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Can Liquidity Constraints Explain the Differences of Growth Across Countries?

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Abstract

This paper conducts an empirical research on the relations between liquidity constraints and economic growth. Based on Kiyotaki & Moore (2019), we establish our econometric model and do regressions with a panel data covering 33 countries from 1996 to 2017. Countries in our sample include developed and developing countries. We find that increasing liquidity premium by 1%, will decrease the growth rate of capital by 0.31%, and that of GDP by 0.24%. Moreover, developing countries appear to be more sensitive to the change of liquidity premium, with more decreasing by 0.31% on capital growth and 0.22% on GDP growth than developed countries, when equally faced with 1% increase of liquidity premium. It can be inferred that different level of liquidity constraints, leading to a different level of liquidity premium, partially explain the differences of growth across countries.

Keywords: liquidity constraints, monetary model, economic divergence

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1. Introduction

This paper conducted an empirical research on the effects of liquidity constraints across different countries of their capital formation and GDP growth. The convergence of economic growth has been widely discussed by many macroeconomists since 1980s. In reality, economic growth across countries seems very different. Some countries enjoy a high speed of growth, like China and India, while some others suffer an economic stagnation. Theoretically, economic growth was usually attribute to the growth of capital, labor force and total factor productivity. However, the cross-country differences of these three factors cannot completely explain the whole story. Most of the existing researches were based on the neoclassical theories of growth with a frictionless transaction assumption. Under the frictionless assumption, financial systems, especially the money and liquidity systems become useless and attracted little attentions in researches of growth. However, the financial crisis of 2007 brought huge challenges to the neoclassical framework for its failure of predicting and explaining the financial crisis. Hence, since 2007, many researchers have tried to extend the framework to ones with more expression of financial systems and market frictions.

In fact, for problems about financial market frictions, there were tons of papers discussing how these frictions causing financial crises. A majority of researches concerning about connecting the crisis with liquidity constraint were on micro perspective. Papers like Beunnermeier & Pedersen (2009), provided a clear map of how the crisis happened and how liquidity drained during the crisis.

However, since the financial crisis of 2007, more and more scholars have been aware that focusing only on individuals' risks and their behaviors was far more than enough. Risks can be generated from marco-level. Specifically speaking, even if we controll the risks of individuals, we are still in danger of systematic risks' striking because when systematic risks occur, most individuals who look safe before will immediately become risky. And therefore, we still need a macro framework to understand the financial systems and financial crises.

Kiyotaki & Moore (2019) established a new monetary model based on the idea that money is more liquid than any other assets in the economy. In their model, investment opportunities randomly came to individual entrepreneurs, who needed to invest as fast as possible before investment opportunities was gone. And therefore, there might be a role for money if entrepreneurs could be benefited from investing, while their assets on hand were not liquid enough to fund for investing.

Their model had several interesting conclusions which were very different from existing models. Firstly, the level of capital stock at the monetary equilibrium was lower than that of first-best(unconstrained) capital stock, indicating an underinvestment of the economy when the liquidity constraint bound. Secondly, the expected return on the illiquid asset was lower than time preference rate, which implied that households who never had an investment opportunity might not participate in asset market. Thirdly, the low risk-free rate puzzle could be explained by liquidity premium of risk-free assets raising their price and therefore lowered

their return.

This paper is enlightened by Kiyotaki & Moore (2019). The basic idea is that since the capital at the monetary equilibrium is affected by the liquidity constraint, the variety of liquidity constraint might be a reason for the variety of capital stock and economy development. More specifically, the liquidity constraints across countries might be different because of the variety of financial conditions, and according to Kiyotaki & Moore (2019), liquidity constraints prevent resource transferring from savers to borrowers, resulting in a negative effect in the process of capital formation and GDP growth.

The main contributions of this paper are to find evidences of the liquidity constraint's effect on capital and GDP to support the theoretical model of Kiyotaki & Moore (2019) to some degree and in the meantime, find a new factor to explain the divergence of cross-country economic development.

In Section 2, we provide a theoretic model with liquidity constraints, based on which we build our econometric model. In Section 3, empirical results and discussions are presented , and in Section 4 we do some robustness checks. Summarization and conclusions are contained in Section 5.

2. Theoretical and Econometric Model

To analyze the relations between liquidity constraints and capital growth as well as GDP growth, we present a reduce-form model of Kiyotaki & Moore(2019) to describe their relations[2].

Supposed that there is a continuum of agents with measure 1. Each of them has a utility over consumption of goods given by:

$$E_t \sum_{s=0}^{\infty} \beta^s \ln c_{t+s}$$

β is the discount factor whose value is strictly between 0 and 1. Every agent is able to produce consumption goods y with their capital k. The production function is given as following:

$$y_t = Ak_t^{\alpha}$$

α is between 0 and 1. And also ,they are able to produce new capital with consumption goods. One unit of capital producing require one unit of consumption

[2] The theoretic model presented in this section is a reduced-form of Kiyotaki & Moore (2019). We ignore the impact of labor force and change variables into pe capita form. Results with labor force will arrive at the same conclusions, while a model in reduced-form can illustrate the connection between liquidity constraints and investment more directly and clearly. Proof of our model isn't presented in this paper. If anyone is interest in the proof, please see Kiyotaki & Moore (2019) for more details.

goods. The law of motion for k is:

$$k_{t+1} = \lambda k_t + i_t$$

λ is the depreciation factor and i_t is the investment of an agent, equaling to the amount of newly produced capital. While not every agent has the opportunity to invest, in each period, only π out of 1 can invest. In order to fund for the investment, an agent could issue papers by mortgage future returns. For each unit of paper, a payment of r_{t+1} at date of t+1 is promised and λr_{t+2} at date t+2, $\lambda^2 r_{t+3}$ at date t+3 and so on. r_t is defined as:

$$r_t = \frac{y_t}{k_t}$$

Besides, an agent can fund for investment by reselling the papers of other agents'. However, papers are partially liquid, meaning that only a part of papers can be resold for funding.

Supposed that θ donates the degree of liquidity: the fraction can be sold in each period, then we retain the liquidity constraint for each agent:

$$n_{t+1} \geq (1-\theta)(i_t + \lambda n_t)$$

n donates the capital stock and paper holding of an agent. And also, agents are still faced with a budget constraint :

$$c_t + i_t + q_t(n_{t+1} - i_t - \lambda n_t) + p_t(m_{t+1} - m_t) = r_t n_t$$

q donates the market price of paper. p donates the price of money in real form and m donates money stock of the economy.

Kiyotaki & Moore (2019) has proven that there is an monetary equilibrium of this model, and we need to discussed the capital stock at the monetary equilibrium. we can get

$$A\alpha k^{\alpha-1} = \frac{(1-\lambda)(1-\pi) + \pi\lambda(1-\pi)(1-\beta)}{(1-\lambda+\pi\lambda)\theta + \pi\lambda(1-\pi)(1-\beta)}$$

The equation above shows that an increasing in θ ,meaning a more relaxing of liquidity constraint, will cause an increasing in k.

However, it is difficult to find the data of θ. According to Kiyotaki & Moore (2019), liquidity premium, equaling to nominal return of papers, increases as θ decreases. As a result, the nominal return of papers is negatively correlated with k.

Hence, we establishes an econometric model as following:

$$Y_{i,t} = a + bX_{i,t} + \sum \varphi control\ variables_{i,t} + u_i + \xi_t + \varepsilon_{it}$$

$Y_{i,t}$ is the explained variable. We have two explained variables: growth rate of capital per capita and that of GDP per capita. $X_{i,t}$ is the explaining variable, which is the nominal risk free rate in our research. Control variables include real return of papers, growth rate of R&D expenditure per capita, growth rate of foreign direct investment per capita. Real return of papers need to be controlled because real return is very likely to affect the capital stock while we want to see the net effect of liquidity constraint. Researches on the convergence of economic growth are always regard TFP as one of the most important factors, while the TFP data for some developing countries are missing. Coe & Helpman (1995) found that both domestic and foreign R&D capital had significant effects on TFP growth. For countries with higher level of TFP, domestic R&D capital was dominant, while for countries with lower level, foreign technologies accompanying with international trade played a vital role on TFP growth. And therefore, the combination of domestic R&D expenditure and foreign direct investment could explain the growth of TFP. We follow Coe & Helpman (1995), as many other researchers did, controlling R&D expenditure and FDI (foreign direct investment) to exclude the effect of TFP. And also, we control the fixed effect and time effect.

Based on the econometric model above, we collect data of 33 countries from 1996 to 2017. Countries in our sample include well-developed ones like U.S., Germany, and geographically include Europe, Asia, North America, South America, Africa and Oceania. The GDP per capita of countries in the sample ranged from $2009 to $62974, with an average of $24685 and an median of $20324. Information of our data and variables are presented in Table 1.

Table 1: Information of variables and data resource

Variable	Explanation	Formula	Resource
Yg	Growth rate of GDP per capita	$\frac{GDP_{t+1}/population_{t+1}}{GDP_t/population_t} - 1$	Database of The Worldbank
Kg	Growth rate of capital formation per capita	$\frac{capital_{t+1}/population_{t+1}}{capital_t/population_t} - 1$	Database of The Worldbank
NR	Nominal return of long term government bond		Database of The Worldbank
RD	Growth rate of R&D expenditure	$\frac{R\&D_{t+1}}{R\&D_t} - 1$	Database of The Worldbank
FDI	Foreign direct investment	$\frac{FDI_{t+1}}{FDI_t} - 1$	Database of The Worldbank
RR	Real return of long term government bond	$NR - GDP\ deflator$	Database of The Worldbank

3. Main Results

Table 2 shows the results of regressions on growth rate of capital formation. The first column reports the results without controlling any other variables, the coefficient of nominal risk free rate on capital is -0.24 at a significant level of 1%. The second column of table 2 reports the results controlling fix effect and time fix effect, showing that it is also significant at 1% level, with a coefficient of -0.54. The last column is a regression of our full model, reporting a coefficient of -0.31 at a significant level of 1%.

Table 2: Results of regressions on Kg with full sample

Variables	Kg	Kg	Kg
NR	-0.24***	-0.54***	-0.31***
RR			-0.76***
FDI			0.01
RD			0.21
Time effect	NO	YES	YES
Fix effect	NO	YES	YES

Table 3 shows the results of regressions on growth rate of GDP. The same as in Table 2, we present 3 regressions with different control variables. It shows that the coefficients of all regressions are significant at a significant level of 1%. Comparing with regressions on the growth rate of capital formation, the coefficients of nominal government rate seem to be smaller, implying that capital growth is more sensitive to the change of nominal rate of long term government bonds. This is easy to understand for liquidity constraint directly affecting investing and capital formation, while indirectly affecting GDP growth through capital.

Table 3: Results of regressions on Yg with full sample

Variables	Yg	Yg	Yg
NR	-0.16***	-0.41***	-0.24***
RR			-0.33***
FDI			0.03
RD			0.52*
Time effect	NO	YES	YES
Fix effect	NO	YES	YES

These results indicate that nominal rate of long term government bonds, which representing the liquidity constraint of the economy, has a significant effect on the process of capital formation and GDP growth. Countries with higher nominal rate of long term government bonds, implying a tighter liquidity constraint, will have a lower speed of capital and GDP growth. Quantitively, 1% increasing of long term government bonds decreases the growth rate of capital formation by 0.31%, and that of GDP growth by 0.24%.

It seems that we have found evidences of liquidity constraint's effect on capital formation and GDP growth, but we still need to take further steps on this problem.

According to Kiyotaki & Moore (2019), liquidity constraints in fact reflect the degree of trust among agents. If they completely trust each other, then no liquidity constraint will occur, turning into the case of neoclassical frictionless framework. Because of incomplete trust, agents' papers cannot circulate, causing a liquidity problem and calling for a more common trusted agent's papers, like money, to lubricate the economy. In reality, there might be many factors influence the degree of trust. However, it can't be denied that financial system is one of the most important factors. A well-developed financial system, like the U.S., can help individuals in the economy to issue private papers and has a stronger ability to resist risks, and thus will be less sensitive to liquidity constraint changes than a developing financial. Hence, we redo the above regressions use two sub-samples. One contains 13 developing countries, whose GDP per capita were below $14000 in 2008, and the other includes countries of G7. Based on what we have discussed, if a well-developed financial system can help to ease the liquidity constraint, then we are supposed to see that the coefficients of the 13 developing countries are larger than those of the full sample and the coefficients of the G7 are smaller than the full sample.

Table 4 reports the sample of 13 developing countries and Table 5 reported the sample of G7. It reveals that the coefficients of 13 developing countries is significantly larger than the full sample and the G7 sample, while those of the G7 sample becomes insignificant and much smaller. All these results are consistent with our guessing above.

Table 4: Results of regressions with sub sample of 13 developing countries

Variables	Kg	Kg	Kg	Yg	Yg	Yg
NR	-0.41***	-0.69***	-0.50***	-0.29***	-0.31***	-0.25***
RR			-1.15***			-0.21***
FDI			1.06*			0.43*
RD			2.12**			0.39
Time effect	NO	YES	YES	NO	YES	YES
Fix effect	NO	YES	YES	NO	YES	YES

Table 5: Results of regressions with sub sample of G7

Variables	Kg	Kg	Kg	Yg	Yg	Yg
NR	-0.07	-0.23	-0.19	-0.05*	-0.01	-0.03
RR			0.65***			-0.24**
FDI			0.14			0.11*
RD			0.97			0.62**
Time effect	NO	YES	YES	NO	YES	YES
Fix effect	NO	YES	YES	NO	YES	YES

4. Robustness Check

The risk free rate used in this research is the return of 10 years' government bond. But some countries may not use this return as a risk fee rate in its financial market. In the database of Worldbank, we can find data of risk premium defined as loan rate of banks to their major clients, as well as real loan rate of banks. Therefore, we use these two data to compute for risk free rate and replaced the return 10 years' government bond. The result is showed in Table 6 to Table 8. All the results indicate that even we use another way measuring the risk free rate, the conclusions we arrive above are still unchanged.

Table 6: Regressions using a new measure of risk free rate with full sample

Variables	Kg	Kg	Kg	Yg	Yg	Yg
NR	-0.22**	0.39***	0.31***	-0.17**	-0.29**	0.18***
RR			0.47***			-0.31**
FDI			0.04			0.12**
RD			0.97			0.36**
Time effect	NO	YES	YES	NO	YES	YES
Fix effect	NO	YES	YES	NO	YES	YES

Table 7: Regressions using a new measure of risk free rate with sub sample of 13 developing countries

Variables	Kg	Kg	Kg	Yg	Yg	Yg
NR	0.38***	0.61***	0.45***	0.35***	0.51***	0.36***
RR			0.78***			0.66***
FDI			0.09*			0.23*
RD			1.22			0.75*
Time effect	NO	YES	YES	NO	YES	YES
Fix effect	NO	YES	YES	NO	YES	YES

Table 8: Regressions using a new measure of risk free rate with sub sample of G7

Variables	Kg	Kg	Kg	Yg	Yg	Yg
NR	-0.04	-0.25	-0.18	-0.02*	-0.01	-0.01
RR			-0.33**			-0.24**
FDI			0.13			0.23*
RD			1.36			1.45***
Time effect	NO	YES	YES	NO	YES	YES
Fix effect	NO	YES	YES	NO	YES	YES

Variables in our research are in per capita form except for real interest rate and nominal risk free rate because the theoretical conclusions are in per capita form. One may be interest that whether the conclusions we get can still hold in aggregate form. Table 9 reports the result in aggregate form. It can be seen that some of the coefficients become insignificant while that of risk free rate on capital growth still significant at 5% level and 10% significant on GDP growth.

Table 9: Regressions with variables in aggregate form

Variables	Kg	Kg	Kg	Yg	Yg	Yg
NR	0.12	-0.24*	-0.32**	-0.02	-0.08**	-0.12*
RR			-0.72***			-0.13**
FDI			0.23			0.12*
RD			1.24			0.25
Time effect	NO	YES	YES	NO	YES	YES
Fix effect	NO	YES	YES	NO	YES	YES

5. Conclusion

This paper tries to study the relationship between liquidity constraints and capital as well as GDP growth. Based on the research of Kiyotaki & Moore (2019), we present a reduced model of theirs to get the theoretical relation between liquidity constraints and capital growth. And also, according to Kiyotaki & Moore (2019), liquidity constraint cannot be directly observed, but liquidity premium, equaling to the nominal rate of papers, can be easily observed. Because both of Kiyotaki & Moore (2019)'s model and ours are under the circumstance of risk free, liquidity premium can be expressed as the nominal risk free rate. Hence, we retain a econometric model of risk free rate on capital growth and GDP growth, controlling for real interest rate, foreign direct investment, R&D expenditure.

Empirical results are consistent with our theoretic model, supporting that liquidity constraints indeed have influences on capital and GDP growth. Quantitively, 1% increase of risk free rate leads to -0.31% change of capital growth and -0.24% of GDP growth. What's more, sub-samples of 13 developing countries and G7 implying that countries with well-developed financial systems are less sensitive to liquidity constraints, with a much smaller effect on the capital and GDP growth comparing with developing countries.

Besides, we do robustness check in two ways. Firstly, the risk free rate used in this paper are the return on 10 years' government bonds. One may argue that it is not the risk free rate for all countries. And thus we used data of loan rate and risk premium to mimick the risk free rate. The results remain unchanged. Secondly, all variables in our research, except for real interest rate and nominal risk free rate, we conduct the regressions again with all per capita form variables turning into aggregate form. Despite of some variables become less significant, our conclusions can still hold in this robustness check.

Our research supports Kiyotaki & Moore (2019)'s conclusions, showing that liquidity constraints indeed affect the capital and GDP growth. Developing countries might be faced with more severe liquidity constraint than developed countries and thus more sensitive to the change of liquidity premium. And also, our results implies that the variety of liquidity constraints across different countries

might be a factor of explaining the divergence of the economic growth of different countries.

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