Risk-taking Channel of Bank Liquidity Creation Affecting Real Economy: Recommendation to tobacc industry

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Objection:We investigate whether risk-taking channel exsits in the interaction of monetary policy, macroprudential regulation, liquidity creation and enterprise output. Methods: We adopt the mediating effect model with stepwise regression, Sobel and Bootstrap test to identify risk-taking mechanism of liquidity creation impact on real economy. Results: We find that pricing tools of monetary policy and macroprudential tools can inhibit the changes of risk-taking and liquidity creation caused by quantitative tools. In particular, the increasing systemic risk arises the off-balance-sheet liquidity creation. Consequently, risk-taking is an important channel for regulating affect liquidity creation. We also find that liquidity creation can increase business income through credit line. Conclusions: Reducing the internal conflict between monetary policy and macroprudential regulation and improving the banks' soundness is beneficial to liquidity creation, further stimulating the sustainable development of enterprises. In particularly, bank should innovate credit products, for example tobacco loan in Yunnan or Gui Zhou, to support of regional economic growth.

Keywords: Liquidity creation; Risk-taking; Enterprise output; Tobacco industry
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INTRODUCTION

Banks pursue profits in nature as the main entity for creating liquidity. Insufficient regulation on bank liquidity can trigger the "Minsky Moment" easily. Also, the dual-pillar regulation policies made by monetary policy and macroprudential policy affect the real economy through the liquidity created by banks [1] Bank credit, as an important part of liquidity creation and an important external financing source for enterprises, plays an important role in solving the unaffordable financing and difficulty in financing.

According to the modern theory of financial intermediary, banks convert on-balance-sheet liquid

liabilities into on-balance-sheet illiquid assets or off-balance-sheet liquid assets through loan commitments. [2-4] However, liquidity creation is risky. Banks may reduce the individual liquidity and increase risk exposure, which are coerced to monetize illiquid assets to meet customer liquidity needs, thus increasing the possibility of loss [5,6] In extreme cases, increased aggregate demand for liquidity may bring about bank failures, which are caused by depositors. The increasing liquidity creation leads to the increase of bank illiquidity, causing bank vulnerability [7] At the micro level, the co-sharing risk of bank capital liquidity affects liquidity creation and may cause bankruptcy risk [8,9] High capital adequacy ratio improves bank-borrower relationships. It reduces the excessive risk-taking from the bank side, but also creates more risks because of searching for yield. For enterprises, uncertain economic policies may affect the leverage decision through changing loan behaviors and risk-taking channels [10]

Some researchers focus on the relationship between bank credit and industries. Bank can mitigating the negative effects of financial crises on growth for industries. Agriculture in financial crisis, farmers are struggling to refinance in Denmark[11] The tobacco industry attract consumers[12] which is profit for bank lending to these firms. Therefore, establishment of tobacco products available for the credit standard maybe a benefit project for commercial banks. [13]

However, the past study on dual-pillar regulation and bank liquidity creation paid little attention to the role of banks and enterprises. By contrast, this paper selects the data of listed banks and companies from 2014 to 2018 to explore the risk-taking channels and liquidity creation affects the output of listed companies. This paper aims to test the existence of risk-taking channels based on stepwise regression, Sobel and Bootstrap methods. It can empirically study the impact of dual-pillar regulatory policies on liquidity creation, and test the mechanism of liquidity creation on enterprise output using bank credit lines as mediating variables. In addition, the paper provide some implications to tobacco industry as an example of credit financial innovations to tobacco firms in China. The structure of this paper is as follows. Section 1 is literature review. Section 2 is data and methodology. Section 3 is empirical analysis. Section 4 is conclusions.

LITERATURE REVIEWE

Monetary Policy, Macroprudential Policy and Risk-taking

Loose monetary policy can increase banks' risk-taking behavior, and worsen maturity mismatch and high leverage risk, while tight monetary policy can restrain banks' risk-taking behaviors. Due to information asymmetry, banks are prone to loosen regulation on borrowers under excessive loose monetary policy, and will expand their balance sheets excessively. Low interest rates also increase risks taken by banks. [14] In addition, central banks inject liquidity into the market through asset purchases, which cause banks to take more risks.[15] However, according to some scholars, there is no significant correlation between monetary policy and risk-taking behavior of financial institutions.[16]

Macroprudential policy can restrain banks' risk-taking behaviors through capital. On the one hand, capital can be used as a buffer [17] to deal with potential losses and reduce risks. On the other hand, capital mobilizes banks to better monitor their relationship with borrowers and reduce excessive risk.[9] However, capital requirements can restrain banks from taking excessive risks, but strict regulatory standards will curb bank credit.[18,19] In addition, liquidity regulatory tools outperform capital regulatory tools to some extent. A certain amount of unoccupied liquid assets held by banks can effectively strengthen the banks' resistance to the risk of run, and tightening liquidity requirements for reducing the probability of crisis does not undermine the consumption growth. [20,21] Therefore, the following hypothesis is proposed:

Hypothesis 1: Loose monetary policy encourages banks to undertake more risks, but different cases vary as the tools differ from each other; macroprudential policy helps reduce risk-taking and maintain bank stability.

Liquidity Creation and Risk-taking

The central bank regulates liquidity creation by money supply and demand to adjust total credit and interest rates. Monetary easing policy affects liquidity, and banks overissue or reduce loans because of underestimated or overestimated risk.[22] The theories on how the capital influences liquidity creation mainly can be divided into financial fragile theory and risk absorption theory. Stress tests adversely affect liquidity creation, and economic policy uncertainty may improve liquidity creation.[23,24]

There is controversy about the relationship between liquidity creation and bank bankruptcy risk. Some argue that liquidity creation is positively related to bank bankruptcy risk [5,6] Others hold that liquidity creation is in negative correlation with bank bankruptcy risk. Banks create liquidity and support macro economy through maturity transformation, which is conducive to financial stability.[25] Therefore, the following hypothesis was proposed:

Hypothesis 2: The less risk the bank takes, the more stable the bank, which helps to increase the bank liquidity creation.

Liquidity Creation and the Real Economy

Banks create liquidity through on- and out-of-balance-sheet operations, as well as asset and liability, and expand the real economy by bank loans. Liquidity creation is in positive correlation with economic output , but it could accelerate economic cyclical fluctuations.[1] Low on-balance-sheet liquidity creation can cause economic recession, and excessive liquidity creation may bring about asset price bubbles and even financial crisis.[26-28] Bank credit can not only provide liquidity for enterprises, but also help enterprises overcome financial difficulties and promote enterprise investment , which is especially important for China with financial system dominated by banks.[29] Therefore, the following hypothesis is proposed:

Hypothesis 3: Bank liquidity creation positively impacts enterprise output through bank credit, and acts on the real economy.

DATA AND METHODOLOGY

Samples and Data

Macroeconomical, banking and enterprise data from 2015 to 2018 are referred in empirical analysis.

At the macro level, the data for reserve requirement ratio and M2 growth rate of monetary policy tools come from the website of the People's Bank of China. Systemic risk data (based on the daily closing price of 16 listed banks which is converted into annual data) and interbank lending rate in Shanghai were derived from the database.

At the banking level, 16 Chinese commercial banks are selected, including ICBC, CCB, Agricultural Bank, Bank of Communications, Bank of China, Ping an Bank, CITIC Bank, Pudong Development Bank, Industrial Bank, China Merchants Bank, Everbright Bank, Minsheng Bank, Huaxia Bank, Bank of Beijing, Nanjing Bank and Ningbo Bank. Macroprudential regulatory tools, capital adequacy ratio, leverage ratio, and data for calculating risk-taking are originated from Bankscope databases.

At the enterprise level, the data of bank credit line (proxy of bank credit) and financial statements of listed companies come from CSMAR database. Given the shortage of bank credit line data, according to the 2012 Industry Classification of the CSRC, after excluding the financial industry and the ST companies of the year, this study selects the top 10 industries of GDP in China Statistical Yearbook, , including 824 listed companies in agriculture, forestry, animal husbandry, fishery, mining, manufacturing, construction, wholesale and retail trade, transportation and warehousing postal, accommodation and catering, real estate and software and information technology services. Furthermore, considering the possible impact of outliers on the empirical results, all continuous variables are winsorized at the level of 1% and 99% for non-equilibrium panel data.

Core Variables

Explained variable: bank liquidity creation

According to the liquidity creation index from Berger & Bouwman,[30] the "cat fat" classification is adopted to divide the internal and external items of the balance sheet of commercial banks into three categories: liquidity, semi-liquidity and illiquidity. Given the reality of China, this thesis uses this index to re-screen the report items to measure the liquidity creation *Lc* of Chinese commercial banks (Table 1).

Mediating variable: bank risk-taking

Z-score is used to measure risk taken by banks (logarithmic *Z-score* was expressed as *lnzscore*), and the calculation formula is: $Z = (CAR + \mu_{ROA}) / \sigma_{ROA}$. When $E \le -\pi$ (π was the profit), bankruptcy occurs, and bankruptcy probability is expressed as $P(ROA \le -CAR)$. Where $ROA(=\pi / assets)$ was the return on assets, CAR $(CAR = equity / assets)$ is the capital-asset ratio. Suppose that ROA is a random variable and obeys normal distribution, that is, $ROA \sim (\mu_{ROA}, \sigma^2_{ROA})$. *Z-score* and bankruptcy probability are in negative correlation. The *Z-score* is bigger which implies the bank risk aversion is greater, and the bankruptcy probability is smaller. A three-year window scroll is adopted to calculate the *Z-score* (table 1).

Other Variables

Table 1

Other variables

Variable name	Variable symbol	Variable meaning	Variable type
Reserve requirement ratio	Req	It is a central bank regulation that sets the minimum amount of reserves that must be held by a commercial bank or a deposit financial institution to the total amount of its deposits. The higher the value, the less capital the commercial bank can use.	Explanatory variable: monetary policy instrument
Broad money supply	M2	It is the cash and enterprise deposits, resident savings deposits and other deposits circulated outside the banking system. M2 growth rate is used as the quantitative tool variable of monetary policy in this thesis.	
Interbank lending rate in Shanghai	Shibor	It refers to interbank open-in rate and the open-out rate of financial institutions, which reflect the short-term capital supply and demand relationship in money markets and financial markets. 7-day interbank offered rate (R7) is chosen as the price-based monetary policy instrument in this thesis.	
Capital adequacy ratio	Car	Ratio of total bank capital to its risk-weighted assets.	Explanatory variable: macroprudential tool
Liquidity coverage ratio	Lcr	The aim is to ensure that commercial banks are able to maintain sufficient, non-disable, high-quality liquid assets under the set severe liquidity pressure scenarios and meet liquidity needs for the next 30 days by monetizing these assets.	
Leverage ratio	Lr	Equal to the sum of primary capital divided by weighted risky assets.	

Banking systematic risk	Bsr	The CoVaR calculated based on Copula function (after repeated tests, t Copula, Gumbel Copula and Frank Copula functions are mainly used in this thesis) 1	
Enterprise output	Loutput	Logarithmic operating income	Explained variable
Operating cost	Lcost	Logarithm of operating cost	Output substitution variable
Bank credit line	Lcreditline	Logarithm of borrowing by listed companies from banks	Mediating variable
Monetary cost	Lcash	Logarithm of corporate cash, bank deposits and other monetary funds	
Enterprise scale	Lsize	Logarithm of total assets	
Investment efficiency	TobinQ	Enterprise market value/total assets	
Equity cost	EquityCost	CAPM Model is used to calculate the required rate of shareholder	Control variable
Management compensation ratio	MS	Total annual management compensation/ operating income	
Financial expense rate	FCR	Financial expense/operating income	
Asset-liability ratio	Lev	Liabilities/total assets	
Fixed asset ratio	FL	Fixed assets/total assets	
Growth rate of main operating income	Growth	(Main operating income - main operating income of the previous year)/ main operating income of the previous year	
Listing age	Lage	Logarithm of listing age	

Empirical Models and Test Methods

The mediating effect model of risk-taking channel that monetary policy and macroprudential regulation influenced bank liquidity creation is shown as follows:

$$Lc_{it} = \alpha_0 + cP + e_{1it} \quad (1)$$

$$lnzscore_{it} = \beta_0 + aP + e_{2it} \quad (2)$$

$$Lc_{it} = r_0 + c'P + blnzscore_{it} + e_{3it} \quad (3)$$

Where *Lc* is the liquidity creation, which can be divided into on-balance-sheet liquidity creation (LCN) and off-balance-sheet liquidity creation (LCW). *P* means the policy tool variable for monetary policy or macroprudential regulation. Monetary policy tools include *Req*, *R7* and *M2* growth rate. Macroprudential regulatory tools refer to *Car*, *Lr*, *Lcr*, and *Bsr*（table 1）. Where *i* is each individual bank, *t* refers to the year, and e_{it} represents the residual error of each model.

The empirical model of liquidity creation affecting enterprise output is listed as follows:

$$Loutput_{it} = \alpha_0 + cLc_t + \gamma Control_{it} + u_i + e_{4it} \quad (4)$$

$$Lcreditline_{it} = \beta_0 + aLc_t + \gamma Contro_{it} + u_i + e_{5it} \quad (5)$$

$$Loutput_{it} = r_0 + c'Lc_t + bLcreditline_{it} + \gamma Control_{it} + u_i + e_{6it} \quad (6)$$

Where $Loutput_{it}$ is the output level of the enterprise individual *i* after taking logarithm in the year *t* and it is expressed by operating income; $Lcreditline_{it}$ is the credit line sum that bank endows the enterprise individual *i* in the year *t*; Lc_t is the total liquidity creation of 16 banks in the year *t*; $Control_{it}$ means the other enterprises' characteristic variables affecting bank credit lines, including *Lsize*, *Fl*, *Growth* and *Lage*, *Lcash*, *Ms*, *Fcr*, *Lev*, *EquityCos*t and *TobinQ*; u_i is the enterprise individual effect, and e_{it} refers to the residual error of each model.

[1]Brunnermeier (2009) put forward the CoVaR method based on VaR. He introduced a conditional concept to calculate the level of VaR of other financial institutions when one financial institution is at a certain level. This improvement can measure the spillover effect of one financial institution on other financial institutions. Comparing the CoVar data of all financial institutions in normal state with that of the whole system when a financial institution is in trouble, we can also describe the contribution of the financial institution to the system risk.

The model focuses on the significance of *a, b, c, c′*. According to the test method of mediating effect, the specific steps of the test (bank risk taking and credit line) are as follows: (1) Test the significance of regression coefficients in order: the coefficients *a* and *b* are significant. In terms of paths *a* and *b*, if the originally significant *c* becomes the non-significant *c′*, which shows it is complete mediation; if the c' is significant, it is shown to be only partial mediation; (2) Test whether the product *ab* of regression coefficients on the path of mediating variable is significant. If the original hypothesis is rejected, the mediating effect is significant. In this thesis, the *Sobel* and *Bootstrap*[2] methods are mainly adopted to test whether mediating effect exists.

EMPIRICAL ANALYSIS

Descriptive Analysis

Table 2

Analysis of descriptive statistics

Variable	Mean value	Standard deviation	Minimum value	Maximum value	Observed value
Lnzscore	4.941	0.5490	3.9370	6.4030	64
Lc	0.2008	0.0982	-0.0365	0.3637	64
Lcnr	0.1280	0.1019	-0.1088	0.2779	64
Lcwr	0.0675	0.0236	0.0211	0.1452	64
Req	0.1650	0.0118	0.1450	0.1750	64
M2	0.0994	0.0255	0.0699	0.1334	64
R7	0.0305	0.0031	0.0255	0.0332	64
Car	0.1311	0.0147	0.1080	0.1719	64
Lr	0.0615	0.0080	0.0484	0.0805	64
Lcr	1.1295	0.2232	0.7554	2.0657	64
Bsr	0.0459	0.0205	0.0176	0.1054	64
Output	1097011	3694877	1300.194	73000000	2636
Cost	893782.6	3223922	361.7068	65900000	2636
Creditline	535993.1	1961949	12	39900000	2636
Size	2151852	7487390	22477.51	153000000	2636
Cash	295301.4	998372.5	537.4785	18800000	2636
TobinQ	2.006014	1.610949	0.734936	27.33802	2636
EquityCost	69.97364	62.3982	-49.32689	251.26	2636
MS	0.2872037	0.7132652	0.0011092	27.65511	2636
Lev	51.83646	20.03422	1.9687	175.8354	2636
Fl	21.80236	16.64278	0.0215733	86.81863	2636
Gowth	22.91635	147.3117	-87.80543	5848.691	2636
Nature	0.5417299	0.4983501	0	1	2636

The unit of enterprise output, operating cost, bank credit line, enterprise size, monetary fund and listing age are all ten thousand yuan. Except for that, the above variables are marked based on the ratio. The enterprise

[2]The approximate formula s obtained by Sobel (1982, 1988) gained the approximate formula $s_{ab} = \sqrt{\hat{a}^2 s_b^2 + \hat{b}^2 s_a^2}$ based on the Taylor expansion of order 1, where s_a, s_b is the standard error of a^, b ^.The test statistic is $z = \hat{a}\hat{b}/s_{ab}$ or Sobel test, which is higher than sequential test. Bootstrap method is a kind of repeated sampling method. It does not involve population distribution and parameters (so normal hypothesis is not required). It uses empirical distribution derived from samples to replace population distribution and belongs to nonparametric method.

output, operating cost, bank credit line, enterprise size, monetary fund and listing age have corresponding logarithm in empirical analysis From the results of descriptive statistics（Table 2）, bank risk-taking varies. In the total amount of liquidity creation, the *LCN* dominates. *Req* is above 2 digits. *M2* mean value is also close to 10%, which shows abundant money supply. R7 is about 3%, and the financing cost is still higher than the one-year deposit rate. *Car* is as high as above 10%, because of strict supervision of large banks. *Lr* is above 4%, and *Lcr* is more than 100%, which meets the regulatory requirements. However, the *Lr* and *Lcr* of individual banks are lower than the regulatory requirements. The difference in systematic risk exposure of *Lr* is also great. Both state-owned enterprises and non-state-owned enterprises account for half in terms of systematic risk exposure of *Lr* and there is heterogeneity in enterprise size and output. The difference in *Lcreditline* obtained by enterprises is also great, with the minimum value of 120,000 and the maximum value of 39,900,000. *MS* is 0.29%, occupying a small part of enterprise labour costs, and the mean value of enterprise investment efficiency is about 2. Other control variables (*Lev*, *FL*, etc.) of listed companies also varied greatly.

Empirical Test of Risk-taking Channels

Table 3

Empirical results of bank risk-taking channels of financial regulatory policies affecting liquidity creation

Regulatory policy	Regulatory tool	*a*	*b*	*c*	*c'*
Monetary policy	*Req*	-28.9125***	0.0303***	-0.7821**	0.0940
	M2	-9.4500***	0.0261***	-0.3674**	-0.1205
	R7	102.9993***	0.02360***	3.8936***	1.4633
Macroprudential policy	*Car*	11.4628***	0.0257***	1.3960***	0.5439
	Lr	20.1336**	0.0243***	2.7834***	1.3475
	Lcr	0.9822***	0.0259***	0.0527**	0.0215
	Bsr	0.3299	0.0289***	0.0970	0.0820

Note: *, **, *** indicates that the coefficient is significant at 0.1, 0.05 and 0.01, respectively.

Based on Table 3, the coefficients a, b, c are statistically significant. Because of the risk taking, the coefficient c' is not statistically significant, which means that the mediating effect of bank risk taking is obvious when regulatory policy affects bank liquidity creation. By changing bank risk taking, regulatory policy changes the bank risk preference and the structure of *LCN* and *LCW*. There are positive and negative regulatory policy variables and bank risk taking symbols, which is in line with the Hypothesis 1. As *Req* and *M2* increase, the bank should take more risks. Whereas the *R7*, *Car*, *Lr* and *Lcr* increases, the bank bankruptcy risk decreases. Easy monetary policy and quantitative instruments will increase the level of bank commitment, while price instruments and macro-prudential instruments will restrain banks from taking excessive risks. This is also true for their effect on bank liquidity creation. *Bsr* has little effect on bank liquidity creation and risk-taking. Bank risk-taking is positively related to liquidity creation, which is in line with the Hypothesis 2. Reducing the risk of bank bankruptcy can increase the sustainability of lending scale and improve liquidity creation. Therefore, it can be seen that the establishment of a decision framework suitable for bank risk preference helps realize bank stability, further regulating the total amount of bank liquidity creation.

Table 4

Empirical results of bank risk-taking channel of financial regulatory policies affecting *LCN*

Regulatory policy	Regulatory tool	*a*	*b*	*c*	*c'*
Monetary policy	*Req*	-28.9125***	0.0269***	-0.9560***	-0.1781
	M2	-9.4500***	0.0199***	-0.61120***	-0.4233***
	R7	102.9993***	0.0234***	4.1131***	1.6988
Macroprudential	*Car*	11.4628***	0.0257***	1.5306***	0.6725
policy	*Lr*	20.1336**	0.0215***	3.6584***	2.3610***
	Lcr	0.9822***	0.0266***	0.0538**	0.0215
	Bsr	0.3299	0.0301***	-0.2886	-0.3010

Note: *,**,*** indicates that the coefficient was significant at 0.1, 0.05 and 0.01, respectively.

Table 4 shows that the mediating effect of bank risk taking was obvious when regulatory policy tools affect bank liquidity creation. The bank risk taking is part of the mediation effects of *M2* and *Lr* on *LCN*. The influence of *M2* and *Lr* on the *LCN* is partly transmitted through risk-taking channels, and may also be affected by other channels, such as lending channels and balance sheets. The bank risk taking is also positively related to the *LCN*. The more stable the banking system, the larger the scale of on-balance-sheet business lending will be, and the greater the *LCN* becomes.

Table 5

Empirical results of bank risk-taking channels of financial regulatory policies affecting *LCW*

Regulatory policy	**Regulatory tool**	***a***	***b***	***c***	***c'***
Monetary policy	*Req*	-28.9125***	0.0029	0.2582	0.3416
	M2	-9.4500***	0.0040	0.2318***	0.2695***
	R7	102.9993***	-0.0010	-0.4411	-0.3371
Macroprudential	*Car*	11.4628***	0.0008	-0.4799**	-0.4931**
policy	*Lr*	20.1336**	0.0022	-1.1184***	-1.2115***
	Lcr	0.9822***	0.0024	-0.0318***	-0.0341***
	Bsr	0.3299	-0.0024	0.2980***	0.3000

Note: *,**,*** indicates that the coefficient is significant at 0.1, 0.05 and 0.01, respectively.

According to Table 5, the mediating effect of bank risk taking is obvious when the regulatory policy tools affect *LCW*. Except for the *Bsr*, it is obvious that the regulatory policy tools have significant effects on bank risk taking. The risk-taking channels of regulatory tools do not have significant effects on *LCW*, so there is no need for the next test. Except for the *Req* and *R7*, the effect of other policy tools on *LCW* is significant. After risk-taking variables being introduced, monetary policy easing and *Bsr* rising increases *LCW*, while increasing *Car*, *Lr* and *Lcr* significantly reduces *LCW*. Generally, the Sobel and Bootstrap tests show that there is no risk-taking channel for regulatory tools to create the liquidity of off-balance-sheet business (Table 6).

Table 6

Sobel and Bootstrap tests for non-significant a and b coefficients

Regulatory policy	Regulatory tool	Product of Coefficients Approach	*Sobel / _bs_1*	*P>/Z/*	Deviation correction confidence interval BCBCI
Monetary policy	*M2*	Sobel	0.0053	0.9246	
		Bootstrap	0.0053012	0.925	(-0.074723，0.120935)
	Car	Sobel	0.00592301	0.9213	
		Bootstrap	0.005923	0.924	(-0.125791，0.114423)
Macroprudentia l policy	*Lr*	Sobel	-0.00931646	0.9309	
		Bootstrap	-0.0093165	0.937	(-0.208921，0.193803)
	Lcr	Sobel	0.00352528	0.5032	
		Bootstrap	0.0035253	0.557	(-0.009071，0.016360)
	Bsr	Sobel	-0.00174358	0.9232	
		Bootstrap	-0.0017436	0.939	(-0.044835，0.049840)

Note: the Sobel value of the Sobel test and the bs_1 of the Bootstrap test is $\hat{a}\hat{b}$, which reflected the mediating effect of agent variable lnzscore of risk-taking channel.

Test of Mediating Effect of Bank Credit Line

Based on Table 7, total bank liquidity creation and *LCN* are positively related to enterprise output. The expansion of on-balance-sheet business activities is conducive to the business income of enterprises. *LCW* is negatively correlated with enterprise output. The expansion of off-balance-sheet business activities reduce the proportion of bank credit business, weaken the bank liquidity creation, and inhibit the promotion of liquidity creation to operating income. The increase of cash flow and *Lev* increases the operating income. Management compensation, financing cost and *TobinQ* reduces enterprise output. After testing, there is an individual effect of company.

Table 7

Impact of bank liquidity creation on enterprise output

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	*Loutput*	*Loutput*	*Loutput*	*Loutput*	*Loutput*	*Loutput*
Lc	10.6566***	6.2150***				
	(0.5886)	(0.7461)				
Lcn			10.0666***	6.2927***		
			(0.5488)	(0.8038)		
Lcw					-61.8232***	-17.7313***
					(3.6412)	(5.7915)
Constant	10.2524***	8.0441***	10.9880***	8.5573***	16.4790***	10.1750***
	(0.1430)	(2.3662)	(0.1011)	(2.3727)	(0.2142)	(2.8531)
Controls	NO	YES	NO	YES	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES
Observations	2,632	2,632	2,632	2,632	2,632	2,632
R^2	0.223	0.606	0.244	0.609	0.202	0.580

Note: *, **, *** indicates that the coefficient is significant at 0.1, 0.05 and 0.01, respectively. The values in parentheses are cluster robust standard errors.

According to the results of Table 8, the total liquidity creation and LCN are positively correlated with the bank credit line, while the *LCW* is negatively correlated with that, which accords with the Hypothesis 3. This is especially important for commercial banks in China, because the vast majority of liquidity creation comes from on-balance-sheet business and is mainly enterprise loans. The increase in *LCW* means the decrease in on-balance-sheet business and enterprise loans.

Table 8

Impact of bank liquidity creation on credit lines

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	*Lcreditline*	*Lcreditline*	*Lcreditline*	*Lcreditline*	*Lcreditline*	*Lcreditline*
Lc	8.8883***	5.1500**				
	(1.5924)	(2.2895)				
Lcn			8.5713***	6.0220***		
			(1.4649)	(2.2751)		
Lcw					-59.5516***	-48.1131***
					(9.9033)	(13.7450)
Constant	9.5028***	6.9541***	10.0841***	7.3604***	15.1661***	11.4896***
	(0.3869)	(1.6643)	(0.2698)	(1.6197)	(0.5826)	(2.0008)
Controls	NO	YES	NO	YES	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES
Observations	2,632	2,632	2,632	2,632	2,632	2,632
R^2	0.020	0.039	0.023	0.041	0.024	0.043

Note: *,**,*** indicates that the coefficient is significant at 0.1, 0.05 and 0.01, respectively. The values in parentheses are cluster robust standard errors.

table 9 shows that bank credit lines are positively correlated with enterprise output. Liquidity creation and its structure as well as enterprise output symbol results are identical to those in the Table 8. The increasing banks' credit to enterprises can provide low-cost funds for enterprises' production activities and meet their demand for expanding production. If banks can provide more credit lines for enterprises and meet the growing capital needs of enterprises, the vitality of the economy will be enhanced. The financing channel of enterprise equity is limited, the management performance is not good, and there is a shortage of bank credit support. In the uncertain economic environment, enterprises are likely to be plunged into bankruptcy and impact the real economy.

Table 9

Impact of bank liquidity creation on enterprise output through credit lines

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	*Loutput*	*Loutput*	*Loutput*	*Loutput*	*Loutput*	*Loutput*
Lcreditline	0.0290***	0.0196***	0.0263***	0.0187**	0.0281***	0.0209***
	(0.0095)	(0.0076)	(0.0095)	(0.0075)	(0.0097)	(0.0076)
Lc	10.3992***	6.1138***				
	(0.5829)	(0.7294)				
Lcn			9.8415***	6.1800***		
			(0.5440)	(0.7845)		

Lcw					-60.1525***	-16.7268***
					(3.5980)	(5.6180)
Constant	9.9771***	7.9075***	10.7232***	8.4195***	16.0535***	9.9351***
	(0.1778)	(2.3114)	(0.1461)	(2.3194)	(0.2442)	(2.7804)
Controls	NO	YES	NO	YES	NO	YES
Firm FE	YES	YES	YES	YES	YES	YES
Observations	2,632	2,632	2,632	2,632	2,632	2,632
R^2	0.230	0.609	0.249	0.612	0.208	0.583

Note: *, **, *** indicates that the coefficient is significant at 0.1, 0.05 and 0.01, respectively. The values in parentheses are cluster robust standard errors.

Based on Table 10, bank credit lines are mediating variables that liquidity creation are used to affect enterprise output. All of bank credit lines belong to partial mediating effect, and the direct effect exceeds the mediating effect. This shows that liquidity creation can not only affect enterprise output through the mediating variables of bank credit lines, but also directly affect enterprise output. The liquidity creation may affect the enterprise output through other mediating variables, providing some enlightenment for future research to clarify the transmission channel.

Table 10

Bootstrap test results with credit line as the mediating effect of bank liquidity creation

Policy variable	Type of coefficient	Coefficient	z/t	p>|z|/ confidence level	Deviation correction confidence interval BCBCI
Bank liquidity creation (*LC*)	_bs_1	0.4827	2.75	0.006	(0.2545355, 0.9647025)
	c'	6.1138	8.38	0.000	
On-balance-sheet liquidity creation	_bs_1	0.4683	2.75	0.006	(0.2059661, 0.8217244)
(*LCN*)	c'	6.1800	7.88	0.000	
Off-balance-sheet liquidity creation	_bs_1	-3.1485	-2.43	0.015	(-8.554801, -1.27574)
(*LCW*)	c'	-16.7268	-2.98	0.003	

Note: bs_1 is $\hat{a}\hat{b}$, which reflects the mediating effect of bank credit line. The coefficient of c' model (6) reflects the direct effect of bank liquidity creation on enterprise output after the mediating effect of bank credit line is deducted.

Robustness Test

Industry heterogeneity

Table 11 shows that except for the wholesale and retail, real estate and software services, listed companies in other industries can significantly be affected by the direct effect of liquidity creation on the operating income statistically, and the impact on the credit line of listed companies in manufacturing, wholesale and retail industries is also significant. Based on the Bootstrap test, the mediating effect of bank credit line that liquidity creation affected the output of non-manufacturing enterprises does not exist, but the credit line has an obvious supporting effect on the manufacturing industry.

Table 11

Impact of industry heterogeneity on the mediating effect of credit line

	Key coefficient	Agriculture	Mining	Manufacturing	Construction	Wholesale & retail	Transportation	Software services	Real estate
(4)	c	11.4013***	10.3021**	5.6588***	5.9382**	2.4019	5.9906*	1.5901	0.1884
		(2.8762)	(3.9733)	(0.5539)	(2.3748)	(1.6637)	(3.2540)	(2.8902)	(2.1587)
(5)	a	-23.2703	20.8967	5.6775**	2.3466	13.2170*	-8.0280	-5.0099	-24.5966**
		(15.7715)	(19.4938)	(2.8764)	(7.8555)	(7.8601)	(13.0662)	(16.0301)	(10.4200)
(6)	b	0.0066	-0.0426	0.0080	0.0188	0.0151	0.0181	0.0322	-0.0018
		(0.0240)	(0.0263)	(0.0050)	(0.0192)	(0.0197)	(0.0309)	(0.0281)	(0.0153)
Mediating effect	_bs_1	-0.9141	-0.0715	0.3331**	0.1936	0.3127	0.5383	0.0791	0.4285
	BCBCI	(-8.515335,	(-2.226433,	(0.098815,	(-0.15853,	(-0.22846,	(-0.34524,	(-1.57102,	(-1.284497,
		2.733618)	0.6883619)	0.759371)	1.192307)	1.346969)	2.881904)	2.973694)	2.224174)
Direct effect	c'	11.5565***	11.1923***	5.6133***	5.8939**	2.2021	6.1362*	1.7514	0.1435
		(2.8330)	(3.9359)	(0.5532)	(2.3203)	(1.7542)	(3.4000)	(2.8616)	(2.2381)

Note: (1) _bs_1 was $\hat{a}\hat{b}$; (2) *,**,*** indicats that the coefficient is significant at 0.1, 0.05 and 0.01 respectively. (3) The numbers in parentheses are cluster robust standard errors. For all Bias-Corrected bootstrap Confidence Intervals (BCBCI), if they include 0, the original hypothesis of ab=0 is accepted; if they do not include 0, then the original hypothesis is rejected, and the mediating effect is significant; (4) If there is only one mediating variable, the total effect = direct effect + mediating effect.

Enterprise ownership heterogeneity

Table 12 shows that liquidity creation increases operating income of state-owned (SOE)and non-state-owned enterprises (**Non-SOE**). SOE has partial mediating effect of credit line while non-state-owned enterprises do not have. SOE are more likely to obtain credit from banks at low cost because of their implicit government guarantees, while the non-state-owned enterprises are free from the significant mediating effect of bank credit due to the insufficient government guarantees, collateral and credit guarantees.

Table 12

Test of the mediating effect of credit line on the output of enterprises with different property rights

Testing procedure	Key coefficient	SOE	Non-SOE
(4)	c	6.8955***	5.1877***
		(1.0758)	(0.6855)
(5)	a	5.9669*	3.2101
		(3.3227)	(3.2648)
(6)	b	0.0283***	0.0088
		(0.0098)	(0.0081)
Mediating effect	_bs_1	0.8476***	0.2166
	BCBCI	(0.4281647, 1.665731)	(0.020081, 0.5611562)
Direct effect	c'	6.7263**	5.1591***
		(1.0430)	(0.6868)

Note: the same as that in Table 11.

The case of tobacco industry

According to the results on Tables 11 and 12, after The World Health Organization calls for tobacco control, but there should be financial support for quality tobacco industry. Tobacco industry is controlled by

government, which contribute to tax. Tobacco industry is related to agriculture, processing industry and service industry. In Yunnan, Guizhou or other regions, it is usually a pillar industry which promotes the regional economic development. Therefore, some commercial banks, such as ICBC, ABC, China Everbright Bank, provide a lot of credit products according to local conditions, such as tobacco loan.

Conclusions

After the bail-out policy instills daily liquidity into the financial system in 2020, all kinds of financial risks become inevitable. Monetary policy and macroprudential regulatory tools can regulate bank liquidity and create reasonable fluctuations through risk-taking channels. The conclusions of this paper are as follows: (1) Monetary policy quantitative tools are negatively correlated with liquidity creation, and the price-based tools and *Car*, *Lr* and *Lcr* are positively correlated with liquidity creation. (2) *Bsr* has a significant impact on *LCW*. The capital regulation mobilizes banks with high *Car* to create more on-balance-sheet liquidity, while other banks tend to create more off-balance-sheet liquidity, resulting in increased exposure and greater risks. (3) Risk-taking is an important channel for dual-pillar regulation to influence bank liquidity creation. It is not significant how the risk-taking channels of each regulatory tool affects *LCW*. (4) Bank liquidity creation is positively related to enterprise output, and bank credit is one of the important channels for liquidity creation to affect enterprise output. (5)Bank should innovate a great of financial products to support industry chain and loan to these firms easily, such as tobacco industry.

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Author contributions

The present form of the manuscript is the full result of the joint work of all the authors. All authors have equal contributions in designing, work conceptualization, data acquisition, analysis and interpretation of data and results, drafting the article. All the authors have intellectuality discussed and agreed to submit the manuscript.

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