

A Risk Assessment Model Based On Attribute Theory

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Abstract

Since the global financial crisis in 2008, the Chinese government has invested 4000 billion to maintain the economic growth. And the investment made the inflation became more seriously. However, the investment has led to high inflation rate. To fight inflation, it is important to understand the effects of changes in interest rates, which is itself a complicate issue. This article investigated the roles and the interrelationship of five main parties that involved in the issue using Attribute Theory method. These 5 main parts are Banks, Government, Enterprises, Domestic capital and International capital. Each of the 5 main parties was considered to consist of 5 attributes, including agriculture, construction, service, manufacturing and mining. In principle, these 5 main parties each directly play a role in the changes of interest rate, and, at the same time, affect each other. Here we used the Attribute Theory method to investigate how the five parties affect the interest rate and their impacts on each other. As a result, we built a mathematical model to provide guidance on determining the interest rates to properly deal with various economical issues.

Keywords: Qualitative theory; Interest rate; Economy

1. Current Economic Situation

Since the global financial crisis in 2008, the global economy has experienced serious depression. In China, during a considerably long time, the central bank has issued too much currency to the market that becomes one of the main problems in China economy and leads to serious inflation. Especially due to the price increase in staple commodities, the input inflation worsens the Chinese inflation. In July 2012, the CPI Consumer Price index rate reached 6.5%, and kept running high until now. The high price of commodities lowers the living standard of Chinese people. Hence, the government has to adjust the price of commodities to release the pressure of inflation. National central bank, for example, the Federal Reserve (FED) can influence the inflation through adjusting interest rate as well as other currency policy. Raising the interest rate, as a typical method to control the inflation, will also leads to high unemployment rate and lowers production. Recently, the China, government tried to handle the inflation issue by

increasing the Reserve Requirement and interest rate to withdraw the extra currency and slow down its negotiability. However, we have to realist inflation is not the only issue in Chinese economy. As a consequence of the financial crisis, Chinese government has invested 4000 billion in total to protect the local economies and markets. Till now, this policy combines with other local government investment has reach 15000 billion Yuan. In 2011, there is big demand to repay capital with interest. Rising interest rate will make the government facing higher pressure to repay the capital with interest. As a result, the government would encounter the risk of serious debt crisis, which has happened to Greece government. On the other hand, continuous rise of the interest rate will stop the enterprise from financing. In the worst case, this will result in bankruptcy of a great number of medium-and small sized enterprises. This in turn will cause a reduction in government tax income. . The data released by the State Administration of Taxation (SAT) in 2010 revealed

that the national tax revenue reached 7739 billion Yuan, constituting 89% of the overall government revenue. Therefore, mass bankrupt of enterprises will seriously impact government income.

2. Methods and Attribute Theory

2.1. The partial order category and Topos of attribute set

Based on information received by the human brain, and can only feel the feeling of the property to respond to the fact that we made the human brain is deciphering the properties of things, and encode the information for the brain, so as to get the construction of thinking, the basic ideas and the formation of intelligence. We concluded that decipher the properties of object is the basic way for the brain to construct mechanism. At the same time we study the basic structure of the property set of things. Finally, we made a conclusion that: The Attribute Set of any object with level order between both attributes constructs a partial order category, and it with the conjunction becomes a Attribute Inference Lattice Category and a Monoid Category. They not only constitute the corresponding Topos respectively, but also there is representation model of an attribute barcentric coordinate system $K^{(m)}(u)$ for for them. It is not only proved the mathematical description and discussion tool for the reasoning and the generation attribute based on conjunction between both attributes, but also using the functor categories, Topos and attribute coordinate system $K^{(m)}(u)$.

Example: Let $x(t) \in X$ be the borrower's income, $y(t) \in Y$ be the loans he need to repaid, f is the function that describe the relationship between x and y , $f: X \rightarrow Y$. We will get $y' \in Y$ and $y'(t) = f'(x'(t))$ to all $x' \in X$.

Let $x'(t) \in X'$ be the loans that can be repossessed by the bank, $y'(t) \in Y'$ be the bank's risk, f' is the function that describe the relationship between the $x'(t)$ and $y'(t)$, $f': X' \rightarrow Y'$, We will get $y' \in Y'$ and $y'(t) = f'(x'(t))$.

With the borrower and commercial bank as an example, as shown in Fig.1 and the connection of the five deep attribute can be seen in Fig.2.

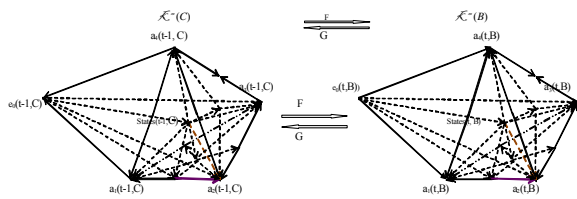


Fig.1. the attribute category between the borrower and the bank's loans ,the model that show the functor F and G (note: is the borrower's attribute category, F is the functor between them).

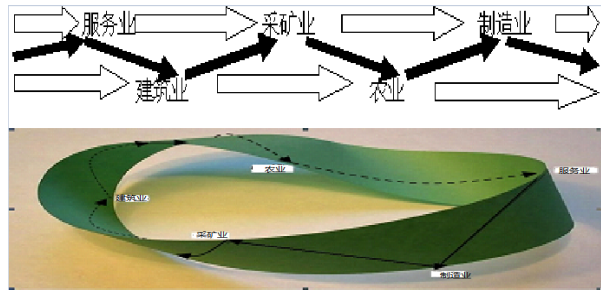


Fig.2. Möbius strip

2.2. A attribute Topos consist of the category of functors $Func(L(A_u, \leq), S)$

We can see from the category theory that to any category C , it will be a Topos by the dual category C^{op} and the functor category $Func(C^{op}, S)$ of the set category S .

$L(A_u, \leq)$ is the dual category of the $L(A_u, \geq)$. If $Func(L(A_u, \leq), S) = Hom(L(A_u, \leq), S)$, the $Func(L(A_u, \leq), S)$ will be an attribute Topos.

In fact, as functor $hom(-, b) \in Hom(L(A_u, \leq), S)$, so, not only $hom(-, b)$ can be seen as a functor from functor category $Func(L(A_u, \leq), S)$ itself, but also attribute Topos $Func(L(A_u, \leq), S)$ can be seen as category, its object is the hom-set of the $hom(-, b)$. It will be the state shot with two functor natural transformation $\tau: hom(-, a) \rightarrow hom(-, b)$ between two functors.

The attribute Topos $Func(L(A_u, \leq), S)$ have the key properties:

Assume that a is the top attribute of $L(A_u, \geq)$, then a will be the bottom attribute of $L(A_u, \leq)$, so it can be the final object Iu of $Func(L(A_u, \leq), S)$. If a is the performance properties of b , that is we have a state shot $f: a \rightarrow b$ in $L(A_u, \geq)$. It induces a synthesis of partial order $S_a = \{f_n = g \cdot f \mid f_n: c_n \rightarrow a\}$ in $Func(L(A_u, \leq), S)$, as shown in Fig.3, which is called the Sieve screen or filter with the target a . To the attribute of the partial order A_u or category $L(A_u, \leq)$, because all the synthesis partial order f_n is the arrow f_n from different attributes c_n to the top attribute or final object a , S_a is the cluster of the partial order f_n which is the way from c_a to a . As shown in Fig.4, they are not only constitute a pullback but also exist a limit.

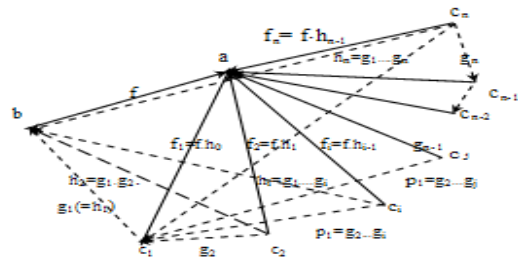


Fig.3. The Sieve S_a, S_b, S_1 consist of $\{f_i\}, \{h_j\}$ and $\{p_j\}$.

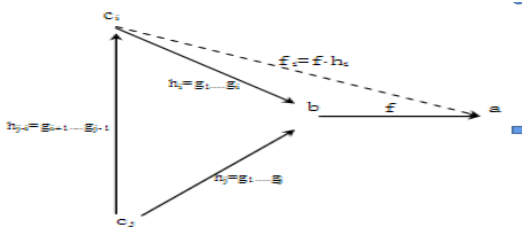


Fig.4. The limit $\lim c_i = b$ of Sieve Sa

3. Model for the Relationship of Bank Interest Rate and China Economy

This model was developed to investigate the role and interrelationship of 5 main parties: Bank, Government, Enterprise, Domestic and International capital.

In addition to the 5 main parts, we introduce another two variable, time dimension and fundamental economy. The ranges of interest rate studied are four Sets: (10%~8%)、(8%~6%)、(6%~4%)、(under 4%) We provide each of them the bank interest, a different weight which represent its effects in real economic situation.² Furthermore, we also see that interest rate impact the economy slowly and usually accumulate in a long run. Hence we should not only concern the impact of an interest rate to the inflation when it is set, but also consider the effect of accumulation in the future. Time dimension has the unit of Year.. Then using the model to work out how the interest rate in this year can influence the coming years. Meanwhile, different fundamental economy behaves differently in different interest rate situation. Here we set 3 fundamental economy: Inflation (set to 1), Normal (set to 2), Deflation (set to 3). We are aware that same economic behaviors have very different result in these 3 situations. Here we try to give a proper weight to the 3 fundamental economy in order to simulate the real world economic behavior.³

Above all, based on our analysis of all the main parts and dimensions, we built the mathematics model from macroscope to microscope, and from entirety to parts.

Table 1 represent the condition (“represent sth” add object here) when only considering 1 year interest rate impact on various economy situation.

In this case, we need to analyze in deep. Table 3 describes in normal economy, how overall macroscopic economy behave when interest rate changes. We can find the reasons by analyzing the through the table.

Table 2 describes in normal economy, how the 5 main parts behave when interest rate change. However, in inflation or deflation, we should not only consider the effect of interest rate, but also add proper weight. For example, interest rate of 4% in normal economic situation should benefit to domestic capital. But in inflation case, 4% interest rate will promote capital circulate and exacerbate the inflation. That will badly impact other main parts.⁴

Through the analysis of Table 2, we understand that each main partier’s behavior toward the change of interest rate in deep is judged by their interactions. All of them impact each other. And the accumulation of the impact represents real world's behavior in certain interest rate. The relationship table below represents typical ways that they impact each other. Certainly, we have to consider the economic situation, (Foreign hot money is sensitive to the interest rate and exchange rate, in short is the high interest rates will influx and low interest rates will flow out. So the article will not calculation specific but it needs to be considered.)³ as shown in Table 3.

Meanwhile, we should realize that economy is not a shorter process. We should not only concentrate on the effects of interest rate changes in short time but also consider its influence to future economy. Of course, the longer the accumulation time, the smaller its effects. S represents the impact and t represent the time.⁵

$$S = Xt/t \tag{1}$$

And obviously, a certain weight should be adopted in different fundamental economy.

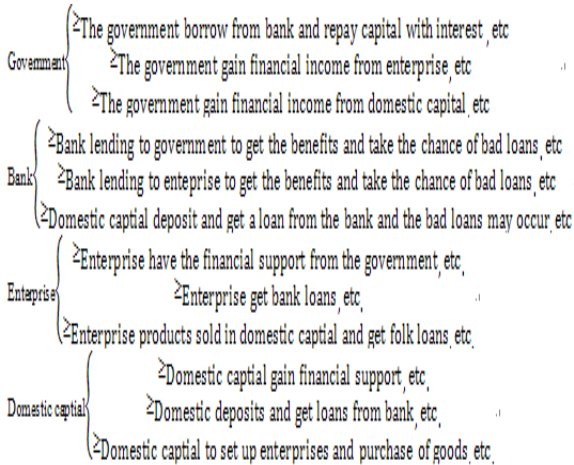
Table 1. Year interest rate impact on various economy situation

	Deflation	Normal	Inflation
Interest rates (10%~8%)	It would be devastating if we take a high interest rates under Deflation.	If we take a high interest rates for a long time, may be it would cause deflation.	It is benefit to the overall economy and will help to reduce the economic mobility
Interest rates (8%~6%)	It would be adverse to the overall economy and will aggravating inflation.	It would increase the uncertainty to the economy and likely to cause deflation.	It would help to ease high liquidity
Interest rates (6%~4%)	A littl higher interest rates would be a block for the economy turn back to normal.	The interest rates has both advantages and disadvantages.	It would be adverse to the overall economy and will make the inflation to be more serious
Interest rates (under 4%)	It would be beneficial to the economy and will increase the domestic liquidity.	Low interest rates is good for economic development ,we suggest to maintain.	It would be devastating if we take a low interest rates under Inflation

Table 2. The 5 main parts' reaction in interest rate change

	Interest rates (50%~30%)	Interest rates (30%~20%)	Interest rates(20%~10%)	Interest rates (under 10%)
Government	The revenue of the government have an significantly decrease and expenditure increased significantly which will increase the risk.	The government's revenue decreased and expenditure increased	The revenue of the government have a slight decrease and expenditure increased	The revenue of the government increase and expenditure decreased
Bank	The bank's revenue decreased significantly and defaults increased(equals to expenditure) which increase the risk	The bank's revenue decreased and defaults increased(equals to expenditure)	The bank's revenue increased slightly and defaults decreased(equals to expenditure)	The bank's revenue increased and defaults decreased(equals to expenditure)
Enterprise	The enterprise faces a serious problem of cash flow and circulation of goods slow down.	The enterprise faces a problem of cash flow and circulation of goods slow down.	The enterprise faces a little problem of cash flow and circulation of goods improve slightly.	The enterprise have a good cash flow and smooth circulation of goods
Domestic financial	The liquidity of the domestic capital declined obviously and overall economy become weak	The liquidity of the domestic capital declined and overall economy become weak	The liquidity of the domestic capital declined slightly and have a slightly adverse effect on overall economy	It is good for overall economy and the circulation of the domestic capital.
Foreign hot money	The foreign hot money pour into and will have an impact to the domestic financial.	The foreign hot money pour into	The foreign hot money have little desire to get in.	The foreign hot money have little desire to get in.

Table 3. the deep impact between 5 main parts



After realize the relationship of all the main parts, the mathematics model can be achieved by JAVA. Fig.5 shows the simulation results.

Fig.5 describes the experiment result in time dimension T=3(year), and deflation environment. Interest rate in first year is 2.6%, second year is 6.8%, and the third year is 2.2%. We assumed all the economic parts can process properly in the range of [0,100]. The lower of the score, the less dangerous it is. If exceed 100, it means the main part is in danger. From picture 1, we see that in deflation environment, keep the low interest rate in 3 years, the overall economy can maintain a smooth progress, and in low risk.

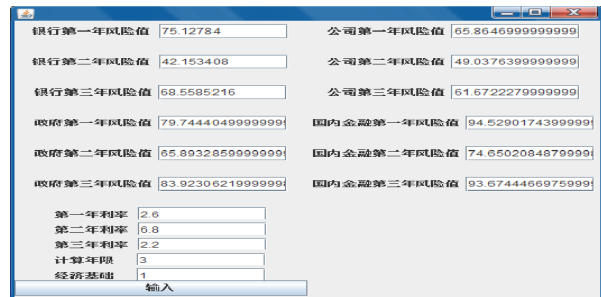


Fig.5. Result in the rate(2.6%,6.8%,2.2%)

Same precondition, let's adjust the interest rate as 7.1% in first year and 6.6% in second year, 6.0% in the third year. Then we can get the result shown as Fig.6:

Obviously we see that under a high interest rate, the accumulation effect is very clear. All the main parts are facing the risk of break up. Overall risk value also exceeds the preset 100. It correctly represents the requirement of interest rate in different economy situation.

After the basic model we also want to build is a model that can show the instant contact of the five parts, so , we use the NEATBEANS IDE 6.9.1 to build out a real-time visual program as shown in the Fig.7.



Fig.6. Result in the rate(7.1%. 6.6%. 6.0%)

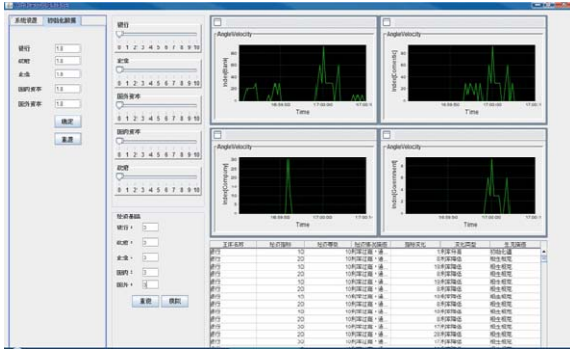


Fig.7. Real-time demonstration figure

4. Conclusion

To sum up, this article built a mathematics model for the 5 main parts and their relationship based on Qualitative theory method, correctly represents how these main parts behave and their impacts on each other in different interest rates, and properly estimates the risk value for these main parts. The relationship functions provided in this article was based on various related papers, which would require further practice. Next, I will work on the relationship functions as well as the weights in order to make it represent closely to real world economy, and let the model work properly.

Acknowledgements

We thank for Jingjuan Feng, Ph.D Candidate of US Berkeley, for her help in English transformation.

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