Market Imperfection: Credit Rationing and Excess Liquidity

Hye-Jin Cho

Market Imperfection:
Credit Rationing and Excess Liquidity

Abstract

This article seeks to understand how the monetary policy facilitates credit channels such as credit growth, credit creation and investment spreads . A major task is tackling asymmetric information in credit markets. A decline in wealth transfer from the lender to the borrower which raises the adverse selection problem, thus leads to decreased lending and finance investment spending. The simulation with two representative countries provides us with detailed evidence on savings and investment expressing supply and demand of loanable funds at the economic level; but this is largely ignored in the conventional macroeconomic analysis: e.g. in the Arrow-Debreu model, firms can fund all projects on a pay-as-you-go basis. Further investigation will be conducted for the lender as the principal how to face a low interest rate environment.

JEL classification: E22, E32, E52

Keywords: credit rationing, fixed investment scale, excess liquidity, low interest rate.

1. Introduction

Credit rationing matters to the market imperfection. There are several arguments to define credit rationing. Firstly, which one is "rationed?" Generally speaking, the market situation is "rationed" when the excess demand for loans in the market is greater than the supply of loans, e.g. Jaffee and Modigliani (1969). By the way, this is not so clear with changes in the interest rate. The reason is that if the interest rate changes, it implies that some receive a loan and others do not. Possibly, the rejected borrower is willing to pay a higher interest rate, e.g. Stiglitz and Weiss (1981). Hence, some borrowers are completely "rationed" out of the market.
Secondly, does credit rationing play an role in the monetary transmission? The low interest environment suggests that banks are not lending much. It

doesn't shortly conclude that loan pricing is sufficiently changing to changes of credit. There is no evidence that poor credit demand is rationed out of non-prime borrowers. Hence, the further investigation is needed how the credit channel works.

Why would companies, banks and the government not be able to meet their liquidity needs in international markets? Foreign investments and foreign debts have to be paid with the country's tradable income. The limit in the market to transfer the wealth is not as a whole to be traded with the insurance. Aggregate liquidity shortage shows the international credit supply as the last resort such as the model of a country's international collateral and its domestic collateral in Caballero-Krishnamurthy (2001, 2002, 2003 a,b). It possibly has another reason that there may be the friction in the enforcement mechanism by domestic government policy because of scarcity of international collateral in Holmstrom-Tirole (1996).

Sequential loan claims have the accelerator effect in economics. That is, an economic boom implies more machinery called fixed investment. This goes in the other way. Falling GDP discourages fixed investment. To measure the accelerator effect, one driver can be excess liquidity defined as excess cash [1] plus excess reserves. Excluded from excess liquidity, required reserves has the money multiplier effect on demand deposits.

Related to the international market, required reserves are inside liquidity - within the international market, otherwise excess liquidity has outside liquidity - mainly within the domestic economy. If cashflows into the banking system persistently exceed from the market by the central bank, that is surplus liquidity within the international market. However, the comparison of two countries is more accurate with the concept of excess liquidity than surplus liquidity since the cost of the international market is not aggregated.

The goal of this project is to model institutional decisions of lending and hence analyze the impact of measures taken to promote investment for households and firms and insure the precautionary amount of reserves in banks. Specifically, the research aims to:

- Develop a tractable model of investment behaviors at the country level with the banking sector, capturing of credit rationing and the risky nature of investment for lenders.
- Build compound probability models, calibrated to two representative

[1] Practically, the cause of excess liquidity is rarely only from excess cash.

villages incorporating the impact of credit rationing on monetary transmission mechanism and growth; hence support better macroeconomic and microeconomic policy analysis.

The reason to start with two countries is to compare the risk appetite whether the country prefers to have precautionary liquidity or not. How many banks or countries are efficient to say in this framework? Actually, for the policy implication, the number of the national bank is 0% among total banks. For example, in the European Central Bank (ECB) data of the euro area monetary aggregates, the number of national central bank is 20 among 5,286 monetary financial institutions (MFIs) at the end of May 2019 (The calculation is simply done such as $20 \div 5,286 = 0.00378$). When it comes to loan claims by countries or central banks, the risk appetite is not comparable with one of commercial banks since the risk acceptance level such as bankruptcy is significantly reduced at the country level. Empirically, there is a debate between monetary policy changes and significant movements. Significant movements can be aggregate bank lending volume in Bernanke and Blinder (1992) such as the following model in this article or liquidity of smaller banks, i.e. the bottom 95 percent of the size distribution such as Kashyap and Stein (2000).
For the balance match, the bank-level data ought to be explicable in the monetary transmission. In the same sense, Jiménez et al (2012) argue this omitted variable problem in the temporary fall of loan demand. The reason can be that data are depending only on macro data in Bernanke and Blinder (1992) or bank-level data in Kashyap and Stein (2000).
In addition by Jiménez et al (2012), separating the effect of monetary conditions from economic activity is problematic because of a Taylor rule - determined short-term interest rate changes. Hence, we need to adopt the monetary condition separated from economic activity. Credit rationing is useful to check the precautionary aim of loan opportunities in excess loan demand. This situation is depicted in numerous literature as the funding value adjustment in Andersen, Duffie and Song (2016). In the economic cycle, credit rationing is explained as an instrument such that if an interest ceiling is sufficiently high, then it discourages demand and conserve their assets up to demand equivalent to zero in Jaffee-Modigliani (1969) and Stiglitz-Weiss (1981). However, on the other hand, it doesn't have the economic value at the Nash equilibrium since no credit rationing may be the first-best optimum investment or low investment which is the first-best case for everybody in Piketty (1997).

2. The Basic Model

The model has two types of agents: a credit-rationed country, a non-credit-rationed country and the principal as the international lender. There are ten periods after the post-crisis period. In the first period, the loan contract is signed between an agent and the principal. From the second period, the principal wants to evaluate whether additional loan claims are acceptable. Two agents are risk-neutral with a non-negative liquidity position.

2.1. The Banking Sector

There is a continuum of banks. There are two indices of credit rationing. One is a "demand deposit index", which measures by how much demand deposits are larger than total reserves; the other is a "required reserve index", which measures ratios of excess reserves to required reserves or total reserves. The underlying assumption is that as banks hold more liquidity, they increase credit supply and are less likely to be credit-rationed.
For simplicity, we design the first-period inside money assumption. In detail, the aggregate amount of bank capital is required to be reserved equal to or greater than the money multiplier amount in the market. The first-period inside money in the loan market can be the loan market value M. The distribution of inside money across banks has the money multiplier m such as $1/m$ M. The optimal capital value K is credit-rationed by a reserve requirement rr, $1/m \times M \times rr = K$.
Each country has different demand deposits DD. In a country, withdrawals of demand deposits DD are costly to be liquid in a period 1.

2.2. An international lender

The lender is big such as the international financial institution. I refer it as the uninformed principal who monitors the liquidity position and offers the loan contract. If $DD > R$, the optimal capital value K is reduced than the optimum. The contraction of credit supply is considered as credit rationing $DD - R$. If $DD < R$, the optimal capital value K is over than the optimum. The bank intends to save the precautionary fund $R - DD$.

A. Interest Rate Channel

The interest rate channel is the standard Keynesian channel of monetary transmission. A fall in real interest rates lowers the cost of capital and boosts investment spending. What if the low interest rate cannot imbue the rise of investment? One reason can be price rigidities which differently react in the short-term horizon and the long-term one according to rational expectation.

Holmstrom and Tirole (2013) show the fixed investment scale which is inherently rationed for firms. Investment decisions depend on the continuation of social values rather than the negative expected return. Possibly, initial investments and continuous investments would be credit-rationed.
We assume that the principal cannot monitor the low interest rate because they have sufficient capital to operate the international loan business. Furthermore, the lack of the world driver will have not to reduce the loan contract.
The low interest rate may lead to rise the aggregate output such as fixed investment, housing investment, consumer durable expenditure and inventory investment through the interest rate channel.

3. Incorporating Credit Rationed Investment Into Macro-Financial Decisions

The following phase of the article is analyzing macroeconomic implications of financial stability and monetary policy modeling of the basic setting. The macroeconomic importance of market imperfection with credit rationing is widely recognized and some have attempted to address the credit growth and GDP. Ramcharan, Verani and Van den hovel (2016) explain shocks in the US economy from market losses of the asset-backed securities (ABS) and the supply of credit: new lending per year fell from an average of around 40 billions before the crisis to about -1.5 billions a year after 2008. 80 billions in loans over 2009-2010 may depress credit demand, as the US entered into a recession at around the same time, i.e. U.S. GDP in 14.96 trillion USD (World Bank, 2010).

B. Credit Channels

Changes in aggregate credit are expected to persist along continuous positive investment, the negative shock causes a large gap in the expected GDP per capital growth. For example, in the World Bank national accounts data and OECD National Accounts, GDP per capita growth (annual %) was -2.936% in 2009 for the world. It immediately went up to 3.104% in 2010 and maintained from 1.301 % in 2012 to 1.977 in 2017. On the one hand, Aghion, Angeletos, Banerjee and Manova (2010) claim credit rationing may lead to both higher volatility and lower mean growth according to the cyclical composition of investment. Here, we assume that investment is not a continuous decision but rather occasionally triggered when opportunity is given.
There are two credit channels: the bank lending channel and the balance-sheet channel. (1) The bank lending channel shifts the supply of intermediate

credit and screens credit-worthy agents. (2) The balance-sheet channel estimates the probability of financial distress. For example, the expansionary monetary policy increases bank reserves and bank deposits - available bank loans. The increase in loans will cause investment and consumer spending to rise.

For (1), in the following table 3.B, the behavior of credit worthy agents is depicted as demand deposits (DD) above reserves (R). There are two subcategories in which one is greater between DD and R. For (2), required reserves (RR) are fixed per country. The financial distress is possible to be measured by plugging excess reserves $R - RR$ into two different criteria, the regulated rate RR or a real banking variable R. Therefore, credit rationing can be interpreted in two situations. Firstly, when DD is greater than R, the possibility of bank runs is crucial to know how much savings can be withdrawn in the worst scenario. Secondly, when DD is less than R, it may have excess liquidity hence, checking reserves above required reserves is crucial.

The demand deposit (DD) Index	$\frac{DD-R}{R}$	$\frac{DD-R}{DD}$
The required reserve (RR) Index	$\frac{R-RR}{RR}$	$\frac{R-RR}{R}$

Table 3.B. Two Indices of Credit Rationing.

3.1. Composition of Liquidity

In an asset-liability match, demand deposits exerted a strong influence on reserves. It suggests required reserves as a percentage of net demand deposits for financial regulation. Demand deposits against reserves is total demand deposits less "due from" in Allen (1956). No single explanation can account for the single driver to describe changes of reserves according to credit and demand deposits. However, several assumptions are worth to be mentioned for the sake of financial regulation.

As a monetary instrument, optimal reserve requirement on demand deposits in Siegel (1981) controls the value of monetary aggregates. It can be in a safety reason in 1930. That is to say, holding excess liquidity can be from various economic reasons, e.g. lack of good loan opportunities. Much complicated after crisis 2007, good loan opportunities hinge on a series of remedies in a bad economic situation up to one country and more. Excess liquidity passively accumulated is not merely explained by the conservatism of fractional banking system. For proper loan commitment, it is no less dubious

that holding excess liquidity is a good reason to show credit facility. The bank transparency induces good loan opportunities and obtains safer investment returns by overnight interests. It requires a quite logical explanation of reserves in several countries.
At the heart of credit rationing lies the conception of the liquidity composition. Let's assume that there are two villages whose excess liquidities are different.

(Current USD, million)	Village I	Village II
Outside Liquidity in domestic currency, liabilities		
currency issued	2,027	400
required reserves	183	4500
excess reserves [2]	400	14,150
reserve money	2,610	15,000
demand deposits, commercial banks	3,400	1,000
excess liquidity	R < DD	DD < R
Inside Liquidity		
overnight deposit window rate	2.75	2.75
domestic credit to private sector by banks to GDP (%)	70	99.2
net commercial bank lending and other private credits	250	-43

Table 3.1.1. Selected Liquid Characteristics of Village I and Village II

As a first step in the above table 3.1.1, the total reserve ratio has strong overtones of non-required reserve holdings. Two different reserve requirements 7% in village I and 30% in village II bear uniformed non-required reserve holdings during simulated 10 years as of $93\% = 100\% - 7\%$ in village I and $70\% = 100\% - 30\%$ in village II. The comparison of only different reserve requirements may not offer the clearest proof for precautionary holdings of excess reserves.

Village I	R	DD	7 % RR	RR/DD	R-RR	(R-RR) ÷ R	(R-RR) ÷ RR	(DD-R) ÷ DD
Year 1	2610	3400	183	5 %	2427	**93** %	1326 %	**23** %
Village II	R	DD	30 % RR	RR/DD	R-RR	(R-RR) ÷ R	(R-RR) ÷ RR	(DD-R) ÷ R
Year 1	15000	1000	4500	450 %	10500	70 %	**233** %	**-93** %

Table 3.1.2 The liquidity composition in the Village I and Village II [3]

It carries the total reserve ratio omitted in the analysis of required reserves. Even if the attention on "RR/DD" is regulated at same lower rate as of 5%,

[3] identification symbols: DD (Demand Deposits), RR (Required Reserves), R (Reserves)

how can we interpret the fluctuation of the ratio (DD-R) ÷ DD varies? I lay heavy alert that this reserve ratio analysis should not be partial only by the reserve ratio.

3.2. Reserve choices and liquidity controls

The methodology to measure a reserve requirement in Eurozone is more complex according to policy rules after Eurozone cuts as of 1% in 2012 from 2%. Given the fact that almost all financial requirement on reserves in Eurozone countries are uniformly implemented by same redlining. This is not hardly surprising when we look up constraints of each country's loan accessibility.

However, it is still expected to be effective as a policy instrument. For example, China cuts bank reserves as of 17.00 % again to counter slowdown as of 29 February 2016.

In the following table 3.2, village I has excess reserves than required reserves ($400 > 183$). Currency issued is mostly a dummy variable in many cases of excess liquidity. Likewise, the empirical evidence is not enough that excess cash entirely causes excess liquidity. It merely implies the case of excess liquidity is able to have excess cash. Additionally, village II has excess reserves than required reserves ($14150 > 4500$). In brief, credit rationing of village I is positive as of 790. On the other hand, credit rationing of village II is negative as of -14000. Therefore, the contraction of loan demand is greater in village I than one in village II.

Village and Liquidity Composition	Credit Rationing I : DD-R II: -(R-DD)	Excess Liquidity I: (R-RR) ÷ R II: (R-RR) ÷ RR	Inside Liquidity I: (DD-R) ÷ DD II: (DD-R) ÷ R
Village	Village I, II	Village I, II	Village I , II
currency issued	2027, 400		
required reserves	183, 4500		
reserve ratio	7%, 30%		
excess reserves	400, 14150		
reserve money	2610, 15000		
demand deposits	3400, 1000		
credit rationing	790, -14000		
		93 %, 233 %	
			23%, -93 %

Table 3.2. The Precautionary Level in Liquidity Composition[4]

[4]identification symbols: DD (Demand Deposits), R (Reserves), RR (Required Reserves)

C. Equity Price Channel

Building an explanatory model with two countries, the credit rationing model is useful to measure both aggregate credit and GDP. The simulation is to calibrate against various features of financial shocks. Therefore, the systematic response to the emergence of future shocks is presented with a slowing-down point. The result will offer a clear and comprehensive overview of key measures before and after redlining of debts which is applicable in the country level. This will be undertaken in two stages, first a relatively measured chart about money composition that captures key liquidity figures; second a more detailed analysis calibrated to the large amount of data available on credit growth and GDP.

Village I								
YEAR	R	DD	7 % RR	RR/DD	R-RR	(R-RR) ÷ R	(R-RR) ÷ RR	(DD-R) ÷ DD
1	2610	3400	183	5 %	2427	**93** %	1329 %	**23** %
2	2650	3500	186	5 %	2465	**93** %	1329 %	**24** %
3	2690	3600	188	5%	2502	**93** %	1329 %	**25** %
4	2730	3700	191	5%	2539	**93** %	1329 %	**26** %
5	2770	3800	194	5%	2576	**93** %	1329 %	**27** %
6	2810	3900	197	5%	2613	**93** %	1329 %	**28** %
7	2850	4000	200	5%	2651	**93** %	1329 %	**29** %
8	2890	4100	202	5%	2688	**93** %	1329 %	**30** %
9	2930	4200	205	5%	2725	**93** %	1329 %	**30** %
10	2970	4300	208	5%	2762	**93** %	1329 %	**31** %
Village II								
YEAR	R	DD	30 % RR	RR/DD	R-RR	(R-RR) ÷ R	(R-RR) ÷ RR	(DD-R) ÷ R
1	15000	1000	4500	450 %	10500	70 %	**233** %	-93 %
2	15000	1100	4500	409 %	10500	70 %	**233** %	-93 %
3	15000	1200	4500	375 %	10500	70 %	**233** %	-92 %
4	15000	1300	4500	346 %	10500	70 %	**233** %	-91 %
5	15000	1400	4500	321 %	10500	70 %	**233** %	-91 %
6	15000	1500	4500	300 %	10500	70 %	**233** %	-90 %
7	15000	1600	4500	281 %	10500	70 %	**233** %	-89 %
8	15000	1700	4500	265 %	10500	70 %	**233** %	-89 %
9	15000	1800	4500	250 %	10500	70 %	**233** %	-88 %
10	15000	1900	4500	237 %	10500	70 %	**233** %	-87 %

Table 3.C.1. The liquidity composition in Village I and Village II [5]

In the above table 3.C.1, the demand deposit index in village I is positively increasing such as 23% to 31% during 10 periods. On the other hand, the demand deposit index in village II is negatively decreasing such as -93%

[5] identification symbols: DD (Demand Deposits), RR (Required Reserves), R (Reserves)

to -87% during 10 periods. What we get from this table 3.C.1 is, in village II, the ratio "RR/DD" fulfills a pledge-able reserve level which has negative in $(DD-R)\div R$. On the contrary, in village I, even though non-required reserve ratio (R-RR) $\div$ R is stabilized as of 93%, the investment scale $(DD-R)\div DD$ increases. There is the possibility that the domestic credit to GDP is so high that lending was not needed in village II. Remark that the following table 3.C.2 is about domestic credit to GDP and lending. Comparably, lending is higher in village I than village II. Hence, credit rationing is well-going in village II but credit rationing in village I should be regulated by the principal.

(Current USD, million)	Village I	Village II
Inside Liquidity		
overnight deposit window rate	2.75	2.75
domestic credit to private sector by banks to GDP (%)	70	99.2
net commercial bank lending and other private credits	250	-43

Table 3.C.2. Selected Liquid Characteristics of Village I and Village II

4. Conclusion: The Impact of untightening credits.

Recognizing credit needs and constraints is important across the economic population and along the healthy life-cycle of firms and households. Untightening credits may support the facility of financing sources. The lack of appropriate forms of finance is limiting loan entry, no measurement in advance and renegotiation enforcement at the country level. By removing supply-side hurdles, such as the overall opacity of the credit market, the awareness may promote sources by this article.

The first objective of this article was to address the question about the contraction of loan demand: do decreased lending imply the contraction of loan demand? Two different measures of loan demand were obtained for continuous investment categorized into two stages according to precautionary and risk-loving levels. The investment in the credit channel of the transmission mechanism here is of particular importance. Investment is relevant to an interest ceiling constraint which is the specific loan model for banks. We were trying to describe investment for the country-level decision by the international lender in the transmission mechanism.

As the numerical simulation of two countries shows, even though no transaction fee for getting loans do not precise the international monetary market, the result can eventually specify key variables and effects of the low interest environment. When considering possibilities and policies of loans that would

generalize the situation for decision-making of the international lender, we need to compare two countries. A credit-rationing country may have excess liquidity as excess reserves.
We can therefore assume that inside liquidity, supposed to be in the market, may have less money than a credit-rationed country. Not all cases of excess liquidity involve the loan claim as we suggested here. If the credit-rationed country proclaims the liquidity position for loan requests, we try to demonstrate the mostly argued case such that domestic credit to GDP of village I is less than the one of village II and net lending of village I is greater than village II. In the institutional aim, the international lender need enough simplicity to answer why lending is not directly affecting to domestic credit to GDP. The key to answer this is the liquidity position: (1) positive liquidity increases and (2) negative liquidity decreases.
Thus, the monetary policy of the low interest environment intends to decrease the contraction of loan supply and increase the growth of investment. In conclusion, the importance to understand the liquidity position is crucial to explore new ideas about potential monetary policy and lending.

5. References

[1] Aghion, P., Angeletos, G. M., Banerjee, A., and Manova, K. *Volatility and growth: Credit constraints and the composition of investment.*. Journal of Monetary Economics, 2010.

[2] Allen, W. R. *Interbank Deposits and Excess Reserves.* . The Journal of Finance, 1956.

[3] Andersen, L., Duffie, D. and Song, Y. *Funding Value Adjustments.* . The Journal of Finance, 2016.

[4] Bernanke, B. S., and Blinder A. S. *The Federal Funds Rate and the Channels of Monetary Transmission* . The American Review, 1992.

[5] Bernanke, B. S., and Gertler, M. *Inside the black box: the credit channel of monetary policy transmission* . Journal of Economic perspectives, 1995.

[6] Cressy, R. *Introduction: Funding Gaps* . The Economic Journal, 112(477), pp.F1-F16, 2002.

[7] Garreth, R. *Centre for Central Banking Studies Handbook – No.32 Understanding the central bank balance sheet.* Bank of England, 2015.

[8] Caballero, R. and Krishnamurthy, A. *International and Domestic Collateral Constraints in a Model of Emerging Market Crises.* Journal of Monetary Economics, 2001.

[9] Caballero, R. and Krishnamurthy, A. *A Dual Liquidity Model for Emerging Markets.* American Economic Review Papers and Proceedings, 2002.

[10] Caballero, R. and Krishnamurthy, A. *Excessive Dollar Debt: Financial Development and Underinsurance.* Journal of Finance, 2003a.

[11] Caballero, R. and Krishnamurthy, A. *Smoothing Sudden Stops.* Journal of Economic Theory , 2003b.

[12] Gorton, G. and Pennacchi, G. *Financial Intermediaries and Liquidity Creation.* The Journal of Finance, 1990.

[13] Holmstrom, B. and Tirole, J. *Private and Public Supply of Liquidity.* Journal of Political Economy, 1996.

[14] Holmstrom, B. and Tirole, J. *Inside and outside liquidity.* Cambridge, MA: MIT Press, 2013.

[15] Jaffee, D. and Modigliani, F. *A theory and test of credit rationing.* The American Economic Review, 1969.

[16] Jiménez, G., Ongena, S., Peydro J. L. and Saurina, J. *Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications.* The American Economic Review, 2012.

[17] Kashyap, A. K. and Stein, J. C. *What do a million observations on banks say about the transmission of monetary policy?.* The American Economic Review, 2002.

[18] Kehoe, T. J. and Levine, D. K. *Liquidity Constrained Markets Versus Debt Constrained Markets.* Econometrica, 2001.

[19] Kiyotaki, N. and Moore, J. *Liquidity, Business Cycles, and Monetary Policy.* mimeo. LSE and Princeton University, 2012.

[20] Piketty, T. *The Dynamics of the Wealth Distribution and the Interest Rate with Credit Rationing* . The Review of Economic Studies, 1997.

[21] Ramcharan, R., Verani, S. and Van den Heuvel, S. J. *From Wall Street to main street: the impact of the financial crisis on consumer credit supply.* The Journal of Finance, 2016.

[22] Saxegaard, M. *Excess Liquidity and the Effectiveness of Monetary Policy: Evidence From Sub-Saharan Africa*. IMF Working Papers, 2006.

[23] Siegel, J. J. *Bank Reserves and Financial Stability*. The Journal of Finance, 1981.

[24] Stiglitz, J. E. and Weiss, A. *Credit Rationing in Markets with imperfect information*. The American Economic Review, 1981.