

# The regulation of Commercial paper market based on evolutionary game analysis

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**Abstract** –The commercial paper market is used by commercial banks, nonbank financial institutions, and nonfinancial corporations to obtain short-term external funding. There are two main types of commercial paper: unsecured and asset-backed. Unsecured commercial paper consists of promissory notes issued by financial or nonfinancial institutions with a fixed maturity of 1 to 270 days, unless the paper is issued with the option of an extendable maturity. Unsecured commercial paper is not backed by collateral, which makes the credit rating of the originating institution a key variable in determining the cost of issuance. In recent years, China's paper business has developed rapidly, we saw a geometric Series upward in this market and the cumulative acceptances amount has up to 25 trillion RMB. Short-term financing market become prosperous to some extent, but it also brings some problems. This paper analysed the behavior of company and the bank or other discount capital provider according to the evolutionary game theory. In the end, normative research results and suggestions are given regarding policy-making in CP market supervision.

**Keywords** –Commercial paper; Illegal issuance; Banking supervision; Discounted demand

## 1. Introduction

Financial instruments commercial paper is a settlement method, with China's reform and opening up officially entering the country, then after 30 years of development, from the initial stage of exploration, experience to promote the use of the system construction from 1999 rapid development stage. The size of the market continues to expand. In the issuing market the total commercial acceptance is exponentially increasing. In the secondary market, the discounted business growth far higher than the growth rate of acceptances. The end of 2011, the national the cumulative financial institutions issuing the commercial bills of 15.1 trillion yuan, the cumulative discounted 25 trillion, the end of 1999,

growth by 30 times and 100 times, respectively.

The country in recent years, the increase of cumulative financial institutions issuing and the amount of commercial papers discounted is high. The cumulative acceptances amount of growth in the amount of slower than the growth rate of the cumulative discounted amount. Promissory balance of discounted overall has continued to rise, but discounted promissory balance in 2007 and 2010 with a significant decline, notes the size of the market has been shrinking. Rediscount amounts incurred a decreasing trend, and nowhere near the scale and the acceptance and discounting business, indicating that the deposit reserve in the central bank continuously improve financial market, all financial institutions will be taken in the case of insufficient liquidity rediscount and other

forms of intermediation capital to meet demand growth paper acceptance and discounting. seen paper doubling of the size of the market in the intermediation of short-term funds, reduce financing costs, and configuration of commercial bank funds, increase profitability, and many other baking play an important role. (Figure 1)

But such rapid development, whether implicit deposit some problems. Xin Chunhua, Ding RiJia and Wu Theyitheyi for the current situation and problems of the development of the commercial paper market, they established banks and enterprise game model to identify the development of our commercial paper market, found the deeper reason of undeveloped of our commercial

paper market. Yu Xiang and Liu Yuxun thought under the unbalanced background of the financial system, enterprises, banks and regulatory agencies as China's money market participants, there is a complex relationship of game, their analysis reveals the development of China's money market imperfections reasons. This paper use evolutionary game method analysis of discount business, banks and other financial institutions should be solve the problem of how to control the intensity of regulatory, and then discuss the further development of the finance notes and commercial paper market in China has reference.

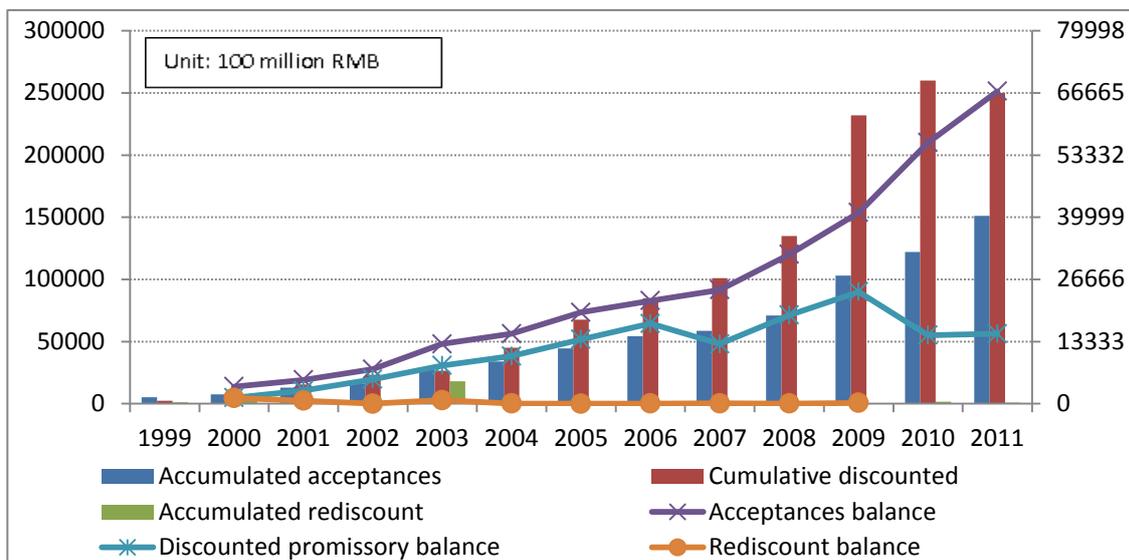


Figure 1 1999 - 2011 China's paper market transactions

Source: 1999 - 2011 Currency Implementation Report

With Similar to Treasury bills, CP is typically issued at a discount, meaning that the buyer pays less than face value and receives face value at maturity: The “interest” is equal to the face value minus the purchase price. Although CP is issued at short maturities to minimize interest expense, many issuers roll over CP by selling new paper to pay off maturing paper. Because of modest credit risk, yields on CP are slightly higher than on Treasury bills of similar maturity. Large denominations and short maturities typically limit the CP market to large institutional investors, such as MMMFs. CP generally is classified in three broad (but overlapping) categories: nonfinancial, financial, and asset-backed. Further, CP may be classified as being sold with the assistance of a CP dealer (dealer placed) or without (directly placed). Traditional nonfinancial and financial

paper, respectively, are unsecured short-term debt issued by highly rated corporations, including industrial firms, public utilities, bank holding companies, and consumer finance corporations. ABCP, on the other hand, is more complicated. The simplest description of ABCP is as a form of securitization: As the name implies, it is CP with specific assets attached. In financial industry jargon, ABCP is issued by “conduits.” Conduits are structured to be bankruptcy remote and limited in purpose. Each conduit includes a special-purpose vehicle (SPV) that is the legal entity at the center of the program and a financial adviser (usually a commercial or investment bank) that manages the program and determines the assets to be purchased and the ABCP paper to be issued.

The owner of the conduit receives nominal dividend payments; and because the SPV does not

generally have any employees, fees are paid to an administrator (normally a bank) to manage the flow of CP and funds. Yudong Zhang used traditional methods cannot reach satisfying classification accuracy due to the high dimensional features. In this study, they proposed a novel method based on wrapper-based feature selection. Moreover, a novel genetic ant colony algorithm (GACA) was proposed as the search method, and the rule-based model was employed as the classifier. Stratified K-fold cross validation method was taken as the statistical resampling to reduce overfitting.

In order to solve the cluster analysis problem more efficiently and quickly, Yudong Zhang, Lenan Wu (2012) presented a hybrid method based on Tabu Search Particle Swarm Optimization (TSPSO) in this paper. First, they built the optimization model using the variance ratio criterion (VRC) as the fitness function. Second, TSPSO was introduced to find the maximal point of the VRC. TSPSO makes full use of the exploration ability of PSO and the exploitation ability of TS and offsets the weaknesses of each other. And in the same year, they found automated and accurate classification of MR brain images is extremely important for medical analysis and interpretation. Over the last decade numerous methods have already been proposed. In this paper, they presented a novel method to classify a given MR brain image as normal or abnormal. The proposed method first employed wavelet transform to extract features from images, followed by applying principle component analysis (PCA) to reduce the dimensions of features. The reduced features they are submitted to a kernel support vector machine (KSVM).

## 2. Evolutionary game model design and solution

Zhang Yudong (2009) proposed an improved bacterial chemotaxis optimization (IBCO), which is then integrated into the back propagation (BP) artificial neural network to develop an efficient forecasting model for prediction of various stock indices. Experiments show its better performance than other methods in learning ability and generalization. The algorithm and methods of construction of the model used by Zhang Yudong, Lenan Wucan (2012, in their documents could provide a way of thinking to improve the analysis of the extent of this

article. There are also economic growth is the result of the finance land using Granger causality test. And the methods and models of computation are called to how Yudong Zhang and Wu Lenan (2009, 2011) used in their study to analyze the relationship between the stock and the S & P 500.

Bounded rationality game, have a truly balanced stability must be achieved, after learning and adjustment by the game player and the subject even after a small amount of interference restore equilibrium. Stability here refers to the stability of the strategy of the game player groups, that the same proportion of the members to adopt a specific policy groups, rather than the same groups of individual strategies. This game theory have been widely used in research work in the field of biological evolution, it is also referred to as evolutionary game, the game reached equilibrium strategy is called evolutionary stable strategy (Evolutionary Stable Strategy, ESS).

### 2.1 Basic assumptions

(1) Game model, there are two game parties. Game player 1 represents banks and other financial institutions, game player 2 represents companies that issue commercial paper. And both are rational economic parties, they pursuit of profit maximization in the case of certain costs.

(2) Game parties focus on short-term interests of the game many times. Asymmetric information may make every game can't be completely rational under the conditions of the optimal strategy, but the interference can be reduced by repeated game, and are able to return to a stable equilibrium point.

(3) Strategies of game parties. Assumptions game party 1 has only two strategies, using high regulatory strength or low-regulatory strength of commercial paper discounting behavior, game player 2 only two strategies, the issue of commercial paper compliance or violations.

(4) Assuming the financial institutions are able to meet the discounted demand of the company's commercial paper.

(5) In the game, the game player 1 use  $N^n$  to represent its normal income,  $C_3$  represents the cost of its regulatory,  $B$  represent the extra income of penalties for violations,  $T^n$  represent the offense cause by the control invalid; the game 2 use  $R^n$  to represent normal income,

$R^e$  represent its investment higher than normal income because of issuing with violations to other high-risk assets,  $C_1$  represent penalties via issued the commercial paper in violations way (including corporate reputation and risk of loss),  $C_2$  represent manufacturing cost of untrue commercial paper. Generally,  $C_1 > R^e + R^n > R^n >$

$C_2$ , ie, That is, the game party 2's violation caused this to be less than its normal income, higher than the normal income due to the additional revenue obtained by the non-compliance, but found that the penalty is higher than its earnings;  $T^n > C_3$ , ie. the loss is greater than the cost of regulation due to violations brought.

**Table 1** commercial paper discounted market regulatory model strategy

		Game party 1	
		Banks and other financial institutions	
		High regulatory strength (X)	Low regulatory strength (1-X)
Game party 2	Company need to issue commercial paper	$(N^n - C_3 + B, R^n - C_1 - C_2)$	$(N^n - T^n, R^n + R^e - C_2)$
	Violation/illegal (Y)		
		Compliance (1-Y)	$(N^n, R^n)$

2.2 Evolutionary Game Model Analysis of the Solution

They are going to found the result through the evolutionary game. They first calculate the game player 1, when "supervised" its expected revenue is  $U_{1G}$ , when "not supervised" the expected revenue  $U_{1N}$  is and the group average expected revenue is  $U_1$ .

$$U_{1G} = Y(N^n - C_3 + B) + (1 - Y)(N^n - C_3) = BY + N^n$$

$$U_{1N} = Y(N^n + T^n) + (1 - Y)N^n = N^n - YT^n$$

$$U_1 = XU_{1G} + (1 - X)U_{1N} = (B + T^n)XY + N^n - C_3X$$

The expected return when the game player 2 Select "irregularities" is  $U_{2S}$ , when compliance expected revenue is  $U_{2N}$  and the group average expected revenue is  $U_2$ .

$$U_{2S} = X(R^n - C_1 - C_2) + (1 - X)(R^n + R^e - C_2)$$

$$= R^e + R^n - C_2 - C_1X - R^eX$$

$$U_{2N} = XR^n + (1 - X)R^n = R^n$$

$$U_2 = YU_{2S} + (1 - Y)U_{2N} = R^n + (R^e - C_2)Y - (R^e$$

Now they copy of the evolutionary game dynamic analysis for two positions on the game side, replicator dynamics equation line to the proportion of the type of game player in the game, at the position of player as following,

$$F(X) = \frac{DX}{Dt} = X(U_{1G} - U_1) = X[U_{1G} - XU_{1G} - (1-X)U_{1N}]$$

$$= X(1-X)(U_{1G} - U_{1N}) = X(1-X)[(B+T^n)Y - C_3]$$

Then they used the similar method at the position of game player 2 replicator dynamics equation as following,

$$F(Y) = \frac{DY}{Dt} = Y(U_{2S} - U_2) = Y[U_{2S} - YU_{2S} - (1-Y)U_{2N}] = Y(1-Y)(U_{2S} - U_{2N})$$

$$= Y(1-Y)[R^e - C_2 - (C_1 + R^e)X]$$

Nest they do some analysis through replicator dynamics equation and the position of player 1, and they need to calculate the stable point of the replicator dynamic equation. Based on the dynamic equation, if

$$Y = \frac{C_3}{B+T^n}, F(X) \text{ is constantly equal to 0, which}$$

means that in this condition, the X are also at steady state;

If  $Y \neq \frac{C_3}{B+T^n}$ , they need to solve the case

when  $\frac{DX}{Dt} < 0$  to determine the trend of the groups.

When  $Y > \frac{C_3}{B+T^n}$ , x equal to 0 for ESS. When

$Y < \frac{C_3}{B+T^n}$ , X equal to 1 for ESS. The three phase

diagrams represent the dynamic trend of the three state of X and its stability.

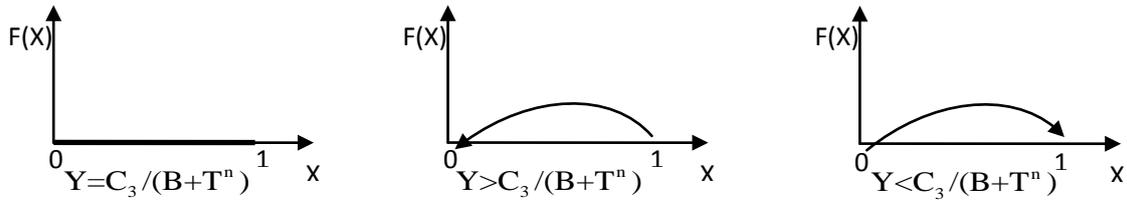


Figure 2 Evolutionary Game Analysis Game party dynamic trends and stability diagram

Similarly, they can copy the dynamic equations at the position of player 2 for some analysis. According to the dynamic equation, if  $X = \frac{R^e - C_2}{C_1 + R^e}$ , the  $F(Y)$  is constantly equal to 0, which means that all of the Y levels are at steady state; if  $X \neq \frac{R^e - C_2}{C_1 + R^e}$ , when solving the

case  $\frac{DY}{Dt} < 0$  to determine the trend of the groups. You

know when  $X > \frac{R^e - C_2}{C_1 + R^e}$ , then Y equal to 1 for ESS,

when  $X < \frac{R^e - C_2}{C_1 + R^e}$ , Y equal to 0 for ESS. Three

phase diagram represent the dynamic trends and the stability of the three state of Y and its stability.

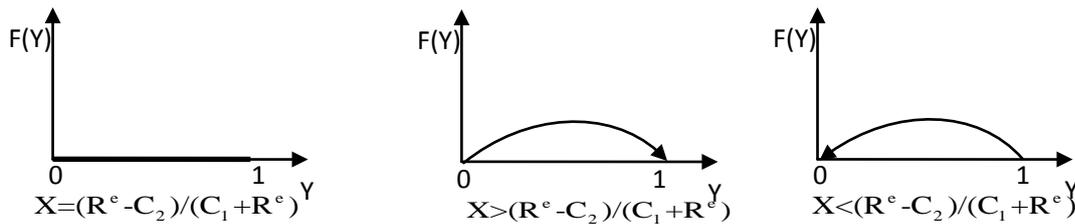


Figure 3 Evolutionary Game Analysis Game a square dynamic trend and stability diagram

Further, they can put on the relationship of replicator dynamic changing between the two game player in the Cartesian coordinates as following,

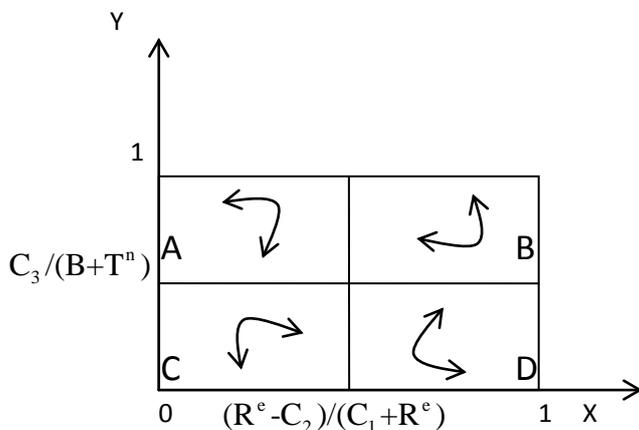


Figure 4 Evolution Game Analysis Game party type proportional trend diagram

### 2.3 Analysis of the results

From the above analysis, they can see how the model in the game, the two player could not reach an evolutionary stable strategy (ESS). So how can they provide the kind of supervision to make the smallest violation of supplier issuing discounted commercial paper? From the point of the parametric analysis, they can discuss those economic issues.

First, they discuss the variable X, the expression  $(R^e - C_2)/(C_1 + R^e)$  the value is a demand for discounted commercial paper, the bank to take a psychological expectations of high regulatory intensity probability and it is a vital economic significance. When the value of X more than take the high strength proportion of bank regulatory  $(R^e - C_2)/(C_1 + R^e)$ , the

company through mutual learning and behavioral strategies they will be convergence on legality of issuing and using and the market will not drive the overall market deviant by small portion of non-compliance behavior, the evolution is stability. Starting from the point of view of the bank's regulatory costs, they hope to reduce  $(R^e - C_2)/(C_1 + R^e)$  values, namely to reduce the demand for discounted commercial paper to the bank to take a high psychological demands of regulatory intensity, or making regulatory the impact force strong enough to achieve this effect. An effective influence means: one is to increase the expected penalty value  $C_1$  of issuing the commercial paper in violations way. The social impact of the bad behavior of offenders means economic punishment is still the most direct and effective way, the guidelines for the establishment and maintenance of good behavior must be organized by the effective punishment for protection. Two is to reduce expected value of the excess return obtained  $R^e$  when the player 2 illegally issuing commercial. But in terms of the banking supervision, value of  $R^e$  can't be determined by the bank's internal economic variables. So the increase is inevitably, the issuer is pursuing the extra income of  $R^e$ . Once it happened, player 1 must increase regulatory strength and improve the rational expectations value of high-intensity supervision and reduce irregularities proportion. Third, they make the cost of forge commercial paper highly, because of the issuance of commercial paper must be real trade. To improve the cost of forge commercial paper which has no real trade background, you can also reduce the ratio of illegal behavior.

Secondly, they discuss variable  $Y$ , the expression  $C_3/(B + T^n)$  extremely important warning of market regulatory authorities, banks and other financial institutions, it can be seen as a critical value of the expected proportion of commercial paper issued on the market in violation. This threshold by  $C_3$ ,  $T^n$  and  $B$  three factors, which means that additional revenue is directly related to the value of financial institutions regulatory costs, low regulatory strength to the banks of the variables of bank losses and the high regulatory penalties for violations. When Moral Risk increased  $C_3/(B + T^n)$  value decreased, comparing with the original rational expectations value  $Y$ , the value of  $F(X)$  becomes positive, so player 1 must increase the

proportion of high-intensity supervision; Conversely, when the increase in regulatory costs  $C_3$  and  $C_3/(B + T^n)$  value increase, comparing with the original expected value of  $Y$ , the value of  $F(X)$  becomes negative, banks and other financial institutions may be reduce the regulatory ratio appropriately, tending to take the low-intensity supervision.

Form the above factors, they can draw the following conclusion.

First, starting from the point of view of the banks and other financial institutions to reduce the ratio of high-intensity supervision  $X$ . Higher intensity of supervision means that much of the human and material cost. So to build a strong regulatory mechanisms, they need to increase the punishment to the offenders  $C_1$ , such as increasing the amount of penalty, improving the margin deposit ratio, introducing market exit mechanism that does not allow illegal enterprises to apply for business related to commercial paper for a number of year, increasing efforts to notification of offenders and major cases to increase the opportunity cost of the enterprise lost commercial paper financing channels, prompting consciously accept the double constraints of financing and marketing. Consider the cost of  $C_2$ , which means forge issuing, relevant departments should be through technical means, let commercial paper with higher technology, increase its imitation cost and difficulty.

The second is concerned about the regulatory threshold expected proportion of illegal issuing, and timely adjust the threshold of supervision. Due to the development of China's commercial paper short time, the magnitude of the change in policy, the lack of reliability of the historical data is measured for  $T^n$ , Participate in the insolvency of the company in the short-term loans, may be able to more precisely measure this economic variables.

### 3. Policy recommendations

(1) Development system of China's commercial paper is not perfect, innovation is much needed in the existing system. Representatives of the New Institutional Economics in Northrop (Doglas C. Nonh) emphasized: the effectiveness of the system in the initial sense is to provide a set of rules to define the relationship bettheyen

the trade subject, reducing uncertainty and transaction costs in trading, clear property rights become a reality, so that the potential income derived from trading activities. According to this theory, the business of commercial paper needs to be improved in terms of system design.

In this regard, I have the Reflections as follows:

Firstly, they should expand market participants. Although the central bank at the beginning of the year to halt the issuance of financing commercial paper, meaning qualified individuals are not allowed to carry out with the commercial paper related to the investment behavior. Reference to the developed money market in the United States, in the future the development of China's money market is bound to expand the market participants, it is recommended to gradually allow the non-bank financial institutions, especially institutional investors, such as the various funds, insurance companies, investment companies to participate in commercial paper market.

Secondly, short-term loan can be transformed to commercial paper. Commercial paper's financing for a period of 1-9 months. They are both short-term financing behaviors that the duration of short-term loans is certain homogeneity; mortgage with our current real trade context of commercial paper, the guarantee similar. Comparing the money market and the credit market, they find that in the credit market the legislative system is more mature, but the financing cost of money market is lower. Appropriate cross-integration of the two markets, it can promote the development of money market through a certain risk control.

And at last is to accelerate the process of electronic commercial paper. In 2007, establishment of SHIBOR system and centre for commercial paper of Shanghai promote the development of China's money market to a certain extent. But compared with the development of early bond market which has perfectly developed, there is still much room for the development of commercial paper market. China is still not had a unified authority notes electronic information network. China's establishment of the Central Securities Depository and Clearing Corporation Limited, its commitment to government bonds and other bonds unified registration, custody and settlement business, which provides a good reference for the establishment of the electronic information network in China's commercial paper.

(2) Unified standard commercial paper market, accelerate the commercial paper transparency of information. China's major commercial banks use different pricing methods, and the SHIBOR online only embodies lines offer, and the true transaction price. Due to the opacity of pricing information and asymmetric information, it has potential arbitrage opportunities, participants prefer to gain more price information resources but not to commit to fair competition in the services and innovation. In the long-term it will not be conducive to the healthy development of China's money market. The Bank's discount rate is directly related to the profit of companies, and SMEs in China always have financing difficulties. This arbitrage behavior to some extent suppressed the development of small and medium enterprises in China. The paper market transparency of information benefits both banks and enterprises.

(3) Acts of bank notes to be prudent operation, to strengthen cooperation with the agencies. Bank through the development of bill business, you can get margin deposits of enterprises issuing commercial paper, can reduce the non-performing loan ratio. In recent years, financial institutions, non-performing loan rate dropped, the bill discounting idling on the back of their fundamental. The Bank through a "short, flat, fast," notes service competition to quality "gold customers, raising the deposit market share, the commercial banks for the blind and disorderly competition, coupled with lax oversight of market, violation punishment probability is very small, banks and other financial institutions also relaxed the supervision of commercial paper, thus further promoting the commercial paper market in China in the early years of strong growth. Money market in China is in the early stages of development, and notes the risk of exposure will take some time, banks must therefore prudent business bill business, avoid blind acts in exchange for short-term gains to abandon the long-term interests. In this regard, the China Banking Regulatory Commission and the People's Bank should increase its regulatory efforts to deal with the bills market, inter-bank should cultivate a sense of cooperation and supervision to third to promote the healthy development of the bill business.

#### 4. Conclusion

In this model, the game can't reach an evolutionary stable strategy. Therefore, the regulatory authorities to provide proper supervision, so that violations tend to be the smallest proportion of discounted bills. Such as increased penalties, increased illegal cause of this and other aspects, and make improvements in the system of science and technology and innovation, and to lay the foundation for long-term development of China's money market.

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## Vitae



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