.4234819)
Constant	0.0162651**	0.0107521*	-0.0211481**
	(0.0057317)	(0.0061651)	(0.0080555)
Time Fixed Effect	YES	YES	YES
Bank Fixed Effect	YES	YES	YES
Observation	1863	1,044	1,305
R_squared: within	0.7405	0.8550	0.7803
between	0.2030	0.7221	0.0086
overall	0.7402	0.8549	0.7784
Cluster	Bank	Bank	Bank

Panel B:How does the bank size affect the effect of WMPs Issuance on stock return

Dep Var: Stock return	(1)	(2)	(3)	(4)
WMPs Issuance	-0.0000559	-0.000042	-0.0001124*	-0.0001134**
	(0.0000331)	(0.0000245)	(0.0000508)	(0.0000383)
Market Return	0.8289854***	1.384797***	0.8309121***	1.372877***
	(0.0214789)	(0.3014865)	(0.0215294)	(0.3015693)
WMPs Issuance*Dummy	0.0000135	0.0000123	0.0000685	0.0000877*
	(0.00003)	(0.0000212)	(0.0000551)	(0.00004)
Constant	0.0039562***	0.0162169**	0.0049045***	0.0168261**
	(0.001061)	(0.0057256)	(0.0012039)	(0.0057322)
Time Fixed Effect	NO	YES	NO	YES
Bank Fixed Effect	NO	NO	YES	YES
Observation	1863	1863	1863	1863
R_squared: within	0.389	0.7407	0.3894	0.7411
between	0.0952	0.0681	0.0429	0.1908
overall	0.3887	0.7402	0.3878	0.7387
Cluster	Bank	Bank	Bank	Bank

Panel C:How does WMPs Mature affect stock return

Dep Var:Stock Return	(1)	(2)	(3)	(4)
ΔShibor O/N		>0.01	(0,0.01)	<0
WMPs Mature/equity	0.1423542	-0.0036717*	0.0005506	0.000799
	(0.5902225)	(0.0024313)	(0.0012815)	(0.0008787)
ΔShibor O/N	2.220303**	-1.037888**	-14.97332	-143.6011***
	(0.7675111)	(0.4199887)	(0.4199887)	(0.4199887)
Market return	1.3837855***	-0.6091213	1.111285***	2.659245***
	(0.1128783)	(0.5646267)	(0.2855084)	(0.6628035)
Constant	0.0124994*	0.0406944**	0.0406944**	-0.0748051***
	(0.0049118)	(0.0123182)	(0.0123182)	(0.007501)
Time Fixed Effect	YES	YES	YES	YES
Bank Fixed Effect	YES	YES	YES	YES
Observation	1863	180	693	963
R_squared: within	0.7201	0.6410	0.7330	0.6911
between	0.0848	0.2738	0.0026	0.3862
overall	0.7191	0.6373	0.7300	0.6902
Cluster	Bank	Bank	Bank	Bank

b) ΔRISK

The results for the Model (11) to (13) are shown in table 4. In panel A, the model (11) estimate the effect of WMPs mature on ΔRisk. Note, ΔRisk capture the change of LRMES, and the LRMES will increase when the daily variance and correlation increase. When the market liquidity is expensive, the coefficient of WMPs mature is significantly positive, which means more WMPs going to mature, higher the risk increments. This could be caused by the worry of a potential default and high borrowing cost results from the WMPs mature.

Model (12) further test the effect of WMPs mature on daily variance. The coefficient of WMPs mature is significantly positive, and the interaction terms between WMPs mature and ΔShibor also has a significant positive coefficient. It means the WMPs mature will increase the daily volatility of the banks' stock. And when the market liquidity become expensive, such effect will be enhanced.

Table 4

Panel A:How does WMPs Mature affect Δrisk

Dep Var:ΔRisk/equity	(1)	(2)	(3)	(4)
ΔShibor O/N		>0.01	(0,0.01)	<0
WMPs Mature/equity	0.511306*	2.327292**	-0.4150134	0.1319605
	(0.2713212)	(0.9504452)	(0.4554157)	(0.3575617)
ΔShibor O/N	6.393181*	1.863054*	5.662079	5.880634
	(3.949571)	(0.9673773)	(3.592914)	(3.873603)
Constant	0.0306686 ***	-0.0345408*	-0.0323882***	0.0304734***
	(0.0083182)	(0.0152184)	(0.0062105)	(0.0081308)
Time Fixed Effect	YES	YES	YES	YES
Bank Fixed Effect	YES	YES	YES	YES
Observation	1863	180	693	972
R_squared: within	0.4113	0.4327	0.3925	0.4237
between	0.1237	0.0057	0.1877	0.2132
overall	0.4105	0.3714	0.3901	0.4233
Cluster	Bank	Bank	Bank	Bank

Panel B:How does change in Shibor affect the effect of WMPs Mature on Δrisk

Dep Var:ΔRisk/equity	(1)	(2)	(3)	(4)
ΔShibor O/N		>0.01	(0,0.01)	<0
WMPs Mature/equity	0.5145997*	1.998752**	- 0.236509	0.2145884
	(0.2714321)	(0.9944858)	(0.4799822)	(0.3695503)
ΔShibor O/N	6.323763	1.913609 *	6.022568	5.800473
	(3.952099)	(0.9676773)	(3.604889)	(3.875142)
WMPs Mature/equity*Δ	17.41393	68.5804*	-136.855	45.16111
	(29.47571)	(61.60071)	(116.5468)	(50.93597)
Constant	0.030621***	-0.0366922*	-0.0330294***	0.0303883***
	(0.0083202)	(0.0153287)	(0.0062325)	(0.0081324)
Time Fixed Effect	YES	YES	YES	YES
Bank Fixed Effect	YES	YES	YES	YES
Observation	1863	180	693	972
R_squared: within	0.4114	0.4374	0.3939	0.4242
between	0.1282	0.0055	0.1728	0.0503
overall	0.4106	0.3635	0.3917	0.4237
Cluster	Bank	Bank	Bank	Bank

Panel C:How does WMPs Mature affect Daily Variance

Dep Var: Daily Variance	(1)	(2)	(3)	(4)
WMPs Mature/equity	0.002721	0.0131185***	- 0.0025762	0.0130912***
	(0.0032554)	(0.0032825)	(0.0032744)	(0.0033022)
ΔShibor O/N	-0.0003128	-0.0213493***	-0.0003127	-0.0213491***
	(0.0007405)	(0.0028823)	(0.0007407)	(0.0028834)
WMPs Mature/equity*Δ$	-0.1365887	0.1898059	-0.1349203	0.1918762*
	(0.2898658)	(0.3583269)	(0.2899458)	(0.3584562)
Constant	0.0003361***	0.0009714***	0.0003365***	0.0009714***
	(0.0000343)	(0.0000728)	(9.80e-06)	(0.0000649)
Time Fixed Effect	NO	YES	NO	YES
Bank Fixed Effect	NO	NO	YES	YES
Observation	1,854	1,854	1,854	1,854
R_squared: within	0.0005	0.48	0.0005	0.4800
between	0.0391	0.0344	0.0393	0.0344
overall	0.0021	0.4354	0.0021	0.4354
Cluster	Bank	Bank	Bank	Bank

VI. Conclusion

Shadow banking in China has just emerged since 2011. Oriented from the motivation of "regulatory arbitrage", the WMPs experience a rapid market growth rate. With the gigantic size and rapid growth rate, it is critical to study the increments of the risk exposure for the issuing banks. This paper, build on previous research about the economic behavior of issuing banks, study the relation between WMPs activities and the systemic risk carried by the issuing banks. Mainly, this paper examines the relation between WMPs and the change of systemic risk and the different relation caused by the change of market liquidity condition and bank size. Firstly, we find that the both WMPs issuance and mature contribute the systemic risk of the issuing banks. Particularly, the effect of WMPs will be enhanced when the issuing banks have a higher NPL ratio and LDR. In other words, the WMPs issued by the bank with poorer loan quality and more strict lending restriction will contribute more to the systemic risk of the issuing banks.

Secondly, this paper also tests the relation between WMPs and the change of systemic risk. We find that for small and medium size banks, the issuance of WMPs will lead to a more rapid increase in their systemic risk. While for the larger banks, such effect is not as significant. Also, the incoming WMPs mature schedule will lead to a more rapid increase in the systemic risk of the issuing banks, especially when the market liquidity becomes more expensive.

Lastly, this paper further study the risk attribution of the issuing banks. The results show that the WMPs issued by small and medium size bank are likely to cause a more significant drop in the stock price, and such drop decrease the banks' equity value so that the systemic risk will increases. The explanation for this phenomenon is that investor tends to regard the WMPs issuance of the small banks as a bad news about their profitability and liquidity condition. Besides, the WMPs mature will also cause a drop in the stock price when market liquidity is expensive, which could be explained by the worry of a potential default and high borrowing cost. Lastly, the WMPs mature will cause the issuing banks' stock become more volatile, and such increase of in volatility leads to an increase in the expected marginal shortfall, which contribute to the increase of the systemic risk.

Overall, based on the estimations from this paper, the close interactions with the shadow banking sector clearly increase the risk exposure of the regulated bank. Besides, the SRISK used in this paper only counter the equity market risk. Actually, the risk exposure will be more significant if the implicit guarantee is taken into the consideration. Additionally, this paper only measures the systemic risk for the issuing banks. However, in reality, the fund

collected through WMPs are eventually used for leverage in the stock market and the real estate market. Such risky and speculating investing project will let the systemic risk increase exponentially. Since commercial banks serve a critical role in the capital allocation and stabilization of the financial market, too much risk exposure by the commercial banks will make the whole economy more fragile.

Therefore, a detailed monitoring system and strict regulations should be introduced to control the risk faced by the banking system. Here this paper will provide few insights based on the findings. Firstly, a more transparent information disclosure system for the shadow banking activities should be introduced. Such information should include the sales amount, mature schedule, guarantee type, as well as the way that the fund is going to be invested in. The transparent information can not only help the regulator and researcher to better see the risk exposure, more importantly, it allows market adjust correspondently, which provide an incentive for banks to reduce their risk exposure. Secondly, the non-principle guarantee WMPs should also be fully or partially included in the calculation of LDR and Capital Adequacy Ratio. Such change could reduce the incentive for banks to use off-balance sheet asset to circumvent the supervision from PBOC. Thirdly, the regulator should apply a more flexible policy to reduce banks' incentive to concentrate the WMPs mature on the end of each month. Last, the regulator should warm and restrict lending for the banks with WMPs mature when the market liquidity is expensive.

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