Endogenous Credit, Global Liquidity and Instability of Financial Market

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The money in the modern economic and financial system is endogenous to a large extent, and this endogeneity incorporates the instability of the financial market. Following this research route, this paper finds that: on the one hand, the financial system centered on bank, on the basis of the assessment of economic status, sets out the premium price for the implicit put option in lender’s debt leverage ratio, and the interest rate under this mechanism is determined as the premium price of debt leverage and endogenously determines the growth rate of monetary supply; on the other hand, the multi-national bank and international enterprises, on the basis of the assessment of international and domestic investment risks, determine the asset allocation decisions and then determine the international capital flow and the exchange rate in the framework of flow equilibrium. On the contrary, the assessment of expected return rate is affected by the exchange rate, and the international capital flow is affected further. This feedback loop gives rise to the reflexivity feature and large mutability of the exchange rate and international capital flow. The domestic and international financial operations are superposed and interacted, which gives rise to the large instability of financial market endogeneity.

Keywords: monetary endogeneity, term premia, volatility of exchange rate, global liquidity, instability of financial market

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The financial market has the self-evident significance to the economy, but the traditional theory does not have enough attention on the relation between financial market and economic fluctuation, which becomes visible in the financial crisis in 2008. Although the theory circle attempts to add the effect of financial variable on the traditional macromodel under the concept “friction”, the financial operation, limited in the interpretation framework, appears in the theory as the fluctuation enlarger (“Financial Accelerator”, Bernanke, Gertler and Gilchrist, 1999), which is an underestimation of the close relation between finance and economy and is helpless for the understanding of the occurrence mechanism of financial market instability. On the other hand, the international nature of the financial crisis in 2008 compels the economists to pay more attention on the relation among the exchange rate, cross-border capital flow and instability of global financial market. Previously, the model based on the purchasing power parity theories has a few supports on the interpretation of exchange rate fluctuation, and the present models have poor predictive and explanatory ability on the fluctuation in exchange rate (Meese and Rogoff, 1983; Engel, Mark and West, 2008; Rogoff and Stavrakeva, 2008). This super volatility of exchange rate is called the “puzzle of exchange rate” (Cushman and Zha, 1997).

In fact, the two theoretical difficulties above are associated, the money in the modern economic and financial system is endogenous to a large extent, and this endogeneity includes the instability of the financial market. Following this research route, this paper finds that: on the one hand, the financial system centered on bank, on the basis of the assessment of economic status, sets out the premium price for the implicit put option in lender’s debt leverage ratio, and the interest rate under this mechanism is determined as the premium price of debt leverage ratio, which also endogenously determines the credit expansion velocity and growth rate of monetary supply. In the international aspect, the multi-national bank and international enterprises, on the basis of the assessment of international and domestic investment risks, determine the asset allocation decisions and determine the international capital flow following the similar mechanism of domestic financial market, and then the exchange rate is determined in the supply and demand balance of international capital. On the contrary, the assessment of expected return rate is affected by the exchange rate fluctuation, and the international capital flow is affected further. This feedback loop gives rise to the reflexivity feature and large mutability of the exchange rate and international capital flow. The domestic and international financial operations above are superposed and interacted, which gives rise to the large instability of financial market endogeneity.

From the monetary endogeneity, this paper builds an interpreting framework with intrinsic consistency, combining the liquidity, interest rate, exchange rate, debt leverage ratio and international capital allocation, providing the model interpretation of the high volatility of the
exchange rate and international investment. In this model, the international capital flow integrates the global financial market in strictness. The risk judgement of each behavioral agent on the global assets determines the international capital flow and the supply and demand of foreign exchange market. The endogenous mechanism of money produces the global excess liquidity during the boom and extends the regional financial tension to the global financial crisis during the crisis.

This paper is arranged as follows: the first section is a brief discussion of the monetary endogeneity, laying a conceptual foundation for the model in the second and third sections; the second section is a discussion on the relation between leverage ratio and interest rate, inferring the decision of interest rate term in the framework of endogenous money concept on the basis of Adrian-Shin model; the third section is a discussion on the relation between exchange rate and international liquidity, raises a new exchange rate determination theory on the basis of the division flow equilibrium, and is a discussion on the relation between international liquidity and instability of global financial market. A brief summary is the end.

**Endogenous money**

Following the research route in this paper, the second section will be a discussion on the relation between yield curve (term premium of interest rate) and debt leverage in the money endogenous framework. This research relates to the academic tradition in three aspects: the theory of endogenous money, the financial root of economic cycle and the structure research of interest rate term. As the conceptual basis of theory model in the second section, the monetary endogeneity will be discussed first in this section.

Endogenous money theory states that in modern financial system, the quantity of money is endogenously determined by the operation of the financial system instead of exogenous factors like the quantity of gold or Central Bank’s base money. The equilibrium models of mainstream economists are hard to incorporate monetary endogeneity and simply consider money as the veil of the real economy. Hence exogenous money theories have occupied the mainstream position all the time. Nevertheless, endogenous money theory has been studied for a long time by some economists, dating back from 18-century banking school to the *THE TREATISE ON MONEY* of Keynes and to post-Keynesian theories.

The endogeneity of money emerges as a new phenomenon (Kindleberger, 2005) since modern financial system came into being in the last half of 17th century. Pioneer modern banks arose in Western Europe, which issued bank notes based on the principal of partial reserves. In this system, banks and debtors are fairly free to initiate credit-debt relation and expand monetary aggregates. From accounting aspects, each loan can be seen as simultaneously increasing the
asset and liability of both banks and borrowers. On the balance sheet of bank, the new asset is the loan of borrower (as the credit) and the new debt is the bank note issued by bank; for a borrower, the new asset is the bank note accepted by the society and the new debt is the repayment obligation to the bank (as the debt). As long as banks and borrowers reach an agreement, ceteris paribus, they can increase the credit and debt to an arbitrary size. Thus, the instrument of “promise to pay”, i.e. money, is no longer a hostage to mintage quantity or money base of Central Bank. Any time they want, banking sector can satisfy this expansion need and create enough money by simultaneously increasing the asset and liability of banks. As long as people keep to the principal of convertibility, the unit value of money is not diluted despite the increasing of monetary quantity for no new net wealth is created (the new assets are always equal to the new debts). This is essentially different from new-found precious metals in the age of commodity money, which inevitably dilute the unit value of money. Consequently, with the operation of modern banking sector, monetary quantity is endogenously determined by the economic entities’ need for expanding credit.

Specifically, money creation mechanism is through “loans create deposits”. For example, when a bank agrees to loan 1 million to a certain corporate, the accounting operation is increasing both sides of the balance sheet, i.e., increasing liability by 1 million as the corporation’s deposits in the bank and simultaneously increasing asset by 1 million as the loan of the corporate owned the bank. The change of balance sheet is as follows.

The origin balance sheet:

<table>
<thead>
<tr>
<th>Asset</th>
<th>Liability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits 90 millions</td>
<td>Deposits 90 millions</td>
</tr>
<tr>
<td>Reserves 10 millions</td>
<td>Capital cushions 10 millions</td>
</tr>
</tbody>
</table>

The updated balance sheet:

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</thead>
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Both the structure and the size of the balance sheet change after the loan is newly increased. Banks may need to execute various financial operations to abide by various rules, like capital adequacy ratios or reservation ratios. For instance, banks may need to finance by selling out
assets or operating in repo market when they are lack of cash reserves, such as the deposit reserve in the account in Central Bank; or banks may need to issue new equity shares to add the capital when they are lack of adequate capital. In most instances, banks have the ability to add the loan and deposit without exceeding rules; in a few instances, banks may also expand its ability through flexible financial operations.

Most payment requests are settled in the manner of deposit transfer between bank and bank, and between bank and client. Bank notes are often in small quantity, only used in the daily micropayment. From this time, the deposit became the main form of money. Hence, the modern banks are capable to create various tools representing the payment acceptance. These tools are different in the form, liquidity and risk attribute. It is only determined by the definition whether a certain tool is called money or whether the tool is used for the statistic of money quantity.

Banks need to do one-to-one negotiation, do due diligence and make final contract decisions when facing with their clients, and consequently charge different clients with different interest rates, leverage ratio and other loan conditions. In numerous case practices, the financial decisions interact and various trades spread in different levels, integrating the financial market.

More importantly, almost all types of credits creditor’s rights (including treasury bonds, national bonds, financial bonds, enterprise bonds, ABS and derivative instruments) are traded continuously. The trades of these credits and derivatives give the assessed value of financial risks endlessly. In this sense, the financial market is a whole. The risk assessment relates to the trades on loan markets, bond markets, stock markets and foreign exchange markets.

For a long time, the money researches in deposit and flow are respectively conducted by two separate research schools. From the description above, the two researches are reconcilable. Both deposit (trade of current credits) and flow (new credit and loan) are the continuous risk assessment activities. The risk relation of stock trade determines the restraint for flow trade in rough, and the flow trade constitutes the newly increased stock. The stock bonds are traded in the secondary market, separated from the credit market in tradition. Recently, this traditional separation is disappearing along with the rise of mode “initiating-packaging-selling”. Meanwhile, even if this separation is considered, the interest rate and risk assessment defined by the secondary market still determines the interest rate and risk assessment of credit and loan.

In other words, banks are continually managing the liquidity and assessment risk though transaction behaviours. The liquidity is the difficulty of asset realization. Banks need hold the certain quick-action liquidity to perform their settlement obligations even if it will sacrifice the earnings of asset holdings.
The loan interest rate earned by a bank is the gross yield instead of net yield. A bank benefits on the condition of the short deposit term of payment capital cost with low interest rate and the long loan term of earning with high interest rate. The profit of bank mainly comes from this difference. In essence, banks mainly deals with the bill swap. This process can proceed in two directions from the monetary endogeneity: banks may either acquire the deposits of low cost for loan issuing or issue loans and then add an asset (loan) and an debt (deposit under the name of company) on the balance sheet.

If the loan is in form of securities and traded in the market, almost all riskless arbitrage opportunities will disappear and the individual risk of loan (and bonds) will disappear, too. The interest rate for enterprise bond of different terms and risks incorporates the following (Mehrling, P., 2010):

\[
\text{Enterprise bond rate} = \text{benchmark interest rate} + \text{IRS} + \text{CDS} \quad 1.01
\]

In this equation, the benchmark interest rate is the short-term government bond (the national bond of three months for convenience), IRS is the interest rate swap, and CDS is the credit default swap. The swap is a trade where the parties promise to pay the income flux per the agreed conditions. That is to say, the long-term enterprise bonds may be sold to three kinds of people in fact: people who are willing to purchase bonds (national bond), people who are willing to bear the interest rate risk and people who are willing to bear the default risk. The latter two kinds of people need not pay any capital for the bond and provide a certain mortgage for risk. In the modern financial system, IRS and CDS are traded in a large scale, and thus, the risks above may be realized in an extremely precise degree.

**Debt leverage and interest rate**

The term structure puzzle of interest rates is always the core of financial economics research, state space switching model developed recently introduces the macroeconomic information into the decision of term structure of interest rate through the traditional affine model framework. Along this direction, this paper goes further with consideration that in the framework of monetary endogeneity, debtor and creditor can negotiate and definite debt leverage ratio and the interest rate term can be considered as pricing share option of the debt leverage ratio in essence, and that pricing is controlled by risk estimation of state space carried out by the actor.

Scholars have carried out considerable researches on the term structure of interest rate, the expectation hypothesis of term structure holds that the long-term interest rate equals the expected short-term interest rate in the future plus a fixed risk premium. As the core of financial economics, this hypothesis has received widespread empirical tests from economists (Campbell
and Shiller, 1991; Frankel and Froot 1987; Bekaert and Hodrick, 2001). So far, these tests still do not have final conclusions, yet some evidences show that more tests tend to reject the expectation hypothesis (Mankiw and Miron, 1986; Campbell and Shiller, 1987; Wachter and angvinatsos, 2005; Sarno, Thornton, and Valente, 2005). Furthermore, numerous researches report the time-varying term structure and risk appetite (Fama, 1984; Lee, 1995; Tzavalis and Wickens, 1997), which encouraged economists utilizing concepts of jump or regime shift to model the risk process (Ahn and Thompson, 1988; Hamilton, 1988; Bansal and Zhou, 2002; Dai, Singleton and Yang, 2007).

Economists also find that nominal short-term interest rates are pro-cyclical, nominal term premia are counter-cyclical while nominal short-term interest rates are mean-reverting (Fama, 1990), and the term premia volatility distributes in a hump shape Litterman et al. 1998). As depicted in America data, during 1983–1998, the volatility of 2-year term premium reaches the maximum and that of one-year and below-one-year term premia are relatively low while the term premia volatility of bonds with maturity longer than 2 years tends to decay with maturity. This property is not immutable and the results based on the same calculation method show during 1954–1978, the term premia volatility is generally low and the volatility of one-year term premia reaches the extreme. The pair of term premia and debt leverage moves counter-clockwise cyclically. In addition, American empirical data displayed that in boom periods, term premia decrease and leverage expands while in recession periods, term premia increase and debt leverage decreases in generally.

To explain these properties, economists pay more and more attention to the impacts of economic conditions on the fluctuation of interest rates, based on classical affine models. However, restricted by the stochastic process hypothesis of interest rate, existing models fail to investigate the specific ways in which macro-economic variables impact the movements of interest rates. After the 2008 financial crisis, economists start to notice the deep connections between monetary/financial factors and economic fluctuations. On the one hand, they lay emphasis on explaining the fluctuation of interest rates with economic factors (Ludvigson and Ng, 2005). On the other hand, they pay more attention to the role of financial factors in real economic fluctuations (Adrian, Tobias and Hyun Song Shin, 2010). Adrian and Shin state that aggregate liquidity can be regarded as the rate of change of the size of financial intermediaries’ balance sheet, which is mainly affected by change of debt leverage ratio. To maintain a constant unit value at risk (VaR), banks tend to adjust leverage and interest rates in line with their assessment of economic condition. In this way, interest rates (and term premia) are determined together with leverage.
Based on the discussion in the first section, the assets can be defined as equipments able to bring in cash flows in the future, and the debts can be defined as the commitments to cash payment in the future. The debtors perform their promise to pay according to the future income flux from assets. As there is “Knightian uncertainty”, i.e. the non-static, time-variant shift of values of liabilities and assets, which is a matter of life and death for banks and enterprises. For debtors, they pay more attention on how to raise return on capital; for banks, they must actively manage their balance sheet. This management, in essence, is a dynamical assessment and pricing on the risk. The values of interest rate and implicit risk are determined in this assessment.

To better understand the risk assessment, we build a simple contract model to illustrate using the framework of Adrian, Tobias and Hyun Song Shin (2012).

Adrian & Shin model considers financial institutions (represented by the bank) as debtor, who borrows funds from creditor. In the following model, the bank is creditor, who lends funds to enterprises. Assume the enterprise’s total assets (A) are partly from equity (E), partly from debt (D), which all from bank loans. Enterprises and banks are both risk-neutral. There is only one stage in this model. The enterprise invests at the beginning, and increase total assets to $A \times (1+\bar{r})$ at the end of the period, where $\bar{r}$ is the return to assets. Equity E is determined in the prior period and is considered as exogenous variable here, and debt D is the decision variable for the enterprise. The enterprise promises to repay $\bar{D}$ at the end of the period, where $\bar{D}/D - 1 = r$ is the loan interest rate. It can be noted that D is the market value of debt, time-variant; $\bar{D}$ is the par value of debt.

Hence, the enterprise’s balance sheets in the beginning and the end of the period are as follows:

In the beginning:

<table>
<thead>
<tr>
<th>Asset</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset A</td>
<td>Loan D</td>
</tr>
<tr>
<td></td>
<td>Equity E</td>
</tr>
</tbody>
</table>

In the end:

<table>
<thead>
<tr>
<th>Asset</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset $A \times (1+\bar{r})$</td>
<td>Loan $\bar{D}$</td>
</tr>
<tr>
<td></td>
<td>Equity $\bar{E}$</td>
</tr>
</tbody>
</table>

Banks need to determine the interest rate level in order to balance their revenues and the risk of default. For them, they hold a credit with par value of $\bar{D}$, whose end value is unknown at the
beginning. According to Merton (Merton, 1974), the value of loan at the beginning actually contains two parts: 1) the par value of $D$; 2) a put option issued by the bank to the debtor, with exercise price of $D$, against the enterprise’s total assets and due at the end of the period. If the enterprise does not default in the end, the price of this option is zero. If the enterprise defaults in the end, the maximum loss of the bank is the total $D$. The latter situation is equivalent to that the enterprise (its equity holders) exercises the put option and thus the bank bears all losses where $D$ is higher than total asset of the enterprise. Consequently, the payoff of the enterprise’s equity holders and banks can be described as following:

Figure 1: Payoff analysis of loan. At the end of the period, if the total value of the enterprise is greater than $D+E$, the enterprise’s equity holders will earn profits; if the value is less than $D+E$ and greater than $D$, the enterprise’s equity holders bear loss; if it is no greater than $D$, the equity is totally lost and the creditor begin to bear loss.

For simplicity, we assume $A = 1$, then the put option sold by the creditor (or the put option held by the enterprise) can be written as:

$$O(D, A) = O(d)$$

This equation represents a put option with exercise price of $D$ and against the value of $A$. If total assets in the future are fewer than $D$ then the enterprise will exercise it and the creditor will be forced to take the loss. Denote $d = D/A$ as the value of debt per total assets. According to 1.02, the enterprise’s put option is priced on its debt ratio $d$. The net value of debt held by the creditor is
\[ \overline{D} - D_0(\overline{d}) = A(\overline{d} - d_0(\overline{d})) \]

Its net profit or loss is

\[ U_D = \overline{D} - D_0(\overline{d}) - D = \overline{d} - d - d_0(\overline{d}) \]  \hspace{1cm} 1.03

Therein \( U_D \) is the creditor’s net profit or loss and \( d = D/A \) is the leverage ratio. For the creditor, it will give out the loan only when the following inequality is satisfied:

\[ \overline{d} - d - d_0(\overline{d}) \geq d * \omega_D \]  \hspace{1cm} 1.04

In this equation, \( \overline{d} - d \) is the interest per total assets earned by the creditor, which must be no less than \( d_0(\overline{d}) \). The unit value of the put option sold by the creditor and the difference must be no less than the threshold level \( d * \omega_D \). \( \omega_D \) stands for the creditor’s capital cost, which for the bank is, approximately, the interest and related cost paid in order to draw deposits; and for direct investor such as pension fund or bond fund, it may be the risk-free return rate that can be earned elsewhere. In any case, via the risk-free trading, \( \omega_D \) is closely related to central bank’s policy interest rate. This is the participation constraint for the creditor. According to researches on option pricing, the price of the put option on the enterprise’s debt is determined by the assessment \( \delta_s \) of the economic regime by market participants, due date \( T \), and risk-free interest rate \( r_w \). Hence, we have:

\[ O(\overline{d}) = O(\overline{d}, T, \sigma(\delta_s), r_w) \]  \hspace{1cm} 1.05

The share option is a monotonically increasing function of the value of debt per total assets in the future value \( \overline{d} \), expiration date \( T \), implied volatility \( \sigma(\delta_s) \), and risk-free interest rate \( r_w \). The implied volatility \( \sigma(\delta_s) \) is a monotonically decreasing function of estimated economic regime \( \delta_s \), namely it increases when the economic state space is negative. Define interest rate

\[ asi = \frac{\overline{D}}{D} - 1 = \frac{\overline{d}}{d} - 1. \]  Plug 1.05 into 1.04, and simply assume \( \omega_D = r_w \), where \( r_w \) is the risk-free interest rate, then we have

\[ i - r_w = O(\overline{d}, T, \sigma(\delta_s), r_w) \]  \hspace{1cm} 1.06

Since \( O(\overline{d}) \) is the monotonically increasing function of \( \overline{d} \), the equation above indicates that the difference of the two interest rates \( i - r_w \) is an increasing function of \( \overline{d} \), that is when the leverage ratio \( d \) increases, the future value of corresponding debt per total assets \( \overline{d} \) increase, then the price of the option with \( \overline{d} \) as the exercise price will increase and consequently, the interest rate beyond risk-free interest rate required by banks will increase. Meanwhile, equation 1.05 also indicates
that the position of the above implicit function’s curve is determined by implied volatility $\sigma(\delta_s)$, which is determined by the economic state space ($\delta_s$). The interest rate difference $i - r_w$ is the sum of term premium and credit risk premium, both of which can be divided and traded and thus priced separately in financial market. For simplicity, we only investigate the term premium among the same bond financing subject.

Based on researches on option pricing, the interest rate defined in 1.06 has a stable positive relation with debt leverage, which is convex to the origin point. With high levels of term interest rate level, a small upward swing of interest-rate spread is not enough to encourage banks to take more risk and permit higher debt leverages ratio for enterprises. However, a small upward swing of interest-rate spread is enough to encourage banks to permit higher debt leverages ratio during low levels of term interest rate level. The relation between debt leverage ratio and interest rate defined in this way is called the debtor's term premium curve.

The total earning of the enterprise is $Ar$, where $r$ is the expected return on capital. The total return is distributed between creditors and equity holders. Hence the net profit of the equity holders is:

$$U_E = Ar - \bar{D} + D + AO(d) = r - (\bar{d} - d) + AO(\bar{d})$$  \hspace{1cm} 1.07

Therein $U_E$ is the net profit of creditor. For the enterprise, it will satisfy the loan on condition of the following inequality:

$$r - (\bar{d} - d) + O(\bar{d}) \geq (1 - d) * \omega_C$$  \hspace{1cm} 1.08

1.08 indicates that for debtors, the difference between expected return on capital and debt cost must be no less than some threshold value $\omega_C$. For simplicity, we further assume $\omega_C = r_w$, and based on 1.08, we have:

$$i - r_w \leq \frac{r - r_w}{d} + \frac{O(d, T, \sigma(\delta_s), r_w)}{d}$$  \hspace{1cm} 1.09

Combining 1.06 and 1.09, we have

$$O(d, T, \sigma(\delta_s), r_w) \leq i - r_w \leq \frac{r - r_w}{d} + \frac{O(d, T, \sigma(\delta_s), r_w)}{d}$$  \hspace{1cm} 1.10

$$r_w + O(d, T, \sigma(\delta_s), r_w) \leq i \leq r_w + \frac{r - r_w}{d} + \frac{O(d, T, \sigma(\delta_s), r_w)}{d}$$  \hspace{1cm} 1.11

Equation 1.08 and Equation 1.04 indicate that with given expected return on capital, 1.08 is the vertical mirror of 1.04, and thus the relation of interest rate on leverage is negative and convex to the origin point. We call the relation between the debt leverage and term premium as debtor’s
term premium curve defined in 1.09. Obviously, debtor’s interest rate curve moves right, then expected return will increase.

Hence, with given equity E, the enterprise’s total assets leverage ratio, total assets and total liabilities depend on the value of \( d^* \) and corresponding \( i^* \) resulted from solving equations 1.04 and 1.08, that is, the interaction of creditor’s curve and debtor’s curve. According to 1.10, the relation can be described as follows:

![Diagram showing the interaction of debtor’s and creditor’s curve](image)

**Figure 2:** determining the interest rate and leverage ratio with debtor’s curve and creditor’s curve.

Ideally, the different constraints for leverage ratio of creditors and debtors will reach equilibrium, determining the debtor’s leverage ratio and difference interest rates. In the procedure above, the option pricing on the risk plays a vital role. The existence of this model’s solution and uniqueness based on the necessary and sufficient conditions that there is monotonicity between prices of embedded option in the debt indenture and implied volatility.

Therefore, the fluctuations of interest rates cannot be simply described by a stochastic process. Previous researches make different assumptions on the properties (for example, whether it fits mean-reverting and whether its fluctuation sometimes becomes equal) of the stochastic process such as whether it's mean-reverting, or whether its volatility is time-variant, following Cox, Ingersoll and Ross (1985) first mean-reverting, square root model. For example, Black-Derman-Toy model and Hull-White model both assume time-varying properties, while Heath, Jarrow and Morton (1992) further explore the relation between the drift and the diffusion term of equation under non-arbitrary condition. However, according to what we state above, these researches fail
to analyze the specific mechanism by which the economic variables affects the interest rates and hence difficult to match the empirical characteristics of interest rates and term premia.

In the aspects of how interest rate is determined, based on Equation 1.10 the yields with different maturities should satisfy the following inequalities

\[
0 \left( \bar{d}_t, \tau_1, \sigma(\bar{\delta}_{s, t, \tau_1}), r_{w, t} \right) \leq i_t(\tau_1) - r_{w, t} \leq \frac{r_{t, \tau_1} - r_{w, t}}{d} + \frac{0 \left( \bar{d}_t, \tau_1, \sigma(\bar{\delta}_{s, t, \tau_1}), r_{w, t} \right)}{d}
\]

\[
0 \left( \bar{d}_t, \tau_2, \sigma(\bar{\delta}_{s, t, \tau_2}), r_{w, t} \right) \leq i_t(\tau_2) - r_{w, t} \leq \frac{r_{t, \tau_2} - r_{w, t}}{d} + \frac{0 \left( \bar{d}_t, \tau_2, \sigma(\bar{\delta}_{s, t, \tau_2}), r_{w, t} \right)}{d}
\]

... ...

\[
0 \left( \bar{d}_t, \tau_N, \sigma(\bar{\delta}_{s, t, \tau_N}), r_{w, t} \right) \leq i_t(\tau_N) - r_{w, t} \leq \frac{r_{t, \tau_N} - r_{w, t}}{d} + \frac{0 \left( \bar{d}_t, \tau_N, \sigma(\bar{\delta}_{s, t, \tau_N}), r_{w, t} \right)}{d}
\]

In the equation, duckling $\tau$ represents maturity and $t$ is time. The above equation suggests that the term premia with different maturities (term premium) for the same debtor depends on the spread of implied option price. For creditors, the implied option depends on five factors including $d_t, \tau_1, \sigma(\bar{\delta}_{s, t, \tau_1}), r_{w, t}$. For debtors, the decision-making has one more variable besides these five factors, i.e. expected return on investment $r_{t, \tau_1}$.

Here maturity plays an important role. For debts with short maturity, creditors will, based on comprehensive and specific economic information, assess the share option premium determined by the probability of business failures and $\sigma(\bar{\delta}_{s, t, \tau_1})$ in $\bar{\delta}_{s, t, \tau_1}$ represents the economic status space on the due date. Theoretically speaking, the risk-free rate can be seen as the result when maturity time approaches zero.

In reality, the central bank’s policy interest rates are greatly affected by the short interest rates in the market. If the short interest rate such as one-week repo rate is far higher than the policy interest rate, banks will borrow more money from central bank and lend more to the market; as a result the size of banks balance sheet will expand. Credit expansion makes up the pressure for raising prices and lead to an upward swing of inflation rate. In this case, the spread of short-run interest rates and the policy interest rates will decrease either through increasing policy rates by the central bank, or added credit pressure down short-term interest rates.

On the other hand, theoretically speaking, when people estimate the value of perpetual bond, i.e. bond with indefinite maturity, $\sigma(\bar{\delta}_{s, t, \infty})$ stays the same and so does the expected return on investments. Hence, the perpetual bond’s interest rate $i_t(\infty)$ keeps the same. Theoretically
speaking, the premium of the longest maturity is the difference between the perpetual bond’s interest rate and the policy rate, which is totally driven by the change of policy rate. Since

$$i_t(\tau_2) - i_t(\tau_1) = (i_t(\infty) - i_t(\tau_1)) - (i_t(\infty) - i_t(\tau_2))$$

Therefore, in general sense, the term premium itself can be seen as the difference between two term premia. At the same time,

$$i_t(\tau) = i_t(\infty) - (i_t(\infty) - i_t(\tau))$$

In this equation, we consider $i_t(\infty)$ as a constant so that interest rate $i_t(\tau)$ is determined by the term premia $(i_t(\infty) - i_t(\tau))$. In this way, $i_t(\infty) - i_t(\tau)$ provides the standard for us to analyze the term premia as well as interest rates.

During economic prosperity period, for shorter term of future economic trend, creditor may be positive of estimating. With low premium, creditor cursive track moving downward, higher expected return on investment and creditor cursive track moving right, interest-rate spread decreases but leverage ratio arises. Thus, rate of shorter term will be largely affected by economic state and its volatility is bigger.

While for longer term bond (such as 5-year or 10-year bond), according to this, creditor can judge that in the 5 years, the information of economic state is less. $\delta_{s,t,n}$ and $r_{t,n}$ will not change a lot as recent economic trend changing. Thus, the above model predicts that the change of long term bond yield difference $(i_t(\infty) - i_t(\tau_2))$ is not big in economic fluctuation, while short term bond yield difference $(i_t(\infty) - i_t(\tau_1))$ is sharpest falling down. Yield curve expresses periodic changing (planarization).

According to above analysis, combination of term premium-leverage shows regular trend with periodic economics. The empirical data of USA expresses this definite periodicity. During economic expansion period, term premium decreases and leverage ratio expands. During the economic recession period, term premium arises but leverage decreases. According to the above theory model, the following figure will show how the term premium-leverage is changing during the analysis of economic recession period.
During the economic recession period, bank changed the evaluation of economic state regime and was more pessimistic to the development of economy. And the bank pre-estimated that the ruin probability of enterprise and option value ($O(d)$) would arise, which showed that its debtor curve was arising. At the same time, the debtor was turning down the expected return on investment and debtor curve shifted to left, which showed that the need of banks credit unwillingness and corporate finance glided down. Its results were level of interest-rate spread increases but leverage of enterprise was down.

After 1980, the economic cycle of America has 40 months or so on average. This fact helps explain the hump distribution of the volatility of interest rates for different maturity. The hump locates around two-year, rightly near the half of the cycle, indicating on average two years is the period when the creditor swings back and forth from the most optimistic to the most pessimistic assessment about the expected return on investments. After the 2-year hump, the volatility of interest rates gradually drops down along with the extending of the maturity. In fact, as described above, theoretically, perpetual bond’s interest rate $i(\infty)$ should be a constant with zero volatility. In other words, since the premia and interest rates of different maturities are both strictly based on the price of the implied option and the assessment of the expected return on investments for the maturity, there is no reason for them to remain stationary. Hence, it is natural that empirical data rejects the expected theory.

**International liquidity and exchange rate**

All kinds of factors may attend credit boom and subsequent fabrication of financial crisis, for example, herd behaviour of bank (Kindleberger, 2011), mutual interdependence between banks caused by asymmetric information problems (Rajan, 1994, Gorton and He, 2005), underestimate of risk (Borio, et. al., 2001), lower lending standards (Dell’Ariccia and Marquez, 2006), visible and invisible government guarantee (Corsetti, et. al., 1999) or inadequate collateral of lender (Lorenzoni, 2005), etc. But debt leverage and interest rates term premium periodic fluctuation, which described in the model of above section, may one of the main mechanisms.
During financial crisis period, all kinds premia (term premia and risk premia) of interest rate surge, while debt leverage sharp declines. And combining with real economy slow down, they constitute a circulation of self-reinforcement. At the moment, bank will find high quality liquid assets he held are less and it is unable to perform legal liquidation obligations. This awkward situation asked central bank to undertake the final lender responsibility (Walter Bagehot, 2008).<ref>
From actual situation, when central bank affords the final lender responsibility, occurrence of heavy financial crisis will quickly reduce. Taken USA as an example, in 1936, after USA abandoning gold standard and Federal Reserve performed its final lender responsibility, frequency and seriousness of financial crisis were obviously low down. This was not an accident. In fact, according to the research of Reinhart and Rogoff (Reinhart and Rogoff, 2014), from gold standard was formally abandoned in 1936 to Bretton Woods system broken in 1973, during the 37 years, no any country in all of the world showed severe financial crisis. After 1936, there were 13 times severe financial crisis in world, compared with the 22 times before 1936, they glided a lot. However, all the 13 times severe financial crisis were happened after Bretton Woods system being broken; and all financial crisis were related with international currency factor, rather than simply related with domestic factor. This suggested that centre festival system which is suitable to endogenous currency system has already the ability to prevent domestic financial crisis, but at the similar arrangement of lacking of international currency system, so that institutional source of many international financial crisis broken is the absent of final lender of international liquidity. From this point, this paper thinks that liquidity can be divided into Domestic liquidity and International liquidity. As the following table shows:

<table>
<thead>
<tr>
<th></th>
<th>Domestic liquidity</th>
<th>International liquidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official liquidity</td>
<td>Asset to balance payment relation of financial setups (in reserve fund of central bank)</td>
<td>Foreign exchange reserve, IMF arrangement, exchange agreement of central banks</td>
</tr>
<tr>
<td>Private liquidity</td>
<td>Asset to balance payment relation of banks and clients of non-bank financial institutions</td>
<td>Asset to balance payment relation of international banks and clients of non-bank financial institutions from all countries (kinds of foreign currency deposit)</td>
</tr>
</tbody>
</table>

According to the definition of present literature, liquidity has microcosmic and macroscopic meaning, in which microcosmic liquidity is used for describing financial product or market, while macroscopic liquidity generally refers to total asset accessible to buy goods or asset in a certain economy, or refers to financing needs and level of difficulty in a certain economy. But in fact, liquidity is financial asset of debt relation cashing “promise to pay” meaning and
extensive acceptance between debtor and creditor. From the point of balancing debt which needs liquidity, we will divide it into four different types in above table:

The first is basic liquidity in domestic of all countries. This mainly refers to reserve fund of commercial banks in central bank. When commercial banks need to balance payment relation between them, they need to divide the reserve fund deposit in central bank. For this, they must frequently and positively manage their own deposit reserve. By repo etc. agreement or transaction of treasury bond, more liquidity is merging in when it needs while more liquidity merging out when it does not need. Central bank also frequently and positively manages deposit reserve of total commercial bank by transaction of repo, treasury bond and bond, thus supply and need of reserve fund can suitably adapt to each other. Central bank can achieve their goal of monetary policy by tools of deposit-reserve ratio, policy rate and others.

The second is basic liquidity among central banks of countries. In order to balance debt relation among countries, central bank needs to hold foreign currency assets which can be provided when banks and clients need. In addition, in crisis period, central banks of countries can get needed foreign exchange reserve by penetrating IMF agreement or currency exchanging among central banks. Foreign exchange held by central banks can effectively support the need of international liquidity to domestic financial institutes.

The third is private liquidity among domestic of countries. This mainly refers to kinds of investor hold kinds of financial assets which especially include check account deposit and treasury bond of high liquidity in each financial institute focusing on commercial banks. Basing on these assets, bank clients can balance kinds of debt relation by penetrating banks, while the asset which clients are held cannot be used for balancing, but it can turn into high liquidity deposit by penetrating transaction of currency market, bond market and stock market. As afore said, no matter banks or clients can both freely extend and shrink the debt and bond relation. The process of extending and shrinking mainly is subjected to policy of financial institutes to enterprise debt leverage.

The fourth is international private liquidity. This mainly refers to kinds of foreign currencies asset held by each international financial institute which replace clients focusing on multinational bank, especially including assets of deposit and treasury bond of high liquidity. At present, currency type of international liquidity includes dollar, Euro, yen and pound. International bank assets allocation and extends credits and bond relation among the world, while typical domestic bank focuses on domestic market. These international banks are massive, and extend or shrink the credit-debt relation priced on foreign currency, according to endogenous currency system described in the first section, to extend or shrink the international private liquidity of countries.
Before, IMF, BIS and other institutes give different definitions to global liquidity. Please see the following table:

<table>
<thead>
<tr>
<th>Theoretical definition</th>
<th>IMF - global liquidity</th>
<th>BIS - global liquidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Core</td>
<td>Official</td>
</tr>
<tr>
<td></td>
<td>Non-core</td>
<td>Private</td>
</tr>
<tr>
<td>Central bank</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Depository financial institutions</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Depository liabilities</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Other liabilities</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Non-depository financial institutions</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Government department liabilities</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Non-financial company liabilities</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Households liabilities</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>

Conceptually, domestic liquidity cannot simply be added as the statistical indicator of international liquidity. The main goal of researching international liquidity is researching the may-be influence of international liquidity to countries economy, especially to economic fluctuation. Form this point, divided standard of this paper is more access to the definition of BIS. Definition of BIS should take private liquidity into international private liquidity, while this paper thinks they should be distinct, which is their important distinction. For example, dollar deposit held by Citibank of US headquarters should be taken into domestic private liquidity, but it should not be taken into international private liquidity. On the contrary, dollar deposit of Citibank of subsidiary in China should be taken into international private liquidity. Therefore, international liquidity is composed of international official liquidity and international private liquidity. Taken China as an example, this means to need to calculate the sum of foreign deposit which is held by central bank of China and financial institutes of China (bank as a core), which can be regarded as the international liquidity data held by China. At the same time, dollar deposit held by US bank is in the form of dollar, but only should be calculated into domestic private liquidity of US, not into the sum of international liquidity. Basing on this definition, international liquidity held by all countries, thus the total international liquidity measurement can be added.

Basing on this definition method, it is obliviously that foreign exchange rate is determined by supply and demand of foreign currency in intonation, and foreign exchange rate is taken as the price of international liquidity. In the other word, domestic dollar number of US is not direct relevant with dollar determining RMB exchange rate, and the exchange rate is related with the
dollar number in China. No matter how foreign currency flow into domestic, it always is foreign currency and must indicate asset purchase of foreign countries (bank deposit or government bond). So, net flow of foreign currency always is zero. Therefore, studying the determined role of foreign currency (global liquidity) number and its price (exchange rate) in domestic needs to make it clear that the supply and demand of foreign currency in domestic.

From the point of economic flow balance, it can be written:

\[ Y = C + I + T_f = C + S + \pi - D_f \]  \hspace{1cm} 1.13

Thereby,

\[ T_f + D_f = S + \pi - I \]  \hspace{1cm} 1.14

In the above formula, \( Y \) is economic output, \( C \) is consumption, \( I \) is capital formation, \( T_f \) is trade surplus, \( S \) is savings, \( \pi \) is corporate profit and \( D_f \) is government deficit. Considering international investment fund flow, that is direct, portfolio and other investment (\( I_f \) of the following formula), we can get

\[ T_f + I_f = S + \pi - I - D_f \]  \hspace{1cm} 1.15

The right of equation is domestic net savings, which are the remains of the sum of resident and enterprise savings minus capital formation and government deficit. It offers net financing to foreign countries and represents foreign currency number turned into domestic currency, thus it requires domestic currency. The higher foreign currency valuation (the lower domestic currency valuation), the less net financing support from domestic (the less net savings), the less need for foreign currency, therefore foreign currency demand curve \( S + \pi - I - D_f \) declines forward. The left of equation are trade surplus and international capital flow \( I_f \), which represents foreign currency supply. The higher foreign currency valuation, the larger foreign currency demand amount (the larger trade surplus and \( I_f \) ), therefore foreign currency supply curve \( T_f + I_f \) is upward-sloping. Equilibrium of the two curves determines the foreign currency exchange rate and net savings.
Figure 4: exchange rate supply and demand curve, which is the determination of equilibrium exchange rate.

International capital flow of above formula measures its net amount which is the difference of international capital flow in and domestic to foreign investment. The research suggests (Fernando Broner, Tatiana Didier, Aitor Erce, Sergio L. Schmukler, 2013), massive of international capital flow out and in is far more than international capital flow net amount with the same changing direction and indicates obviously procyclicality. Inner financial condition of international liquidity support countries like USA, Britain, European and others affects financial condition of other countries. These financial conditions include volatility of stocks (VIX), term premium, risk premium and increase of credit and money. Eugenio Cerutti, Stijn Claessens and Lev Ratnovski (2014) point out that yield curve (term premium) of USA, Britain, European and Japan has a negative correlation with capital flow, which means that when capital in domestic has more higher premium, foreign investment is low. Bruno and Shin (2014) stresses the influence of USA commercial bank leverage to global liquidity. The empirical research of Classens and others (2010) points out that original asset price bubble of a certain country is easily to overflow to other countries and strengthening capital flow can enlarge the fluctuation of domestic financial market. Specific mechanism may be, when the flowed in international capital amount is sufficient to lead the increase of idle fund of bank; bank will broaden the credit limitation of enterprise and private. Similar signs also show that asset price fluctuation among different countries is more and more relevant with each other, and feature of global financial integration is more significant.

For international capital, when two similar international and domestic projects are considered, the decision frame is still an interest rate price of considering debt leverage ratio as stated above. According to interest rate curve of creditor, term premia is in positive correlation with leverage ratio under same conditions and other conditions. Therefore, when American term premium decreases comparing with international term premium (it always corresponds to American economic prosperity and improved interest rate level), capital will improve allocation to international investment. For recipient countries, increased international capital inflow means that larger leverage ratio can be held under same term premia, exchange rate curve of creditor is driven to right in exchange rate model, so that term premia decreases and leverage ratio improves, yields curve is more equalized, and high saving growth and credit growth are stimulated in recipient countries. Thus, economic prosperity of center countries always forces larger-scale
cross-border investment to emerging countries, and drives these countries enter into stalled economy at the same time. The process is accompanied with exchange rate as shown in the following figure.

Figure 5: International liquidity and exchange rate

In the figure above, it is assumed that international factors cause international liquidity increase; foreign currency supply curve ($T_f + I_f$) is shifted to right, equilibrium exchange rate decreases, local currency appreciates, and then trade deficit is expanded. Meanwhile, net savings ($S + \pi - I - D_f$) rises, the gap among household savings, sum of enterprise profit ($S + \pi$) and sum of financial deficit ($I + D_f$) of the country is expanded, which is beneficial for expansion of investment and governmental deficit of recipient countries.

For another hand, net savings curve is mainly affected by the local country factors: robust investment causes net savings decrease during economic prosperity. Foreign currency demand curve ($S + \pi - I - D_f$) is shifted to left, which drives foreign currency devaluation and local currency appreciation. To the contrary, local currency devaluates during economic depression.

Mendoza and Terrones (Mendoza, E. G., & Terrones, M. E., 2012) point out that frequency, amplitude and some stylized facts of credit bubble are similar both for developing and developed countries. During international loan bubble feed, developed countries always register strong capital inflow under trade deficit. Real interest rate, loan growth and capital price are high, and inflation remains low. Then, capital inflow reverses, inflation cools rapidly, and interest rate, asset price and output decline. Developed countries shared similar characteristics, but the amplitude is shallow. Developing countries mainly rely on return on investment to attract
capital inflow, not interest rate. The mode plays a bigger role in interest rates difference of developed countries. The stylized fact conforms to prediction of aforementioned model.

Ivashina, Scharfstein and Stein (2012) further point out that dollar funding resource of a large number of European banks depend on wholesale market, and a large number of dollar loan is distributed to European and American enterprises. When their credit ratings slip and credit must be crunched, dollar loan scale drop is far bigger than European loan scale drop. In European debt crisis in the second half of 2011, American money market decreased dollar financing support for European banks. As a result, large dollar-Euro spread was expanded largely, European banks largely cut the dollar loan, and large devaluation of dollar against Euro occurred. According to aforementioned interest rate model, reduced dollar flow makes creditor curve shit to left, risk premium and term premium are improved while reducing debt leverage, so that loan scale decreases and spread rises. At the same time, foreign currency supply curve shits to left according to exchange rate model, which causes Euro devaluation and dollar appreciation.

In this way, interest rate and exchange rate are mutually linked and decided together. Interest rate and exchange rate are both affected by two factors of local country and globe, so they have high volatility. One crucial point is that foreign direct investment $I_f$ is subject to decision of international capital allocation, while the later one is further affected by exchange rate fluctuation. Positive feedback loop relation is likely to be formed among three variables under overlay, so it has large volatility. Countries with floating exchange rate system have significant difference from those with fixed exchange rate system in this part.

![Figure 6: Super volatility of positive feedback of exchange rate and foreign currency supply curve and exchange rate](image-url)
In the floating exchange rate system, international capital will at any time evaluate fund allocation in each country, and any variation related with this kind evaluation, for example, economic fundamentals, interest rate change, monetary policy, financial policy, geopolitics and others, all may adjust the international capital to the evaluation of expected rate of return of countries, therefore variation of $I_f$ determination is caused. Once $I_f$ is changed, exchange rate will also change. In the figure 5, if $I_f$ of a country is added, foreign currency supply curve shifts right and domestic currency is appreciated. Generally, this variation is self-healing: domestic currency appreciation will throw negative stress to trade surplus, bringing $T_f$ decreasing, and then this can counteract the increasing influence of $T_f$ afore said. In some cases, total equilibrium may be broken. Since exchange rate variation itself may often affect the expected rate of return of $I_f$, feedback relationship is formed: the increase of expected rate of return lead the addition of $I_f$, foreign currency shifts right and domestic currency is appreciated; latter conversely further lead expected rate of return to arise and feedback loop is strengthened. Therefore, in a short term, this feedback loop may make the foreign market imbalanced and domestic currency is continually appreciated. At the same time, net savings $S + \pi - I - D_f$ rise. On the other hand, domestic currency appreciation is bad for trade surplus and delays foreign currency shifting right. After a certain time lag, international capital allocation reverses and $I_f$ declines with positive feedback loop after domestic currency depreciation and foreign currency supply curve re-back its original place even with overreaction which domestic currency depreciation and international capital outflow are together in resonance and exchange rate is out of adaption.

Therefore, in the floating exchange rate system, feedback relation between $I_f$ and exchange rate may cause super mutability of exchange rate which characterised of scattering tendency in short term and mean--reverting value in long term.

For countries with fixed exchange rate system, its exchange rate may have little fluctuation in short term, but fluctuation is big in long term.
Figure 7: the result of misallocation fixed exchange rate

In the above figure, if market equilibrium exchange rate is $\varepsilon_1$ and implementary fixed exchange rate is $\varepsilon^*$, in this condition, domestic currency is appreciated and foreign currency supply should be less than the demand of foreign currency. On the one hand, clandestine dealing of foreign currency may show up where foreign currency is dealt in a high exchange rate and supply foreign currency is lack; on the other hand, the country may have to improve the level of interest rate to lead $I^f$ inflow. Thus, foreign currency supply curve will shift below and depend on $I^f$ to counteract the lack of $I^f$; foreign currency demand curve will shift below, savings and profit sliding while investment arises, which shows that economic foam trend. The longer the state last, the bigger the disequilibrium and may-coming adjustment may more comparative. Mendoza, E. G., & Terrones, M. E. (2012) point out that credit boom-crash event of countries with fixed exchange rate occurs more than countries with floating exchange rate.

Taken financial crisis of Thai in 1997 as an example, before crisis, fixed exchange rate system focusing on dollar was implanted in Thai. After 1995, Thai baht with dollar were appreciated a lot. Thai was always in trade surplus, which mainly depended on huge capital inflow $I^f$ to counteract. In order to continue to inflow $I^f$, central bank of Thai issued high interest rate policy and domestic deposit interest rate was up to 15%. Domestic currency appreciation, $I^f$ inflow and export growth fell fasten the foam of real estate market and stoke market. Beginning with the origin of 1997, capital doubted fundamental, capital began outflow, foreign currency supply shifted upward and domestic currency began to depreciate.

The depreciation conversely intensified the outflow of $I^f$. International speculator recognized the vulnerability of Thai, after three wave’s attacks; financial crisis was broken in Thai and Thai was forced to give up fixed exchange rate system and exchange rate of Thai baht plunged 38%. What’s worse, stock and real estate market were all plunged and numerous banks went bankrupt. The economy of Thai suffered heavy losses.

In the crisis of Thai, the main push force is domestic economy condition. In other cases, international factor played an important role. Schnabl and Schobert (2012) studied the liquidity attack caused by debt default in Russia in 1998 affected economy of Peru. Comparatively speaking, multinational bank is more easily to counteract the outward liquidity attack to loan of domestic branch institutes through headquarter or offshore branch institutes, thus domestic bank of external financing will face bigger lack of liquidity and they will cut off the loan of domestic
enterprise with arising risk premia. Finally, domestic economy is influenced. The system explains the most part of attack which Russia crisis brought to Peru.

From above model, it is not difficult to understand that financial operation has spillover effect and global liquidity linkage may be the biggest driven force of global financial market instability.

Figure 8: Global premia of financial operation

From the above figure, if A country is center country and its central bank issued easy-money policy or credit embedded option premium pricing of bank is lowed caused by economic prosperity, creditor of the country curve shifts downward. And at same term premia and risk premia, more debt leverage can be contained. The variation in A country causes lower term premia and risk premia, higher debt leverage and credit massive. Finance department of A country faces lower term premia and risk premia, which will increase the asset allocation to other countries. If B country is the periphery country which is influenced, cross border asset inflow from A country adds which will cause foreign currency supply curve $T_f + I_f$ shifting to right. Domestic currency of B country is appreciated when exchanged currency of A country. According to aforesaid, this may form positive feedback loop to prompt A country set more asset allocation to B country. Capital inflow also cause creditor curve of B country shifting downward, which can prompt the increase of debt leverage of B country and decrease of term premia. This
contributes to the credit boom and economic growth. Calderón and Kubota (2012), basing on empirical research of 70 countries, points out that surge of international capital inflow is an important leading indicator of credit boom. From the above track, international capital inflow has largest active influence, and it not changes violently, but in a short term changes the equilibrium of foreign exchange market, and then to influence exchange rate, (a time lag) trade equilibrium and real economic. By such operation way, finance operation of A country may affect economic and finance of B country.

Apart from influence of monetary policy, if A country adopts slack fiscal policy, financial deficit will expanse and net savings will decrease, while on external balance, foreign policy demand curve shifts below and domestic currency appreciated. Sum of trade surplus of A country and international capital inflow decreases. On internal balance, creditor curve shifts upward, debt leverage slides down, term premia and risk premia decrease and part of stimulating effect of the slack fiscal policy counteract. At the same time, decrease of international capital net inflow of A country is equivalent to the addition of cross-border of foreign countries and conversely it will push currency appreciation, credit extension and real economic increase of B country. Thus, easy monetary policy and slack fiscal policy of A country will indirect influence the finance operation and real economic activity of B country.

Besides the government policy, the operation of many financial and real economies will have outflow influence in Country A. For instance, it is assumed that Country A enters the economic boom, the expected return-on-investment rate increases, the debtor curve rises up, the debt leverage of Country A increases, and the term premia and risk premia go up, which will cause the decrease in foreign capital allocation of Country A and the currency appreciation of Country A. Country B may have the decrease in capital flow, debt leverage, credit acceleration and real economy, as well as the increase in risk premia. The negative effect of cross-border capital inflow decrease will be counteracted after the trade surplus of Country B expands due to the increase in import demand of Country A.

From this view, Borio, James and Shin (2014) point out that the past researches pay too much attention to the trade imbalance and too little attention to the international capital flow. And in fact, the major factor of international economy interaction is the financial relation and the trade relation is just the passive factor. Rey (2013) also points out that besides the credit and loan boom, the financial crisis can spread in the world. The currency of each country outflows too. The Impossible triangle in traditional understanding does not exist actually. If the international capital flow is not controlled, the domestic financial and monetary conditions must be influenced by the international financial conditions.
In fact, the large fluctuation of import and export is also deeply influenced by the international financial operation. The economists have noticed the large fluctuation which cannot be explained by the traditional theories including relative price and expenditure in international trade, and have raised various model interpretations (such as Alessandria, G., Kaboski, J., & Midrigan, V., 2013). The import and export trade is mainly driven by the degree of specialization in each industry segment field and the competitive edge drop. This specialization deviation provides the possibility of value creation for the international industry chain. Therefore, the import and export trade fluctuation is largely related to the intra-mediate trade. To a large extent, the intra-mediate trade is driven by the domestic investment in each country. Hence, when the international financial operation has the intensive overflow nature, it will also influence the investment of various countries and then influence the large fluctuation of import and export trade.

This paper provides a model interpretation for the puzzle of Feldstein-Horika. In the light of the neoclassical theory, there shall not be tight relation between the saving rate and investment rate of one country. However, the empirical data shows the relation. This is called the puzzle of Feldstein-Horika (Feldstein, Horioka, 1980). The follow-up research shows that the there is a little correlation decrease of saving rate-investment rate of OECD countries although the capital liquidity improves a lot. Meanwhile, although the developing countries are deemed to have less capital liquidity, their correlation of saving rate-investment rate is more than that of the developed countries (Chang, Smith, 2014). The empirical research of Fouquau, Hurlin, Rabaud (2008) on the OECD24 countries shows that the GDP scales of opening degree, scale of economic entities and current account are three indicators which have the biggest influence on the correlation of saving rate-investment rate. The stylized facts of above-mentioned puzzle of Feldstein-Horika are the same with the model prediction in this paper. According to the above-mentioned exchange rate model, the net saving is determined along with the foreign currency supply and exchange rate level, which means $D_f$ in the equation of fixed net saving, $S + \pi - I - D_f$, in figure 4. The difference between saving and investment of one country is fluctuated within a certain range. The fluctuation range is determined by the displacement range of foreign currency supply curve $T_f + I_f$. In the un-crisis state, the foreign currency supply takes a constant proportion in GDP and hence, the saving rate and investment rate are closely related. The high economic openness, small economic scale, high proportion fluctuation of current account, large exchange rate fluctuation and the large scale of cross-border capital inflow will intensify the displacement range of foreign currency supply curve $T_f + I_f$, and then cause the decreased correlation of saving rate-investment rate.
Brief summary

This paper raises a new framework of interpretation, centered on the debt leverage and processing the liquidity, interest rate and exchange rate. Based on this interpretation framework, the further research can be centered on the following: 1) this paper is a discussion on the decision of financial variable in the abstract environment, the real economy’s effect on the financial variable is represented by economic status space or expected return-on-investment rate. Next step, based on the concrete modelling of real economy, the explicit function will be introduced in the above-mentioned model for the discovery of further theoretical results; 2) the international liquidity index will be calculated or determined as defined in the first section, and the quantitative relation will be determined between international liquidity fluctuation and financial variables (such as VIX, interest rate in each country, risk premium and yield curve); 3) the quantitative relation will be studied between international liquidity and financial conditions in each country, and the conductions during the boom or during the crisis will be distinguished in especial; 4) the influence of traditional policies and innovation policies on the international liquidity will be studied; 5) the problem of international money system will be researched in the mentioned framework.

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