Liquidity, Synergy and Winner-take-all Effect

Mingyuan Sun[1]

[1] Graduate School of Economics, Kyushu University, Fukuoka, Japan

Correspondence: Mingyuan Sun, Graduate School of Economics, Kyushu University, Fukuoka, Japan.

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Abstract

The synergy between deposit-taking and lending is the specialness of banking institutions as financial intermediaries. The activities from both balance sheet and off-balance sheet could share the cost of holding liquid assets, which is based on the fact that draw-downs on loan commitments and withdrawals on deposits are not perfectly correlated. However, it matters to reveal the dynamic connections between the two sources of liquidity risk for the purpose of analyzing the real impact on individual banks from a more microscopic perspective. As the evidence shows in this study, a winner-take-all effect is hidden in the synergy and could cause local double cash outflow from particular banks. It also provides new insights on liquidity management of commercial banks.

Keywords: liquidity risk, synergy, double outflow, commercial banking, loan commitments

1. Introduction

The liquidity shock in the 2007-2009 financial crises has been studied more intensively in recent literature. Unlike traditional scenarios, the specific form of liquidity shock has evolved from deposit outflow to the draw-downs of unused lines of credit and interbank financial arrangements. External factors such as the behavioral patterns of borrowers and depositors are no longer perfectly exogenous to the liquidity run dynamics. The bank strategy in liquidity management is also involved and has real impact on the bank run process. These include undrawn loan commitments, obligations to repurchase securitized assets, margin calls in the derivatives markets, and withdrawal of funds from wholesale short-term financing arrangements. Liquidity risk is typically entangled with credit risk in the later stage of the recent crisis. Among those factors, the sources of liquidity risk come from both balance sheets and off-balance sheets and the shock of shortage from these two sources have a severely negative impact on the entire banking system and the real economy.

The classic model shows the existence of a bank-run equilibrium indicating that the transformation of illiquid assets into liquid liabilities such as demand deposits exposes banks to liquidity risk (Diamond and Dibvig, 1983). This natural fragility exposes banks with unexpected runs from depositors when the market liquidity is tightening. Demand depositors have the incentive to monitor the banks due to liquidity mismatch and make an incentive-compatible environment (Calomiris and Kahn, 1991). After causing a series of banking crisis, policy makers and academics start to look for a more stringent regulatory mechanism which aims to bring forward narrow banking to avoid the liquidity mismatch, while this arrangement could eliminate the liquidity provision function of banks and squeeze the access to funding (Diamond and Rajan, 2001). In consideration of both sides of the balance sheets of banks, a prevailing theory argues that banks typically have synergy effects between lending and deposits, which is established on the basis of no perfect correlations between the two activities, and the synergy could be an effective mechanism to lower the opportunity costs of holding liquid assets (Kashyap et al, 2002). By and large, lending through financial intermediaries is directed under the contracts of commitments, which serves as an influential form of relationship lending. Borrowers in the relationship lending could draw their lines of credit at needs and the lender would be then under pressure if the amount of the draw-down is not fully anticipated. Commercial banks are regarded as the institutions with a special feature that they can hedge the liquidity risk in association with the borrowers demand as the market liquidity dries up. A complementary discussion argues that one aspect of the uniqueness of commercial banks is to provide insurance against systematic liquidity shocks (Gatev and Strahan, 2006). While a later paper provides results showing that the liquidity of bank stock return increases along with more unused loan commitments conditioned on insufficient transactions deposits (Gatev, Schuermann and Strahan, 2009). The ability to combine lending with deposit-taking is the reason why commercial banks have advantage to lower general market lending cost. With the synergy between both sides of the balance sheet,

commercial banks, compared with shadow banking institutions, are investing more patiently in illiquid assets with relatively lower fundamental risk (Hanson et al, 2015).

Funding liquidity in the liabilities side of a financial intermediation is closely interwoven with the market liquidity of its portfolio of assets, and they are combined to form a spiral of liquidity risk in the critical times of financial crisis (Brunnermeier and Pedersen, 2009). On the other hand, off balance sheet activities also have significant impact on new lending as draw-downs accelerated in the period of liquidity shortage (Cornett, McNutt, Strahan and Tehranian, 2011), hence worse availability of deposits and heavier burden of credit lines together restrain banks' ability to increase lending (Ivashina and Scharfstein, 2010). One example for explaining the important role of the off balance sheet loan commitments is that more than a half of the liquidity creation was conducted through this particular channel during 1993 and 2003 (Berger and Bouwman, 2009).

However, the correlation between the two sources of liquidity risk may not be consistent in response to different market conditions, especially in the scenario during the recent financial crisis, which means that the loan commitments and deposits can be more correlated than theoretically expected in an unfavorable timing. Evidence also shows that the synergy could not hold before the operation of the federal deposit insurance system (Pennacchi G, 2006).

The observation in this paper is consistent with the findings of previous research. In most of the context of discourses, the synergy is assumed to be a fundamental rule to construct further discussions. While lines of credit extended to firms by a bank are a group of flexible debt instruments, which fluctuate more drastically than other financing channels due to the bank's discretionary power. The correlation coefficients calculated between the two variables, just as the literature shows, are generally weakly positive and also slightly negative in some special circumstances. However, little attention has been focused on the dynamic relationship between deposits and lending from the perspective of external stakeholders. It is important to parse the difference between static and dynamic features because depositors and borrowers could make their decisions on a basis far from the standpoint of banks.

What is crucial in the issue is that determining the proper amount of liquid assets possessed by banks would be very challenging if the behavioral patterns of liquidity needs could not be uncovered thoroughly. The reason to reconsider the synergy effect between the two activities is based on one observed key fact: although the synergy does exist in terms of the banking sector as a whole, the dynamic correlation could be highly positive to a particular individual bank, which will in turn jeopardize the benefits brought by the synergy effect and amplify liquidity risk. More specifically, if deposits flow out of a bank that experiences draw-downs on loan commitments at the same time, the pressure of liquidity needs could be extremely high and thus the liquidity of the bank drains eventually. In other word, the flight-to-quality phenomenon during critical time of scarce liquidity may not occur to some institutions even though their portfolios of assets are still in good shape. The empirical evidence in the following sections shows that positive correlations exist when both the outflows and draw-downs are controlled, which indicates that a bigger deposits outflow is typically accompanied by a greater loan commitments draw-down in some specific banks. This winner-take-all effect could threaten financial health of certain banks and even drive some institutions to fail even if the whole banking system is abundant with liquidity.

The major motivation of this paper is to sort the idiosyncrasy out from the overall profile and to highlight the significance hidden under the peaceful surface in a micro perspective. The dynamic features of deposits and lending are taken into the issue as exogenous variables on the grounds that depositors and borrowers are relatively independent decision-makers to the banking system.

The rest of this paper is focused on the synergy effects and the effects they have on the liquid assets holding strategies of commercial banking institutions. The rest of this paper is organized as follows: section 2 presents an overview of loan commitments and deposits in commercial banks; section 3 shows the empirical analysis of the dynamics of synergy effect; section 4 presents an extension of analysis and section 5 concludes this paper.

2. A Revisit to the Synergy between Loan Commitments and Deposits

2.1 A Glance at Loan Commitments in U.S. Commercial Banks

Loan commitments have been the major way of extending credit to businesses particularly in recent decades. Under a loan commitment, the borrower has the right to use the line of credit to fund his or her investment project and the bank has the obligation to guarantee the liquidity according to the covenants specified in the commitment contract.

Commercial and industrial loans (C&I loans) are typically short-term and the customers who are businesses rather than individuals utilize the loans to fund working capital or capital expenditures. To issue a C&I loan, collaterals may be requested by the bank in usual circumstances and a commitment fee as well as an interest rate based on the

predominating benchmark interest rate will be charged. In the early stage, original commitments are only made to finance commercial and industrial businesses (Summers, 1975). It still appears to be a dominant way of issuing C&I loans: the majority of C&I loans are made under the commitments offered by commercial banking institutions, and the proportion has been continuously over 70% since the beginning of this century. A loan commitment can be viewed as a put option with which the customer has the right to execute the contract at a specific interest rate.

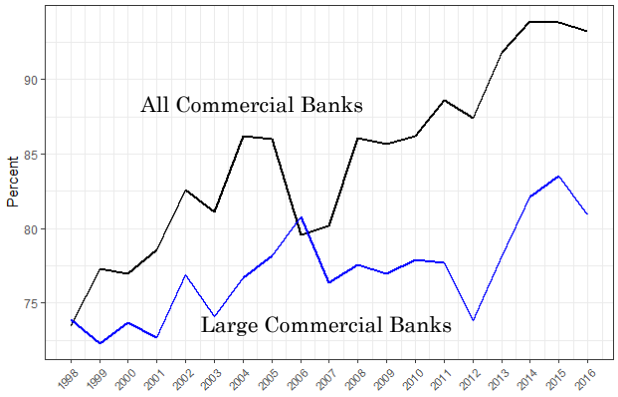
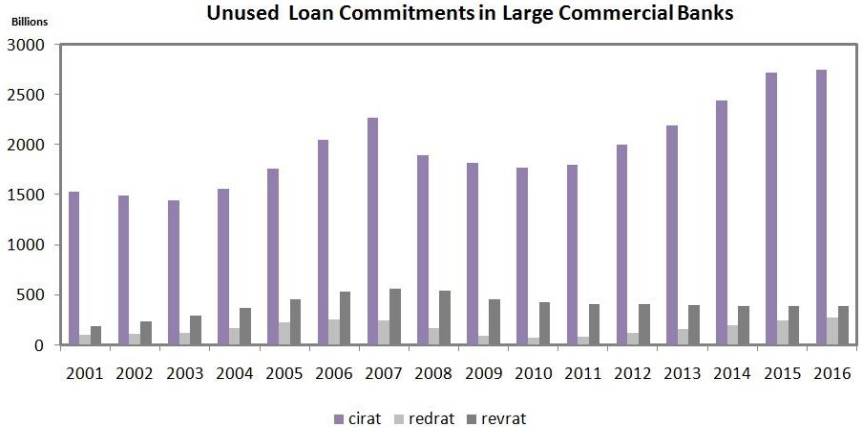


Figure 1. Percent of amount of loans made under commitment for all commercial and industry loans

Data source: Federal Reserve Bank of St. Louis

Commercial banks are exposed to liquidity risk because of the guarantee they provide for the potential borrowers, albeit the banks have the comparatively sufficient capacity of credit rationing. The impact from the real economy may be amplified when a large number of customers rush to the bank to draw down the commitments within a short period of time, leading to credit tension in the banking system. In this paper I select three types of loan commitments of U.S commercial banks: revolving open-end lines secured by 1-4 family residential properties (home equity loans), commitments to fund commercial real estate, construction, and land development loans secured by real estate and other unused commitments (Note 1). In the balance sheets of U.S. banks, unused commitments for commercial and industrial loans account for the major part of total commitments in both large and small banks. The two variables have experienced conspicuously huge decline during the financial crisis from 2007 to 2009. However, as the financial system is getting more stable in the period of aftermath, the paths of recovery from the crisis diverge significantly in terms of bank size. The commitments for C&I loans in large banks have reached a higher level than the previous climax before the onset of credit crunch in the nearly unchanging environment of low interest rate. It may have connections with the rescue facilities from the Federal Reserve. Since the revolving credit lines sunk into depression after the liquidity shock, any sign of an upward trend is still obscure regardless of bank size.



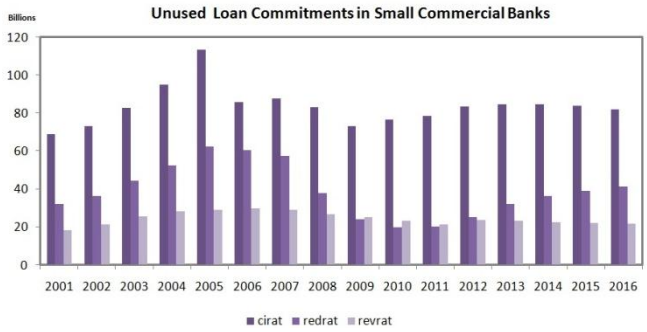


Figure 2. Total unused loan commitments in large and small banks

Data source: FFIEC Call Reports

On the other hand, the dynamic characteristics revealed in Figure 3 and Figure 4 show the three types of major loan commitments: commercial and industrial loan commitments (represented by other loan commitments), unused loan commitments for real estate development (secured) and revolving lines of credit. I calculate the average quarterly changes of each type of commitments in large commercial banks through the period from the beginning of 2001 to the end of 2016. The changes are standardized by total assets of each institution. It can be clearly observed that a sharp decline occurred during the recent financial crisis, which indicates that widespread draw-downs have been made in the emergent time of credit crunch. The type of commitments that has been drawn down the most is for financing commercial and industrial loans. The claim, to some extent, caused liquidity outflow from the banking system and brought pressure to the balance sheets of the banks, even though evidence shows that loan commitments are typically associated with strong financial capacity of a financial institution (Greenbaum and Thakor, 1993).

The specialty owned by the financial intermediaries is employed to solve the problem of asymmetric information about borrowers. In consequence, banks used to extend lines of credit through commitments to the customers who have healthy operations on their businesses. This could be an explanation for the slightly better quality and fewer problems of loans under commitments (Avery and Berger, 1991). In spite of that rationale, what have occurred during the period of liquidity shortage may not be associated with the loan quality, instead, broad draw-downs of loan commitments could be driven by idiosyncratic behavioral reactions of the borrowers to the market liquidity shock in overall scope. The firms that have commitment contracts with the financial intermediaries will take precautionary measures to cope with fluctuating indicators such as interest rates and the contract of a loan commitment automatically becomes an effective instrument to make discretionary strategies. Banks, on the contrary, have far less bargaining chips to prevent cash outflow except for the terms and restrictive covenants in the contracts. Cash, treasury securities and other liquid assets are combined together to form a liquidity buffer to take care of the contingency of liquidity needs.

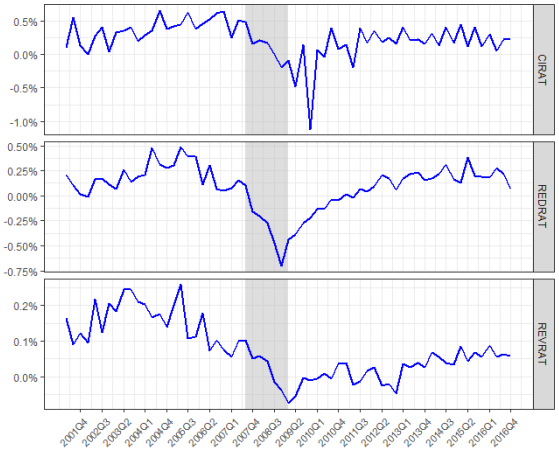


Figure 3. Average quarterly changes of unused commitments in large commercial banks

Data source: Calculated with the data from FFIEC Call Reports

Similar scenarios could not be observed in small commercial banks. Only the unused commitments for secured real estate development experienced a severe decline during the crisis. The commitments for commercial and industrial loans in small commercial banks show seasonal fluctuations especially after the crisis. The commitments for real estate development is more pro-cyclical and basically follows the housing bubble and the subsequent burst. In general, the liquidity risk contributing to the whole banking sector from the loan commitments draw-downs in small commercial banks has a much less significance than large commercial banks.

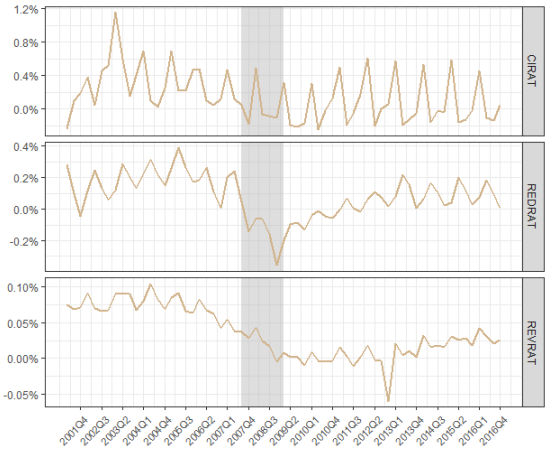


Figure 4. Average quarterly changes of unused commitments in small commercial banks

Data source: Calculated with the data from FFIEC Call Reports

However, by taking a closer perspective, a different story might be revealed. The gap between the biggest inflow and the biggest outflow (noted by IOGap) of loan commitments in large commercial banks shows a clear differentiation within the banking system. I calculate the quarterly changes of each of the unused commitments items of the off-balance sheet statements and pick up the maximum increase and decrease to draw the figure below, winsorizing the top 1% and the bottom 1% of to eliminate the outliers. The result heuristically implies that the draw-downs and new offers of commitments frequently occur at the same time, which means some banks experience harsh claims for liquidity under the contracts of commitments while some others have the ability to enlarge the volume of its unused loan commitments even during the period of liquidity shortage. In other words, the gap belt of each loan commitment is aggressively changing over time. This phenomenon may imply a consistent pattern hidden under the common surface where the overall profile of the banking sector could not reveal microscopic behaviors in institution-level. In the following section, the empirical tests will give explanations to this phenomenon. The gaps are getting narrower shortly after the crisis in both REDRAT and REVRAT, but the rebound trend is also on the track.

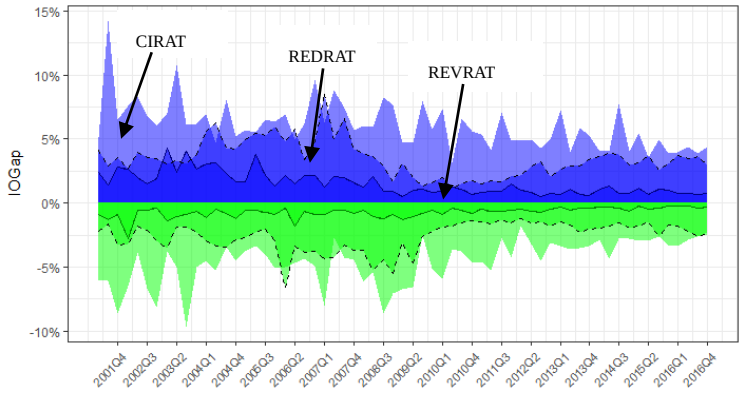


Figure 5. Range belts of loan commitments in large commercial banks

Data source: Calculated with the data from FFIEC Call Reports

Since the federal deposit insurance system was established, traditional bank run incurred by withdrawals of uninsured depositors scarcely occurs in recent years. In the 2007-2009 financial crisis, a variant of bank run stepped on the stage and caused a series of takeovers and failures. Short-term lenders suddenly ceased to roll over the funding to commercial banks and interbank lending also froze up, leading to tightened liquidity in the banking sector and shrinking credit creation to the real economy. The motivation of this paper is to propose a new perspective of liquidity risk management in commercial banks based on the understanding of the new form of bank run. The tricky part of the issue is whether there is a possibility to detect the hidden pattern before the occurrence of crisis. In the long run, the turmoil like the recent crisis is typically a rare event, indicating that it is difficult to obtain adequately comprehensive insights simply by delving into the extreme cases. Through the analysis of the dynamic features of the traditional synergy effect between lending and deposit-taking, a consistent but undiscovered pattern could be detected and identified.

As of the side of liabilities in the balance sheet, the average quarterly changes of transactions deposits and non-transactions deposits (Note 2) standardized by total liabilities are shown as follows. Unlike loan commitments, neither transactions deposits nor non-transactions deposits have experienced a sharp decline during the crisis period (shown in grey shadow). To some degree, the reason for the difference may come from the government interventions. The rescue facilities from the Federal Reserve Bank to save large financial institutions were very helpful to withstand the storm of credit crisis, and the deposit insurance limit was temporarily raised from $100,000 to $250,000 and eventually the new limit became permanent in 2010, which also helped to recover the confidence of average depositors. Turmoil in other financial markets facilitated the flight-to-quality effect so that cash looking for safe heaven flows into the banking system.

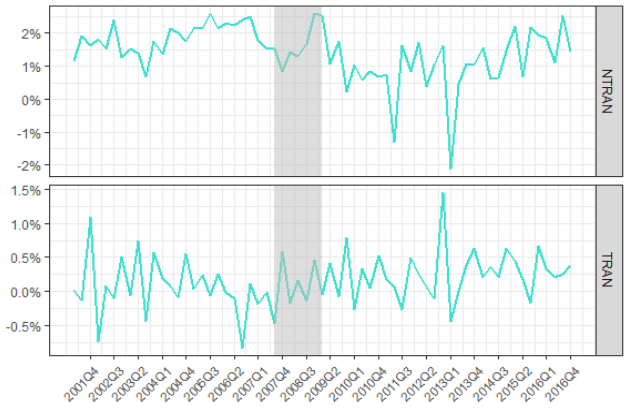


Figure 6. Average quarterly changes of deposits in large commercial banks

Data source: Calculated with the data from FFIEC Call Reports

However, the range between the funding inflow at top 1% and outflow at bottom 1% conveys message similar to the loan commitments. The IOGap fluctuates as giant inflows and outflows occur simultaneously. This pattern seems to be consistent in the selected sample period and it signifies that banks will encounter severe liquidity shortage if large outflows of deposits and considerable draw-downs of loan commitments unexpectedly coincide with each other. A winner-take-all effect is to be investigated, which implies that the liquidity in banking could flow into the banks in healthy operation from the banks with poor quality of assets in some macroeconomic circumstances. The IOGap only shows one aspect of the whole profile, thus the comprehensive behavior including discretionary decision-making, interim irrational reactions and conventional governance policy and strategies of each individual commercial bank has to be analyzed empirically in more details.

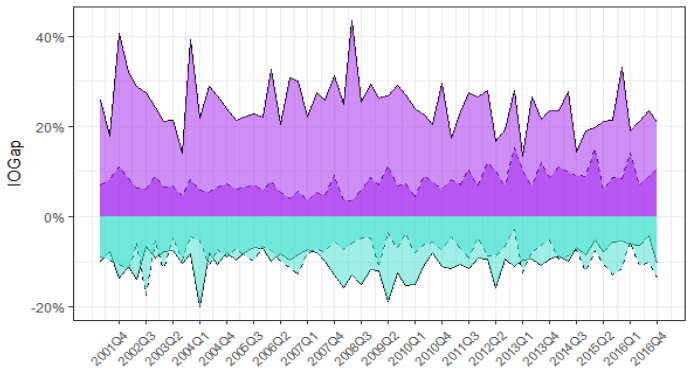


Figure 7. Range belts of deposits in large commercial banks

Data source: Calculated with the data from FFIEC Call Reports

2.2 Data and Model Specification

The data sets are drawn from the FFIEC Call Reports and the time interval selected is from the first quarter of 2001 to the last quarter of 2016. The sample contains nearly the whole period in this century and the financial crisis period is also included. The tests will be conducted in terms of the whole sample, large banks group and small banks group. The criterion to classify large commercial banks and small commercial banks is whether the total assets of the specific bank is greater than 1 billion U.S. dollars. The data is collected at the level of consolidated balance sheet.

The baseline empirical model is to describe the relationship between unused loan commitments and transactions deposits to analyze the synergy effect, which is specified as follows:

$$\mathrm{COMM}_{i,t}^{k} = \mathrm{B}_{0,i}^{k} + \beta_1^{k}\mathrm{DEPO}_{i,t} + \mathrm{Controls} + \mu_{i,t} \quad (1)$$

Where COMM is the ratio of one specific item of unused loan commitments to total assets and DEPO is the ratio of transactions deposits to the total liabilities in an individual bank. The superscript k represents REVRAT, REDRAT and CIRAT respectively. Fixed effect and time effect are also controlled. The hypothesis in the baseline model is that the coefficients of transactions deposits are expected to be slightly positive if the synergy does exist between the two variables. Nevertheless, in this paper, the baseline model is not at the centerpiece empirically, and the focus of this paper is to disclose whether or not this relationship between the two variables can be perfectly positive as the market funding condition evolves.

On top of the baseline model, the practical model to be tested is about the exploitation of a dynamic mechanism, capturing whether the actual liquidity withdrawals from both deposits in the balance sheets and commitments in the off-balance sheets have a co-movement during the liquidity squeeze period. Two dummy variables are modeled into the equation to control the relations in concern. The specific form is as follows:

$$\mathrm{DEPORAT}_{i,t}^{k} = \mathrm{T}_{0,i}^{k} + \mathrm{B}_{0,i}^{k} + \beta_1^{k}\mathrm{COMMRAT}_{i,t-1} + \beta_2^{k}\mathrm{D}_1 + \beta_3^{k}\mathrm{D}_2 + \beta_4^{k}\mathrm{COMMRAT}_{i,t-1} \times \mathrm{D}_1 + \beta_5^{k}\mathrm{COMMRAT}_{i,t-1} \times \mathrm{D}_2 + \sum \mathrm{Controls}_{i,t} + \mu_{i,t} \quad (2)$$

Where DEPORAT stands for the ratio of quarterly change of deposits accounts to total liabilities and COMMRAT is the ratio of quarterly change of loan commitments to total assets, they represent relative liquidity pressure on both liabilities side and off-balance sheet activities. D_1 is the dummy variable indicating 1 if both changes of deposits and commitments are positive and D_2 indicates 1 if they are both negative. Bank fixed effect and time fixed effect will be included in the model. Controls represent control variables for size, profitability, capital sufficiency, liquidity degree of assets and potentiality of non-performing loans. One issue in this model is that long-term relationship could not be detected after the transformation into the difference model. Fortunately, the purpose of this research is to investigate the short-term interaction which is much more essential in the analysis of liquidity shock and conducive to uncover the hidden pattern behind the long-term synergy.

Table 1. Two sample t-test

Panel A Transactions Deposits						
	mean			median (in difference)		
	(I)	(II)	(III)	(I)	(II)	(III)
Lnta	12.345***	12.212***	12.034***	0.058***	0.050***	0.128***
Caprat	0.165***	0.169***	0.175***	-0.001***	0.001***	-0.002***
Liqrat	0.088***	0.098***	0.103***	0.003***	0.008***	0.009***
ROA	0.005***	0.005***	0.005***	0.001***	0.001***	0.000***
PTLL	(0.003)***	(0.003)***	(0.003)***	0.000	0.000***	0.000***
Panel B Non-transactions Deposits						
	mean			median (in difference)		
	(I)	(II)	(III)	(I)	(II)	(III)
Lnta	12.401***	12.257***	12.080***	0.123***	0.114***	0.166***
Caprat	(0.163)***	(0.168)	(0.173)***	-0.005***	-0.004***	-0.006***
Liqrat	(0.086)***	0.095***	0.101***	-0.002***	0.002***	0.004***
ROA	0.005***	0.005***	0.005***	0.000***	0.000***	-0.000***
PTLL	(0.002)***	(0.002)***	(0.002)*	-0.000***	-0.000***	-0.000***

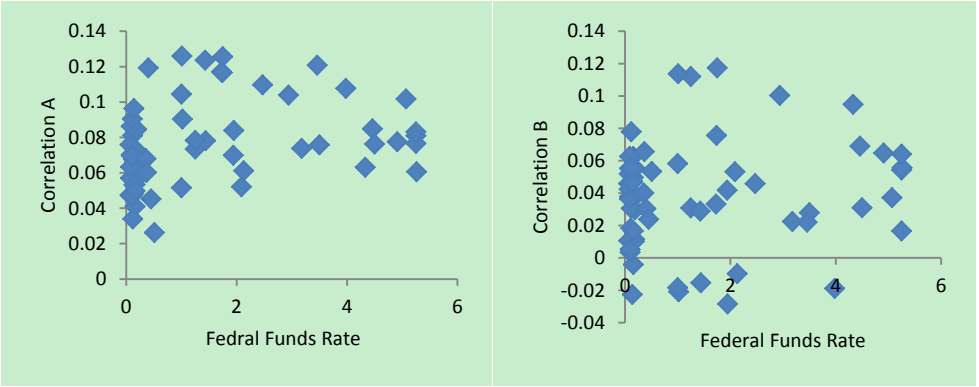
***, **, * are significant at the 1%, 5%, and 10% level respectively.

The two sample t-test shows the difference of means of control variables in the occurrence of double inflow and double outflow. As it implies, cash flow tends to rush into the banks with larger total assets. The indicator of overall bank performance represented by ROA reflects the same effect. The difference of capital ratio, on the other hand, is significantly positive in Panel A but negative in Panel B. Banks who have experienced double outflow typically have more provisions for loans and leases.

3. Empirical Tests for the Synergy

3.1 The Winner-take-all Effect

The theoretical hypothesis is straightforward and intuitive. By calculating cross-sectional correlations between the ratios of deposits change and loan commitments and making scatter plot for the correlation and fundamental funding cost, a pattern is looming. In expectation, the fitted curve for the scatter plot should be in a bell or inverse-U shape. When the funding cost is low, businesses will have the motivation to sign contracts of loan commitments with commercial banks to ensure the low financing cost. On the other hand, depositors will have the incentive to withdraw their cash from banks to pursue higher returns at other capital markets. As a result, the correlations tend to be negative or slightly positive. When the funding cost is high, the relationship should be negative as well for the opposite reason. The correlations will be increasing as the funding cost grows because business customers will keep the pace of obtaining loan commitments due to their expectation of upswing interest rate and at the same time depositors are willing to gradually transfer cash to commercial banks for improved returns. Similar explanation can be made when the interest rate is on the downside track. However, the real results are not consistent with the scenario hypothesized by theory. As I select three types of loan commitments and two classifications of deposits, it is easy to calculate the correlation coefficients in pairs between the two variables. By plotting the correlation with the basic funding cost, the phenomenon characterized in the hypothesis can be observed. In the plots, I select the federal funds rate as the benchmark for market funding cost.



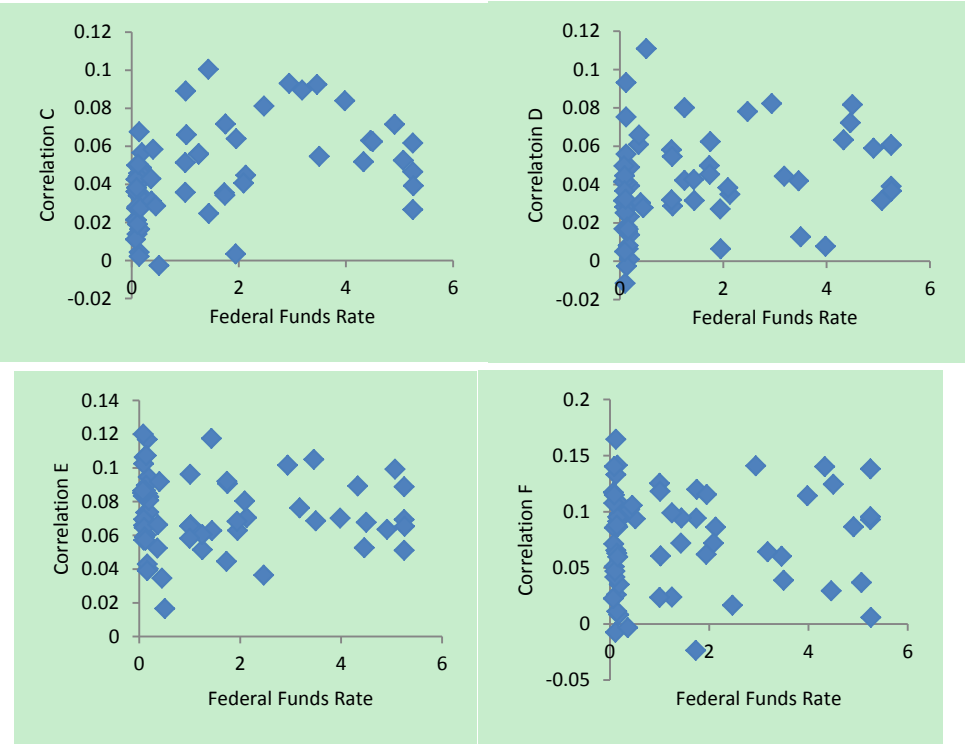


Figure 8. Correlation – FFR curve

Data source: Calculated with the data from FFIEC Call Report

It is obviously shown that only two pairs of correlation (Correlation A and Correlation C) out of the whole six pairs have significant inverse-U shape, which can be tested by regressing quadratic equations. The insignificance arises majorly from the existence of two classes of outliers: strong correlations when the funding cost is extremely low and high and weak correlations when the funding cost is in the average range. The latter type of outliers should not be paid much attention to because they are supportive of the argument of previous literature which concludes the synergy effect based on the fact that lending and deposit-taking not perfectly correlated. The former kind of outliers in the high and low end of the funding cost spectrum is the one needed to be interpreted.

Some explanations about the outliers situated in the undesirable region could be found, at least partially, by highlighting the winner-take-all effect. The existence of winner-take-all effect implies that banks with better performance in their asset portfolios will receive cash flow into the deposits, while other banks with poor corporate governance and lower asset quality will experience deposit outflow during the time of liquidity shortage. In the off balance sheet activities, the unused portion of loan commitments will be drawn in general for the same reason of low liquidity. (Note 3)But customers will have more incentive to draw funds from the banks who, in the anticipation of the customers, have the possibility of financial distress or failure. It will lead to the phenomenon that banks with poor financial status could experience a double outflow of funds, including both deposit outflow and loan commitment draw-downs, on the contrary, banks in good health will face the opposite situation. The double outflow can be observed more clearly by comparing the failed banks with the non-failed banks.

Table 2. Double outflow in failed banks and non-failed banks

Panel A				
	Number of Bank Failure*	Mean Estimated Loss	Average Number of DOF	Average Number of DOF in healthy banks
2001	1	-	-	0.075
2002	10	19 158	0.125	0.076
2003	3	30 984	-	0.086

2004	3	2 998	-	0.090
2005	0	-	-	0.085
2006	0	-	-	0.090
2007	2	-	-	0.121
2008	24	280 866	0.152	0.141
2009	126	152 923	0.282	0.151
2010	139	109 759	0.426	0.175
2011	86	67 923	0.509	0.188
2012	48	49 419	0.452	0.183
2013	24	52 214	0.313	0.189
2014	18	21 722	0.559	0.171
2015	8	113 363	0.281	0.146
2016	5	9 473	0.400	0.129

Panel B

	Last Quarter	2 Quarters	3 Quarters	1 Year
Before Crisis	14.28	-	14.28	-
During Crisis	27.54	27.54	15.94	5.80
After Crisis	46.50	45.75	37.50	38.50

Note: * indicates efficient number of double outflow

The phenomenon of double outflow in failed banks shows a different picture from that in healthy banks which are still in operation till the date of data selection. In Panel A, the quarterly average number of times of double outflow is much higher in the group of failed banks, despite the incompleteness of data due to the scarcity of bank failures. Panel B shows the proportion of double outflow occurrence in 3, 6, 9 and 12 months before the announcement date of bank failure. The double outflow could happen as early as one year before the failure.

The empirical specifications in this paper are designed as a similar framework of the setting in the paper of Kashyap et al, 2002. The part distinguishable is to divide the loan commitments into different items to analyze the effects from each elementary off-balance sheet activity. I choose three types of unused commitments as the independent variables to be tested in the model. They are commitments to commercial real estate construction and land development, commitments to revolving, open-end lines secured by 1-4 family residential properties and commitments for commercial and industrial loans. (Note 4) Transactions deposits and non-transactions deposits are included as dependent variables.

From the results in Table 3, it is indicated that the synergy effect of winner-take-all exists in nearly every pair of relationships in the sample of all commercial banks. The coefficients of the interaction terms are positive with statistical significance and the value subtracted by the base coefficients of the corresponding independent variable is still positive, which means deposits and loan commitments tend to move in the same direction when there is a double outflow or double inflow. In particular, the coefficients of double inflow appear to be smaller than that of double outflow. Double outflow from deposits and loan commitments would cause liquidity shortage or even disaster to the banks with poor performance of operation and diminishing confidence of both depositors and loan commitments users.

The variable which controls the bank size is irrelevant with change of transactions and non-transactions deposits. However, the relationship with capital ratio represented by the particular item of Total Risk-based Capital Ratio is significantly negative through all models. This effect is not notably significant in the group of large commercial banks, while small commercial banks as the majority of the whole sample accounts for the reason. Liquidity ratio is positively correlated with the growth of deposits, which supports the logic that banks with better financial status will have more deposits inflow and the liquidity sufficiency is further enhanced. The relationship becomes slightly weaker in the models of non-transactions deposits. The coefficients of provisions to loans and leases can also provide to some extent consistent evidence that banks with higher provisions will experience lower inflow of deposits, albeit this indicator does not represent realized losses in the asset portfolios.

Table 3. Synergy tests for all commercial banks

	Transactions Deposits			Non-transactions Deposits		
	(I)	(II)	(III)	(I)	(II)	(III)
D1	0.015***	0.012***	0.013***	0.022***	0.016***	-0.002***
	(54.676)	(39.369)	(50.381)	(31.807)	(12.800)	(-2.990)
D2	-0.012***	-0.017***	-0.018***	-0.004	0.011	3.0E-04
	(-3.710)	(-13.156)	(-36.606)	(-0.243)	(0.401)	(0.218)
Revrat	-1.025***			-1.661***		
	(-8.322)			(-8.368)		
Redrat		-0.627***			-1.053***	
		(-30.347)			(-27.939)	
Cirat			-0.066			0.009
			(-1.076)			(0.852)
lnta	-0.001	-0.001	0.033	0.012	0.013	0.170
	(-0.353)	(-0.243)	(1.487)	(0.741)	(0.799)	(1.395)
Caprat	-0.109***	-0.109***	-0.138***	-0.127***	-0.127***	-0.162***
	(-15.401)	(-15.406)	(-15.743)	(-20.157)	(-20.242)	(-17.650)
Liqrat	0.136***	0.130***	0.091**	0.144***	0.126**	-0.148
	(8.426)	(7.956)	(2.034)	(2.769)	(2.329)	(-0.612)
ROA	0.084	0.083	-0.036	-0.445**	-0.425**	0.217
	(0.294)	(0.291)	(-0.376)	(-2.264)	(-2.195)	(0.597)
PTLL	-1.6E-04	-1.7E-04	-0.412***	-0.001**	-0.001**	-0.685***
	(-1.088)	(-1.178)	(-4.511)	(-2.455)	(-2.518)	(-4.103)
Revrat*D1	1.908***			3.966***		
	(11.769)			(10.581)		
Revrat*D2	4.163**			16.899		
	(2.120)			(1.483)		
Redrat*D1		0.964***			1.928***	
		(26.989)			(15.335)	
Redrat*D2		1.212***			7.979*	
		(7.758)			(1.949)	
Cirat*D1			0.313***			0.463***
			(4.488)			(4.848)
Cirat*D2			0.484***			0.646
			(3.572)			(1.154)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	463 123	463 123	178 637	463 123	463 123	178 637
R-square	0.18	0.19	0.22	0.02	0.02	0.02

***, **, * are significant at the 1%, 5%, and 10% level respectively; The sample of Cirat is from the first quarter of 2010 to the fourth quarter of 2016; Revrat is the ratio of quarterly change of revolving, open-end lines secured by 1-4 family residential properties; Redrat is the ratio of quarterly change of commitments to fund commercial real estate, construction, and land development loans secured by real estate; Cirat is the ratio of quarterly change of other unused commitments (Note 5).

The empirical regressions for large commercial banks with a threshold of total assets greater than $1 billion show an even stronger effect in the consideration of double liquidity inflow and outflow. Both deposits and unused loan commitments of large commercial banks account for the larger part of the whole banking sector, and some of the banks are regarded as too-big-to-fail institutions which have received a series of generous rescue facilities from the Federal Reserve Bank. Even a tiny disturbance in funding liquidity of large banks would give rise to an overall turmoil of much bigger magnitude. The winner-take-all effect itself could cause severe liquidity shortage within a specific group of banks, let alone the deterioration of asset quality in some major banks during the crisis period. As it is shown in the Table 4, the winner-take-all effect is slightly stronger than that of the whole sample. However, there is an exception in regressing non-transactions deposits against the commitments for commercial and industrial loans. During the recent financial crisis, borrowers rushed to draw down their existing lines of credit, much of which were

financing commercial and industrial loans. The momentum of commitment draw-downs caused a transitory increase of loan origination. The change of non-transactions deposits is negatively correlated with the change of commitments for commercial and industrial loans, which implies that less draw-down on commitments corresponds to larger outflow of deposits.

The bank size control variable is positively correlated with the quarterly changes of transactions deposits, which is different from the results of whole sample in Table 3. It reveals a fact that funding is chasing the banks with bigger size. The information about financial status and operation for large banks, especially the money center banks, is more available and accessible for the general public and investors. The depositors will make their withdrawal decisions based on the judgment that the bank will suffer from a financial distress in the near future, while the judgment can be subjective and arbitrary. The inflow into the banks with larger size is more significant in transactions deposits. Non-transactions deposits, to some degree, have a different strategic behavior.

Unlike the results of all commercial banks, there is no homogeneous effect of the capital ratio on the flow of deposits in the group of large banks. The coefficients of ROA also suggest a different pathway of cash flow from small commercial banks. Large banks with stronger financial performance will receive inflow of non-transactions deposits. The sample period of unused commitments for commercial and industrial loans is relatively shorter than the former two categories, while this does not affect the consistency in the coefficients of liquidity ratio. The capital ratio in this subsample is approximately irrelevant with the change of deposits. In model (II) of transactions and non-transactions deposits, the bank fixed effect is not significant, indicating that the large banks are homogenous in the relationships with REDRAT.

Table 4. Synergy tests for large commercial banks

	Transactions Deposits			Non-transactions Deposits		
	(I)	(II)	(III)	(I)	(II)	(III)
D1	0.014***	0.011***	0.013***	0.023***	0.021***	-0.001
	(24.824)	(25.728)	(17.338)	(9.434)	(16.972)	(-0.619)
D2	-0.012***	-0.013***	-0.012***	-0.037***	-0.030***	0.004
	(-14.660)	(-23.654)	(-13.660)	(-9.270)	(-18.450)	(1.305)
Revrat	-0.312***			-0.751**		
	(-2.570)			(-2.019)		
Redrat		-0.595***			-1.114***	
		(-11.941)			(-11.439)	
Cirat			-0.640***			0.364***
			(-6.594)			(3.512)
lnta	0.005**	0.005**	0.016**	0.026*	0.026*	0.124
	(2.341)	(2.371)	(2.400)	(1.808)	(1.746)	(1.501)
Caprat	-0.004	-0.004	-0.005*	-0.039	-0.038	-0.035
	(-1.340)	(-1.384)	(-1.921)	(-1.239)	(-1.191)	(-1.219)
Liqrat	0.031***	0.031***	0.075***	0.063***	0.060***	0.198***
	(3.646)	(3.662)	(4.007)	(3.489)	(3.324)	(2.924)
ROA	-0.021	-0.011	-0.056	0.237**	0.216*	0.416**
	(-0.752)	(-0.365)	(-0.651)	(2.044)	(1.896)	(2.138)
PTLL	0.002***	0.002***	-0.093***	-0.004	-0.004	-0.531***
	(3.951)	(4.409)	(-3.763)	(-0.444)	(-0.445)	(-8.151)
Revrat*D1	1.023***			4.697***		
	(5.910)			(4.259)		
Revrat*D2	0.468**			0.765*		
	(2.167)			(1.888)		
Redrat*D1		0.768***			2.340***	
		(10.629)			(11.933)	
Redrat*D2		0.640***			1.535***	
		(8.958)			(12.489)	
Cirat*D1			0.833***			0.700**
			(5.972)			(2.423)
Cirat*D2			0.845***			-0.533***
			(5.159)			(-3.352)

Bank Fixed Effects	Yes	No	Yes	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35 807	35 807	17 490	35 807	35 807	17 490
R-square	0.09	0.10	0.08	0.07	0.06	0.04

***, **, * are significant at the 1%, 5%, and 10% level respectively; The sample of Cirat is from the first quarter of 2010 to the fourth quarter of 2016; Revrat is the ratio of quarterly change of revolving, open-end lines secured by 1-4 family residential properties; Redrat is the ratio of quarterly change of commitments to fund commercial real estate, construction, and land development loans secured by real estate; Cirat is the ratio of quarterly change of other unused commitments.

In the empirical tests for the subsample of small commercial banks, the effects of double inflow and outflow are not as significant as the results in the whole sample and the subsample of large banks, and the double outflow interaction terms are not strictly different from the main effects in the models with non-transactions deposits. One of the reasons is that drastic decline of deposits and draw-downs of loan commitments in small commercial banks do not occur regularly and simultaneously since the beginning of this century. Loan commitment contracts signed with small commercial banks only account for a limited portion of the total amount of unused commitments. Wholesale funding is not the primary tool to finance the lending of small institutions, especially regional organizations like community banks. On the side of the transactions deposits, double outflow and double inflow are much more evident.

The capital ratio is negatively correlated with the change of both categories of deposits, which is quite different from that in the group of large banks. It indicates that the higher capital ratio a small commercial bank has, the lower inflow of funds into the deposits there would be. With higher capital ratio, banks will not have as much cash as the ones with lower capital ratio, hence less opportunity of investment into the assets of higher returns. Therefore, the capacity of pursuing profits will be weakened. The coefficients of provisions to loans and leases also provide evidence that poor financial status is generally connected with less deposit inflow. The normally opposite indicator, liquidity ratio, conveys a similar message that the abundance of cash and treasury securities gives banks more resistance to withstand contingent liquidity shock. The confidence of depositors plays a key role in those two situations. As described above, the source of deposits in small commercial banks mostly comes from retail banking, which gives the banks less room to make discretionary choice to adjust the structure of asset portfolios.

Table 5. Synergy tests for small commercial banks

	Transaction Deposits			Nontransaction Deposits		
	(I)	(II)	(III)	(I)	(II)	(III)
D1	0.016***	0.013***	0.013***	0.022***	0.015***	-0.002**
	(51.993)	(38.428)	(47.958)	(26.125)	(10.993)	(-2.231)
D2	-0.012***	-0.017***	-0.018***	0.002	0.013	-4.2E-04
	(-3.055)	(-12.332)	(-34.595)	(0.089)	(0.464)	(-0.257)
Revrat	-1.151***			-1.761***		
	(-7.957)			(-8.403)		
Redrat		-0.627***			-1.050***	
		(-29.243)			(-26.974)	
Cirat			-0.060			0.008
			(-1.063)			(0.862)
lnta	-0.001	-0.001	0.045	0.014	0.015	0.210
	(-0.319)	(-0.181)	(1.518)	(0.651)	(0.732)	(1.285)
Caprat	-0.111***	-0.111***	-0.141***	-0.128***	-0.128***	-0.166***
	(-19.695)	(-19.668)	(-23.004)	(-22.813)	(-22.809)	(-16.693)
Liqrat	0.140***	0.133***	0.069	0.146***	0.129**	-0.211
	(8.304)	(7.825)	(1.395)	(2.648)	(2.261)	(-0.769)
ROA	0.088	0.086	-0.058	-0.489**	-0.456**	0.181
	(0.288)	(0.281)	(-0.584)	(-2.240)	(-2.147)	(0.509)
PTLL	-1.8E-04	-1.9E-04	-0.489***	-0.001**	-0.001***	-0.776***
	(-1.100)	(-1.190)	(-7.701)	(-2.552)	(-2.639)	(-3.540)
Revrat*D1	2.034***			3.888***		0.344**
	(10.856)			(8.972)		(2.532)

Revrat*D2	4.770**			20.201		0.704
	(2.104)			(1.444)		(1.165)
Redrat*D1		0.971***			1.920***	
		(25.761)			(14.528)	
Redrat*D2		1.236***			8.219*	
		(7.492)			(1.936)	
Cirat*D1			0.331***			0.344***
			(4.883)			(2.530)
Cirat*D2			0.484***			0.704
			(3.432)			(1.161)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	427 316	427 316	161 147	427 316	427 316	161 147
R-square	0.19	0.19	0.23	0.02	0.02	0.02

***, **, * are significant at the 1%, 5%, and 10% level respectively; The sample of Cirat is from the first quarter of 2010 to the fourth quarter of 2016; Revrat is the ratio of quarterly change of revolving, open-end lines secured by 1-4 family residential properties; Redrat is the ratio of quarterly change of commitments to fund commercial real estate, construction, and land development loans secured by real estate; Cirat is the ratio of quarterly change of other unused commitments.

The interpretation of the results could lead to the explanation of why the liquidity shock has brought disastrous consequences to the banking system. When market condition is deteriorating and liquidity in general is shrinking, loan commitment customers who have typically signed the contracts before the occurrence of the first event of disturbance will draw down the lines of credit because of the fear of uncertain financing cost in the future.

In the meanwhile, depositors, especially wholesale depositors would have the incentive to withdraw their money from the bank in which they consider their accounts are too risky to hold as cash or deposit, and transfer the amount into other banks which they consider as safe heaven.

The problem is these two contingent liquidity demands could coincide with one another at some particular banks. The safer banks are the winners who will take all, on the other hand, risky banks are going to lose all, and this effect will deepen the differentiation between the banks that benefit and the banks that suffer. The liquidity shock effect will be doubled up and eventually exacerbate the stress faced by the banks with poor financial capability. Since wholesale funding is relatively more capricious than retail funding, this particular behavioral pattern forms the prelude of the new form of bank run.

4. Conclusions

Liquidity risk has drawn more attention since the recent financial crisis and is considered to be at the core of financial risk, along with market risk and credit risk. In the perspective of one particular banking institution, the key to identify liquidity risk is to capture the real behavioral pattern from each claim underneath the existing operating framework. This paper studies the funding liquidity risk in commercial banking institutions by reconsidering the synergy between deposit-taking and lending. The synergy is one of the advantages of banks to maintain their specialness as financial intermediaries, while the unique characteristic depends on the fact that they two activities are not perfectly correlated. The major findings in this study reshape the traditional viewpoint regarding the synergy.

As it is shown in the cross-sectional correlation coefficients, the overall relationship between loan commitments and deposits is slightly positive or sometimes negative. In the hypothesis of this study, the curve between the correlation and the corresponding fundamental funding cost should be in the shape of inverse-U. However, a hidden pattern, winner-take-all effect, has long been undiscovered behind the synergy appearance. In consequence, there are outliers in the curves and thus the shape of inverse-U does not fit all the curves of every chosen pair of variables.

The empirical results are supportive to the effect. Through the analysis of the dynamic relationship between loan commitments and deposits, the winner-take-all effect is uncovered evidently. Banks which experience a large amount of draw-downs on the loan commitments will also face the outflow of deposits. Furthermore, different dynamic features are unfolded by separating the whole sample into subsamples of large banks and small banks. This phenomenon is concealed under the calm surface of aggregate banking system in the world without large-scale turbulence, but will cause severe liquidity shortage for one particular institution during the period of contingent

shock.

The limitation of this study is that the characteristics of the bank which experiences double outflow could not be captured by the analytical framework in this paper. More specifically, it is also uncertain whether banks of different size or different business model have similar strategies for the liquidity shock of double outflow. Furthermore, the impact of the winner-take-all effect on money supply of the whole financial system is still to be studied. One direction of future research can be forwarded to the investigation of a generalized dynamic relationship between contingent assets from off-balance sheet activities and wholesale liabilities. On the other hand, based on the results of this paper, we can explore the theoretical existence of optimal liquidity buffer in the face of the two sources of funding liquidity risk in commercial banking and find the empirical evidence by comparing the strategies of the failed banks with that of non-failed banks in the period of financial crisis.

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Notes

Note 1. This item reports the unused portion of all other commitments not reportable above. Include commitments to extend credit through overdraft facilities or commercial lines of credit and retail check credit and related plans.

Note 2. The selected deposits accounts are deposits of Individuals, partnerships, and corporations. Total demand deposits are included in the transactions accounts and money market deposit accounts (MMDAs) are included in the non-transactions accounts.

Note 3. The draw-down of loan commitments will increase the realized loans in the assets and also increase deposits in the liabilities. The double outflow of funds occurs only when the increased deposits from draw-down of loan commitments and the existing deposits simultaneously experience withdrawals, and the financial institution will face more pressure on available liquidity.

Note 4. The majority of this item is the category of commitments to commercial and industrial loans.

Note 5. This item of unused commitments is divided into three categories since the first quarter of 2010, which are commitments for commercial and industrial loans, commitments for loans to financial institutions and all other unused commitments.