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Summary: The great achievements made since China's reform and opening up are a major economic theoretical phenomenon, and also a major puzzle of the neoclassical school. Science is a formal logic system constructed by scientists about the development law of research objectives. From a scientific point of view, the major confusion of a theory often means a major defect in the basic logic of the theory, which means the significant innovation needs of the theory.

This paper first discusses the basic methodological problems of science, mathematics and basic law assumption. Through the micro mechanism analysis of the market, it is pointed out that there is no competitive equilibrium in the exchange of investment goods, Pareto optimized competitive equilibrium in the exchange of non-investment goods, and no optimized competitive equilibrium in commodity production. Based on the economic reality that the British unemployment rate remained above 10% (Phillips, 1958) from 1921 to 1939, this paper holds that the basic assumption of market economy without government intervention and full utilization of labor and social capital is too strong; the assumption of Keynes school on the optimization of market economy is too strong.

Based on the research results of other scholars, this paper first puts forward the three basic laws of mutual independence in the market economy. First, the exchange of non-investment goods can realize the competitive equilibrium of Pareto optimization; second, the free market without government intervention; third, knowledge is infinite dimension, but the growth of any dimension is no more than a constant Euclidean space in a certain time. On this basis, this paper constructs a mathematical model of market economy of government management. The model government manages the market economy with the virtual monetary system, and the finance is balanced by monetary issuance.

Similarly, the Solo model suggests that capital accumulation and population ratio have optimized equilibrium solution; the Hicks model suggests that the IS-LM

curve intersection is equilibrium interest rate, corresponding to the optimal government policy and the optimal social output; this model suggests that the constant price social output has an upper limit determined by the economic endowment, and the government policies beyond a certain range cause more inflation and cause economic instability, which constitutes the constraint of government policy. Economy endowment is the first comprehensive index reflecting the capital accumulation of economy proposed in this paper, which is the upper limit of social output of economy at constant price. Under the premise of ensuring the inflation rate in the policy target, the government adjusts the total social demand through monetary policy and government investment and expenditure, so as to minimize the economic fluctuations, maximize the economic endowment, and maximize the growth potential of the economy. The model government realizes its value proposition through government investment and expenditure, such as balanced development and common prosperity in various regions. The government should balance efficiency and fairness and optimize investment and expenditure projects to achieve long-term, sustainable, high-quality and stable development of the economy. Model economies can be protected from financial and economic crises, but managing cross-border capital flows in the private sector is the premise of their establishment and existence.

The market economy model of government management proposed in this paper becomes a new economic theoretical framework juxtaposed with the neoclassical and Keynesian schools. As with Hicks, Solow, Romer, and Manquin, the model is not tested and empirically demonstrated in this paper.

Paper Summary: There are many innovations in this article. For the convenience of teacher review, the paper summary is attached to the front, which brings inconvenience to the teachers, please forgive me.

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Market economy of government management: a theoretical framework

Abstract: This paper puts forward an economic theoretical framework whose underlying logic is different from the neoclassical and Keynesian school. This paper discusses the methodology and the basic laws of mathematical science, points out that the basic laws of the neoclassical school and Keynesian school on the market economy are too strong, puts forward the improved basic laws of the market economy

and constructs the mathematical model of the market economy of government management on this basis. The model economy can be protected from the financial crisis, smooth the economic fluctuations and maximize the economic growth potential, but managing the cross-border flow of private sector capital is the premise of its establishment and existence. This paper gives a very different explanation of China's remarkable achievements in economic and scientific research and some other important economic realities and theoretical problems.

Key words: market economy of government management, economic theory methodology, basic law assumption, mathematical model, economic endowment, cross-border capital flow, and economic theory framework.

1. introduction

At the beginning of the reform in 1978, China gradually implemented the socialist market economy and opened up to the outside world. In 1979 China had a population of 975 million and a GDP of \$178.2 billion; India had a population of 683 million and a GDP of \$153 billion. During the same period, China's per capita GDP was \$183 per person, India's per capita GDP was \$224 per person, and China's per capita GDP was 82% of India's. As of 2020, China's population is 1.414 billion, GDP is \$147227 billion, India's population is 1.38 billion, GDP is \$2622.9 billion, China's per capita GDP is \$10,412 per person, India's per capita GDP is \$1901 / person, China's per capita GDP is 5.48 times that of India. China and India are both populous countries with similar international economic environments, but China's economic growth rate was significantly faster than India's.

The neoclassical school believes that the free market economy can realize the optimized development by itself, while the government's economic policies have a bad impact on the market economy (Lucas, 1975). According to the neoclassical school economic theory, the government of economic intervention less than China's Indian economic growth rate should be higher than China's economic growth rate, the reality is from 1979 to 2020 China's economic growth rate is significantly higher than India's economic growth rate, this means that the neoclassical school of economic growth in the past 40 years reality is not satisfactory, it is necessary to further improve. Although Keynesian school that market economy optimization stable balance of government investment and monetary policy, optimize stable balanced market interest rates, but China's economic practice is not completely follow Keynesian theory, such as China's economic practice without market interest rate policy but the government set interest rate policy, leading to the existence of the black market interest rates.

This paper will reflect on the mainstream economic theory in terms of methodology and logic.

The following part first discuss mathematical scientific methodology, put forward to follow the mathematical scientific methodology of economic theory, according to this point points out that the mainstream economic theory of new classical school and Keynesian school assumption about the basic law of market economy, points out that some of the basic law assumption is too strong, points out that the mainstream economic theory methodological defects. Then put forward three basic assumptions of market economy and construct a mathematical model of market economy of government management on this basis. Then explain some important problems of economic reality and economic theory and mainstream economic theory. The final part is a summary (a new economic theoretical framework) and policy recommendations.

2. Economic theories that follow a mathematical and scientific methodology

(1) Mathematical scientific methodology

Both the natural science disciplines and the social science disciplines are said to follow the scientific methodology. In a broad sense, the logical discourse can be considered to follow the scientific methodology. In this paper, the scientific methodology with specific methodological requirements such as Newton's classical mechanics is called mathematical scientific methodology to distinguish the above broad scientific methodology.

According to Einstein (2011), the development of western science is based on two great achievements: one is the formal logic system invented by the Greek philosopher in terms of Euclidean geometry, and the other is the systematic experiment developed in the Renaissance to verify whether there is a causal relationship between two things. According to the above about science and Newton's classical mechanics three laws of motion, in this paper, the mathematical science methodology is summarized as: mathematical science theory is scientists for the development of something and subjective construction with mathematical symbols, functions and equations about the form of logic system. Firstly, the research objectives are abstracted into a mathematical body, and the coordinate system describing the mathematical body is constructed to determine the mathematical variables describing the characteristics of the mathematical body. Then, some basic activity law assumptions independent of the research objectives are proposed, and the mathematical equations are expressed as the basic logic of the scientific theory of the subject. Finally, on the basis of this basic logic, the experimental or real data are used to demonstrate the basic activity rules and other activities of the subject. The basic law assumption cannot be proved, which is the reason why it is called the basic law assumption, but the basic law assumption can be falsified with experimental or realistic data. The scientific theory is meaningful only when the basic law assumptions and other activity rules can be supported by experimental or

real data and pass the falsification test. The above methodology for constructing scientific theory is called the mathematical scientific methodology.

(2) Economic theories that follow the mathematical and scientific methodology

There have been various theories on what an economic theory is. Wald (1951) called economic theory mathematical economics, advocating the use of mathematical formulas and mathematical relations to analyze and express economic activities. However, it also points out that mathematical economics expresses the law of ideal economic activities that strictly follows the hypothetical conditions. And only when the real economic activities strictly and accurately conform to the hypothetical conditions, can the conclusion of the real economic activities be established. Solow (1956) believes that economic theory is based on a number of simplified assumptions that are not completely true, and it is inevitable that the assumptions need to simplify real economic activities. The conclusion of the economic theory often depends on its key assumptions, and if the simplified assumptions are wrong, the economic theory constructed on its basis will also have problems. Lucas (Lucas, 1988) pointed out that the economic theory is discussed in a narrow sense, which refers to the characteristics of real economic activities calculated on a computer through artificial human simulation. As to what is economic theory and its methodology, Friedman (1953) believes that economics is an empirical science that predicts the results of economic activity and changes in the economic environment based on several widely accepted summaries. In fact, economic theory is a complex of some comprehensive assumptions, and its effective judgment criterion lies in whether it has a good ability to predict and explain the real economic activities. If the results of economic activities are consistent with the prediction of economic theory, it can be said that the reality of economic activities supports this hypothesis, or the results of economic activities cannot disprove this hypothesis, but it does not represent the results of economic activities proves this hypothesis, and cannot determine whether the theory is correct by examining whether the hypothesis is consistent with the reality.

The economic theory discussed by the above scholars actually follows the economic theory of mathematical scientific methodology, but this paper considers three deficiencies: First, the economic theory is the subjective formal logic system, and Keynes School does not put forward the assumption of the economic theory. This paper believes that the mainstream economic theory has been no doubt that the free market economy under ideal conditions can realize the optimal development, general equilibrium is its self-evident basic law assumption, this is the mainstream economists in the economic theory model generally not point out the basic law assumption, nor falsified the test of its basic law assumptions.

In natural science, research objectives are abstracted into mathematical objects, such as abstract concrete moving objects of various shapes into particles in the mathematical sense.

Similarly, economic science can also abstract the real concrete market economic entities (such as individuals, enterprises and governments) into mathematical bodies. In this way, the economic theory can become a normative scientific theory.

Based on the above, this paper believes that the market economy theory, which follows the mathematical scientific methodology, is a formal logical system about the development law of market economy with mathematical symbols, functions and equations constructed by economists for the study of the development law of market economy. First of all, the main body of market economy is abstract into a mathematical body, and the coordinate system is constructed and the economic variables are determined. Then put forward some basic assumptions of market economy, and deduce other activity laws of market economy on this basis. Finally, the experimental or real data are used to prove these rules. The economic theory is meaningful only when the basic assumptions of the market economy and other activity rules of the market economy deduced based on the basic law assumptions can be supported by the experimental data or real data, and stand the falsification test of any experimental data or real data at the same time.

(3) Mainstream market economy theory and its basic law assumptions

The neoclassical school and the Keynesian school are generally known as the mainstream economic theory. Assuming about the basic law of market economy, the mainstream economic theory has important influence of economic theory works or papers include: in 1776 Adam Smith published the nature and causes of national wealth research (wealth of nations), think in the absence of government intervention in the simple economic system market invisible hand make labor automatically optimize social division of labor, make the market economy can realize the optimization development (Smith, 1776). In 1874, Vallas published the Outline of Pure Political Economy, which initiated the general equilibrium theory, and in 1890, Alfred Marshall published the Principles of Economics in 1890, which established the equilibrium analysis method of the neoclassical school (Fu Caihui, 2018). In 1937, Keynes published the General Theory of Employment, Interest and Money, which believed that it was an ideal situation for the free market economy to realize the optimal development by itself, and that the real economic activities cannot achieve the optimal development due to wage stickiness, incomplete information and irrational information of the market economy (Keynes, 1937). Keynes did not construct a mathematical model of the market economy. In 1937, Hicks published "Keynes and Classical Economics; An Interpretation", which believed that investment (savings), consumption, money supply, social output, interest rate and other variables influence each other, and there is an optimized and stable equilibrium point. Specifically, the relationship curve between investment and interest rate, and the relationship curve between money supply and interest rate. The intersection of these two curves is the optimization of stable equilibrium interest rate point, and the optimization of stable equilibrium interest rate point can deduce the social output of optimized stable equilibrium (Hicks,

1937). The above two relationship curves of Hicks are considered as the mathematical models of the Keynesian school, and the economic theory based on these two relationship curves is called the Keynesian school. In 1954, Arlo-Debru constructed a free-market economy in which the general equilibrium was the competitive equilibrium of commodity exchange, the competitive equilibrium of commodity production and the optimization path of commodity consumption time. Its commodity exchange exist competitive equilibrium precondition is the quantity of goods is limited, commodity production is competitive equilibrium precondition is each kind of commodity production meet the requirements of the closed convex temper set, commodity utility consumption exist utility optimization precondition is each consumer goods meet the conditions of the convex temper set (Kenneth J.Arrow & Debru, 1954) 。 In 1956, Solo used the ratio of capital accumulation to labor force as the core variable to explain the specific mechanism of economic activities to achieve competitive optimization and stable state. Let K be the capital accumulation, L be the labor force, and $r=K / L$. When r leads the first order of time to zero, that time, the ratio of capital accumulation to labor is r^* . The premise of the solo model is that: r^* is the equilibrium stability point. When $r < r^*$, the market adjustment will increase r , or the capital accumulation K will increase until $r=r^*$; when $r > r^*$, the market adjustment will decrease r , or the capital accumulation K will decrease until $r=r^*$. The Solo model believes that at the equilibrium stability point of r^* , free market competition will realize the full use of labor employment and capital accumulation (Solow, 1956). In 1979, Krugman published the Balance of payments Crisis Model, which implied a competitive equilibrium of exchange rates (Krugman, 1979). On the basis of the Solo model, Romer constructed a mathematical model that knowledge is the endogenous variable of economic growth, which explains the continuous economic growth of developed countries such as the United States, and also explains the phenomenon of the growing economic gap between developed countries and developing countries (Romer, 1990). In 2021, Bauer and Manquin proposed the optimized neoclassical economic theory model on the basis of the Solo model, put forward the assumption of enterprise market power, and explained the phenomenon that the return on capital of high-tech enterprises such as the United States is higher than the interest rate of the capital market (Ball & Mankiw, 2021). $dr/dt=0$

There is also much more research in mainstream economic theory, To sum up, its basic law assumption about the market economy or that Adam Smith's free market economy can achieve the optimal development through the regulation of the invisible hand of the market; Or a competitive equilibrium in the free-market economy in the Arro-Debru model, Competitive equilibrium of commodity production and the general equilibrium of the optimization path of commodity consumption time; Or that Solo's free-market economy can achieve full labor employment and capital accumulation; Or that Hicks has balanced market interest rates in a market economy, The best point for government spending is to make market rates to the equilibrium rate. The first three

are called the neoclassical school, and the fourth is called the Keynesian school.

(4) the basic rule assumption of excessive hypothesis in the mainstream economic theory

Economic theory is a logical system about the law of economic activity constructed subjectively for the study of the law of economic activity, and its assumption of the basic law of market economy is the logical premise of economic theory. Different economists put forward different assumptions of the basic laws of economic activities and form different schools of economic theories. Any basic law assumption about economic activities is subjectively constructed by economists, which is an ideal assumption in the abstract sense of mathematics, and there must be certain differences with the reality of market economy. However, if the difference between the economic reality and the basic law assumption is too big, it is considered that the hypothesis is too strong. Several basic law assumptions of the mainstream economic theory exist, which are discussed in detail below.

1. There is an optimized competitive equilibrium in the exchange of non-investment goods

In this paper, the commodity with finite times is defined as non-investment goods, and the commodity with infinite times is investment goods. Expressed in mathematical form: non-investment goods investment goods = goods, non-investment goods investment goods = $0 \cup \infty$

Luo-de u model about commodity exchange, there is the precondition of optimization competitive equilibrium is the quantity of goods is limited and any commodity is the number of times is limited, the definition of the investment goods exchange conforms to the condition, so can think the investment goods exchange optimization competitive equilibrium.

2. The assumption of competitive equilibrium in the exchange of investment goods such as exchange rate is too strong

The prerequisite of the Arrow-Debru model for a competitive equilibrium is that the number of goods exchanged is finite and the number of times any goods are exchanged is finite. The investment goods defined above do not meet this condition, because the number of times the investment goods are exchanged is unlimited. A more detailed explanation of no competitive equilibrium in commodity exchange, see appendix 1.

Because there is no competitive equilibrium in the exchange of investment goods, this paper believes that Arrow-Deu assumes that there is a competitive equilibrium in the exchange of investment goods is too strong.

3. The assumption of optimized competitive equilibrium in commodity production is too strong

Appendix 2 specifies whether there is a competitive equilibrium in commodity production. According to Appendix 2, there is no optimized competitive equilibrium in commodity production, so this paper believes that the hypothesis of Arrow-Debru that the optimized competitive equilibrium in commodity production is too strong.

4. The assumption that the market economy equilibrium can realize the full employment of social labor force and the full utilization of social production capacity is too strong

Solo economic growth model believes that economic activities cannot achieve competitive equilibrium in the short term, but economic activities will achieve competitive equilibrium in the medium and long term after the fluctuation of the equilibrium stability point of competition, that is, the medium and long term free market economy can achieve full employment of labor force and full utilization of social capacity. From 1921 to 1939, the UK unemployment rate remained above 10% (Phillips, 1958). This means that Solo's assumption that a free-market economy can achieve full labor employment and full use of social capacity in the medium and long term is too strong.

5. The assumption of equilibrium market interest rate in the market economy is too strong

Since the unemployment rate in Britain remained above 10% from 1921 to 1939, and the British market economy has been in a non-optimal equilibrium during this period, this paper believes that Hicks's assumption that there is an equilibrium market interest rate in the market economy is too strong.

- (5) the defects of the methodology of the mainstream economic theory

As discussed above, the basic assumptions of the neoclassical and Keynesian schools of market economy are too strong. Why do these two schools still have considerable ability to predict and explain real economic activities, and have been sought after by mainstream economists around the world? This is because the advanced nature of econometrics can make up for the excessively strong assumption of its basic laws.

Econometrics, also called empirical economics, summarizes the statistical laws between economic variables through economic data, rather than deduce the causal relationship between economic variables through logical deduction. Econometrics belonging to empirical economics is essentially a mathematical transformation, which transforms the function $F(X)$ reflecting the complex logical relationship between each economic variable into a sequential statistical function of each economic variable, as shown in formula (2-1).

$$Y_t = F(X_t)X_t' \beta^0 + \varepsilon_t \quad t=1,2,\dots,n \quad (2-1)$$

Y_t Here is the dependent variable, X_t is the K-dimensional independent variable vector composed of the economic explanatory variable and its nonlinear transformation, β^0 is the K-dimensional unknown parameter vector, ε_t is an unobservable disturbance term, representing the total effect of all other factors except the independent variable, n is the sample size.

Theoretically, any convergent function $F(X)$ reflecting the complex logical relationship of each economic variable can be converted into a statistical function of the time series of each economic variable. In this way, the statistical function of econometrics can calculate the statistical data relationship between economic variables without leaving the logical relationship between economic variables, and become the basis for explaining economic phenomena and formulating

economic policies.

Econometrics has developed very mature, from normal distribution to normal distribution assumption, from conditional with variance and zero autocorrelation to conditional heteroscedasticity and autocorrelation, from linear model to nonlinear model, from exogenous to endogenous, from the model to model, from stationary to nonstationary, from traditional data to big data (HongYongMiao, 2021). In short, through the complex but rigorous data processing science, econometrics can be separated from the logical relationship between economic variables and find out the statistical relationship between their data.

The dynamic stochastic general equilibrium econometrics Mathematical model (DSGE) is one of the most widely used econometrics models. It can well reveal the statistical relationship between economic variables by assuming that technological progress and monetary variables are random variables (Fernandez-Villaverde, 2010).

Although advanced econometrics models such as dynamic stochastic general equilibrium (DSGE) can effectively reveal the statistical relationship between economic variables, they cannot reveal the causal relationship between economic variables. For example, econometrics cannot reveal the specific causal relationship between economic variables such as government investment, social output, technological progress and social capital accumulation. This is one of the important reasons why the mainstream economic theory cannot well explain the great success of China's economy since 1978.

In his *Collections of Empirical Economics*, Friedman clearly stated that the hypothesis of economic theory should be based on inspiration, intuition and innovation, not bound by theorem, logical syllogism and scientific methodology (Friedman, 1953). The mainstream economic theory relies too much on econometrics and does not pay attention to the basic logic of economic theory, and its too strong assumption about the basic law of market economy has not been corrected, which is the defect of its methodology.

In the understanding of the micro mechanism of market economy is still in the black box stage of "invisible hand", economic theory mainly relies on empirical economics and has important practical significance. However, as the micro mechanism law of market economy is constantly revealed, the methodology of economic theory should progress accordingly, and pay equal attention to logical deduction and empirical demonstration.

3. The basic rule assumption of independence of each other

On the basis of improving and optimizing the assumptions of the basic laws of the neoclassical school and the Keynesian school on the market economy, this paper puts forward the three independent basic laws of the market economy.

(1) Basic law Assumption 1: there is no free market economy forced or restricted by any third party, and the exchange of non-investment goods is limited, which increases the utility of the assets of the transaction subject.

Referring to the study of Zhukovskiy & Kudryavtsev (2016), the basic rule hypothesis 1 can be expressed in mathematical language as follows:

$$\Gamma = \llbracket \mathbb{N}, \{X_i\}_{i \in \mathbb{N}}, \{f_i(x)\}_{i \in \mathbb{N}} \rrbracket \quad (3-1)$$

$$\sum_{i \in \mathbb{N}} f_i(X_i) \leq \sum_{i \in \mathbb{N}} f_i(X^p) \quad (3-2)$$

Formula (3-1) The Pareto optimization competitive equilibrium expressed in the limited commodity exchange formula (3-2) in a free market economy without any coercion or restriction by any third party. Where n is the number of economic subjects of the model economy, which is a limited value; i is the serial number of the economic subject of commodity exchange; X_i is the set of commodities between the first economic subject and other subjects; the set of all economic subjects and other economic subjects, each $f_i(x)$ is the utility of the exchange between the economic subject and other economic subjects, $f_i(x) \geq 0$, all $i \in \mathbb{N}$. $\{1, \dots, N\}$ $X_i \in \mathbb{R}^{n_i}$ $x = (x_1, \dots, x_N) \in X = \prod_{i \in \mathbb{N}} X_i \in \mathbb{R}^N$ ($n = \sum_{i \in \mathbb{N}} n_i$) $i \in \mathbb{N}$. $f_i f_i X^p = (X_1^p, \dots, X_n^p) \in X$ Optimize a competitive equilibrium of commodity exchange for Pareto.

This paper holds that either party of the free market economy without any third party force or restriction obtains an increase in commodity utility greater than or equal to zero, namely $f_i(x) \geq 0$ and all i . Therefore, the basic law assumes that the equilibrium of one is Pareto optimized.

The basic hypothesis is that the optimization of the Arro-DeBru model on the competitive equilibrium of commodity exchange in market economy is manifested in the following three aspects. First, it distinguishes between the exchange of non-investment goods and the exchange of investment goods, and believes that there is a competitive equilibrium in the exchange of non-investment goods, and there is no competitive equilibrium in the exchange of investment goods. Second, it explicitly assumes that the competitive equilibrium for non-investment goods exchange is Pareto-optimized to distinguish between non-Pareto-optimized Nash equilibria. Third, it makes clear that the meaning of the free market is that there is no coercion or restriction. Its physical meaning is that the law protects the legal assets of each economic subject, and the law guarantees that any exchange of goods is consensual.

(二) Basic law hypothesis two: the free market economy is difficult to achieve the full employment of the labor force.

Appendix 2 The discussion of competition in the production of commodities shows that the social purchase of a commodity determines the equilibrium output of the commodity production, and the production capacity of the commodity is often greater than the equilibrium output of the product. Extending this conclusion to a macro perspective is that social demand determines social output, social capacity is often greater than social demand, it is difficult for labor force to achieve

full employment.

During the economic crisis, household income decreased and household consumer demand decreased, further leading to a decrease in the investment demand for producing consumer goods, and finally leading to a decrease in the employment population. This explains the massive labor unemployment during the economic crisis. When the labor force is unemployed, the government investment improves social demand, improves social employment, increases household income, increases household consumption, increases the investment demand of the private sector to meet the government investment demand and household consumption demand, and further increases employment and household consumption. Adb, Furceri, & Imf (2016) analyzed the effects of government public investment with data from 17 OECD countries from 1985 to 2013, and concluded that government investment increased social output in both the long term and the short term, stimulated rather than suppressed private sector investment, and reduced social unemployment. This study supports the aforementioned analysis presented in this paper. This provides the theoretical room for government investment. The significance and constraints of government investment and spending are discussed further in Section 4.

The basic rule hypothesis 2 is contrary to Solo's basic rule assumption that the free market economy can achieve full employment of labor force and full utilization of social capacity. This means that this paper will propose a new theoretical framework of market economy.

infinite dimension: $A^n \in (0, \infty) A_i \in (0, \infty), i \in N(3)$

Basic law Hypothesis 3: knowledge is, and any dimension is infinite, but within a certain period of time, the growth of any dimensional knowledge will not exceed the Euclidean space of a certain constant.

$$dA_i/dt < \alpha, i \in N$$

The basic hypothesis three is the optimization of Romer's knowledge hypothesis, which is manifested in the following three aspects.

First, this paper believes that the knowledge increase can produce products with better performance or lower cost to achieve economic growth. Knowledge is infinite dimension, and any infinite variable of knowledge means that the increase of knowledge can bring about a variety of different new product economy and achieve monotonous and continuous infinite economic growth. Romer only looks at knowledge from a macro perspective, rather than the heterogeneity of knowledge and new knowledge from a micro perspective.

Second, this paper assumes that knowledge is an endogenous variable for all economic subjects. Population investment knowledge hopes to get better wages in market competition, private sector enterprises invest knowledge in research and development and improve management to improve market competitiveness, and government investment in scientific and technological research to promote the improvement of knowledge level in the whole economy.

Romer assumes that knowledge is only the capital accumulation of private sector enterprises investing for profit, and is an endogenous variable in the private sector.

Third, this paper assumes that the increase of knowledge in any dimension over a certain period of time means that economic output is capped over a certain period of time. Romer assumes that the growth of knowledge in a certain time does not exceed a certain constant to meet the conditions for the economic output of the Solo model. That is, this paper assumes that there is an upper limit of the short-term economic output, and the neoclassical school assumes that the short-term economic output converges.

(4) assumptions about consumption

The Arro-Debru model and Lucas model respectively put forward the basic assumption about the utility time optimization of commodity consumption. Its physical significance is that commodity production can not well meet the consumer demand well, and consumption should be saved. Appendix 2 has stated that social demand determines commodity output, and the general situation is that commodity production capacity is greater than commodity consumption capacity, and the utility time optimization of commodity consumption is not the main contradiction of economic activities. Therefore, this paper does not make the basic rule assumption of commodity consumption.

The basic law of this paper assumes that the commodity exchange of non-investment goods, the basic law assumes that the commodity production, the basic law assumption is about the knowledge, the three basic laws assume that the different aspects of economic activities, and are independent of each other. These three assumptions are the optimization and improvement of the assumptions of the neoclassical schools and the Keynesian schools about the basic laws of the market economy.

4. A market economy model of government management

This section first discusses the market economy model of closed government management without international economy, and then relate the semi-closed government management market economy model with international trade but managing the cross-border flow of private sector capital.

(1) Closed model description

The closed model includes both the private sector and the government sectors. Government departments (sometimes referred to as the government) include the central government and local governments at all levels, and various organizations invested by the government such as state-owned enterprises, universities, research institutes, primary and secondary schools and hospitals, etc. Monetary institutions composed of central banks (hereinafter referred to as the

central bank), commercial banks and policy banks are also government departments. Individuals and families and their investment organizations such as enterprises are in the private sector, and various organizations invested by the private sector and government departments are in the private sector. For simplification, monetary institutions are abstracted as pure debt hubs with no output and expenditure, and their actual income and expenditure are classified into government departments. Unless specifically noted, the following government departments of this article include the outputs and expenditures of monetary institutions but not their claims and debts.

The central bank allocates capital to commercial banks and policy banks in accordance with national laws, commercial banks lend loans to the private sector according to the management measures formulated by the central bank, and policy banks lend loans to government departments according to the management measures formulated by the central bank. According to the management needs, the central bank allocates capital to commercial banks and policy banks to manage the loan scale of commercial banks and policy banks, manage the growth rate of money supply and manage social demand.

The capital allocated by the central bank to commercial banks and policy banks is legal, with no physical basis. Central banks can allocate unlimited capital to commercial banks and policy banks, commercial banks from savings customers, and model economies from the financial crisis.

Monetary institutions provide some funds for the investment and expenditure of the private and government sectors. Government finance is balanced by policy bank loans, that is, balanced by currency issuance, which is the currency issuance finance. Final bad debts in the private sector are also borne by monetary institutions.

In short, the model economy government manages the market economy through a virtual monetary system.

(2) The development trend of the monetary system of global market economies

The commercial bank business is borrowed short, the deposit is the short-term debt of the commercial bank, and the loan to the commercial bank is the time mismatch; and the loan given to the commercial bank is several times higher than the deposit of the commercial bank, the quantity is mismatch; this means that the commercial bank has inherent vulnerability. If depositors are concerned about the deposit safety of commercial banks with poor quality and withdraw their deposits collectively, the commercial banks with poor quality will be unable to meet the requirements of depositors' collective withdrawal and go bankrupt. The bankruptcy of the commercial banks with poor quality will affect the banks with good quality, leading to the depositors' collective withdrawal of deposits from the banks with good quality, and finally lead to the outbreak of the financial crisis. With the outbreak of the financial crisis, banks contracted liquidity, social demand shrank, asset prices fell, more enterprises went bankrupt, the financial

crisis further deepened, and finally led to the comprehensive financial crisis and economic crisis (Grauwe, 2010).

Because of the stubborn outbreak of cyclical financial crises and economic crises, market economy countries such as the United Kingdom and the United States have set up central banks to improve the inherent vulnerability of commercial banks. As a government sector, the central bank's mission is to maintain financial stability and economic stability. In normal times, the central bank adjusts the overheating or too cold economy through monetary policies such as raising interest rate or reducing interest rate, and maintains economic stability; In special periods, the central bank, as the lender of last resort, provides unlimited liquidity to commercial banks to ensure that commercial banks will not go bankrupt due to collective withdrawals by depositors (Bernanke, 2012).

From 2007 to 2008, when the US subprime mortgage crisis broke out, the Federal Reserve lowered interest rates and bought mortgage-backed securities (MBS) on a large scale to cope with financial difficulties (Bernanke, 2012). In 2020, with the COVID-10 outbreak around the world, the Federal Reserve and more than 30 central banks around the world collectively acted to implement quantitative easing monetary policy, and the purchase of problematic securities injected liquidity into the financial markets (House & Masatlioglu, 2010). In 2007,2008 and 2020, the United States avoided the collapse of a large number of commercial banks and other financial institutions due to the quantitative monetary easing policies, and avoided the financial crisis.

Since 1999, China has set up four asset management companies to remove the non-performing assets of the four state-owned commercial banks in China, so that the four state-owned commercial banks to restore the healthy capital intermediary function (Ding Chunyan, 2008). China has therefore never had a financial crisis or an economic crisis.

The above analysis shows that the global market economy governments intervene more and more in commercial banks through the central bank, and the government's purchase of non-performing assets of commercial banks through the central bank means that the government takes the ultimate responsibility for the business failure of commercial banks, which is essentially moving to the government of the monetary system. The above analysis shows that the positive effect of governmental the monetary system is significant.

The result of the government of the monetary system is a change in the nature of money. Money itself is no longer wealth, but a virtual tool for the government to manage the market economy. In a closed model economy, the macro sum of debt is zero.

(3) Various relationship equations of the closed model

1. Department debt and debt balance equation

(1) Equation of debt balance of monetary institutions

$$S_p + S_g = M \quad (4-1)$$

$$D_p + D_g = D \quad (4-2)$$

$$S_p D_p + (S_g - D_g) = M - D \quad (4-3)$$

$S_p S_g$ The formula is the savings balance of the private sector in the monetary institution; the savings balance of the government department in the monetary institution; M is the total savings balance of the private sector and the government department, which can be regarded as the money supply; D is the total loan balance of the monetary institution to the private sector and the government department; the loan balance of the monetary institution to the private sector; the loan balance of the monetary institution to the government department, including the balance of loans to state enterprises and the balance of held Treasury bonds. $D_p D_g$

Formula (4-3) is the definition equation of the creditor's rights and debt of the subject of the monetary institution. Its physical significance is that the monetary institution provides a certain source of funds for the private sector and the government sector through the currency issuance (the increase of the loan balance). Because the monetary institution is the government sector, it can also be said that the government sector provides part of the funding source for the private sector and itself through the currency issuance mechanism.

(2) Equation of debt balance between the private sector and the government departments

Formula (4-3) Equation for balance of social debt and debt after transfer:

$$S_p D_p S_g + D_g = M - D \quad (4-4)$$

The physical significance of equation (4-4) is that the net debt of the government sector (including monetary institutions) is equal to the net debt of the private sector, and the total hedge is zero.

(3) Equations for balancing private sector investment, consumption, income, savings and borrowing

From time t to (t + 1), the balance equations for investment, consumption, income, savings and borrowing in the private sector are:

$$I_p = C_p Y_p - S_{p(t+1)} + S_{pt} D_{p(t+1)} D_{pt} \quad (4-5)$$

$I_p C_p Y_p$ The formula is the investment during the private sector time t to (t + 1), the consumption during the private sector time t to (t + 1), the nominal price income during the private sector time t to (t + 1), the savings balance of (t + 1) in the private sector at (t + 1) time, the private sector savings balance in the monetary institution at time t, the loan balance at (t + 1) and the loan balance of the monetary institution to the private sector at time t. $S_{p(t+1)} S_{pt} D_{p(t+1)} D_{pt}$

In equation (4-5), each variable is the nominal price, and its physical significance is that monetary institutions provide part of the funds for investment and consumption in the private sector.

(4) The balance equation for government income, savings, borrowing, investment and consumption

From time t to $(t + 1)$, the balance equations of income, savings, borrowing, investment and consumption of the government sector are:

$$I_g^{t+1} - C_g^t - S_{g(t+1)} + S_{gt} D_{g(t+1)} D_{gt} \quad (4-6)$$

$I_g C_g^t$ This is the investment of government departments from time t to $(t + 1)$; the expenditure of government departments from time t to $(t + 1)$; the nominal price income from time t to $(t + 1)$; the balance of savings of government departments in monetary institutions at $(t + 1)$; the loan balance of monetary institutions to government departments at $(t + 1)$ and the loan balance of monetary institutions to government departments at time t . $S_{g(t+1)} S_{gt}$

the savings balance of the government sector at the monetary institution at time t ; $D_{g(t+1)} D_{gt}$

Each variable in equation (4-6) is the nominal price, whose physical significance is that the monetary institution provides part of the funding source for the investment and expenditure of the government sector.

2. Factors of production

(1) Population and knowledge accumulation

$$L = \int I_i dt \quad (4-7)$$

I_i Formula is the investment of population in knowledge, L is the accumulation of population and its investment in knowledge, and t is time. The physical significance of formula (4-7) is that population invests its own knowledge since birth, and knowledge is the endogenous variable of population. Population and knowledge accumulation L is one of the most important factors of production that reflect the productivity level and international competitiveness of an economy.

(2) Capital accumulation of the private sector

$$K_p = \int I_p dt \quad (4-8)$$

I_p : private sector investment

K_p : Endogenous variables in the private sector. K_p

The formula is the accumulation of private sector capital except for population and knowledge accumulation, including the accumulation of knowledge investment. Knowledge according to the immediate assessment value accounting, immediate depreciation. The accumulation of private sector capital, which includes intangible assets such as knowledge, is one of the most important factors of production reflecting the productivity level and international competitiveness of an economy.

(3) Capital accumulation of government departments

$$K_g = \int I_g dt \quad (4-9)$$

I_g : government investment, K_g Capital accumulation for government departments,

including scientific and technological research completed by government-invested universities and research institutes, government-invested economic infrastructure, and government-invested parks and other leisure and entertainment facilities. Government capital accumulation can reduce the external costs of the private sector, improve the level of social productivity, and improve the international competitiveness of private sector enterprises. Knowledge according to the immediate assessment value accounting, immediate depreciation.

Endogenous Variables in the Government Sector. K_p

(4) Economical endowment

Economic endowment is one of the important concepts of new structural economics, but Justin Yifu Lin (2011) only expresses the meaning of economic endowment in words. This paper makes the following mathematical and quantitative definition of economic endowment.

$$a=A(L, N, \dots) K_p K_g \quad (4-10)$$

Where N is a natural resource. Formula (4-10) is the equation defining economic endowment. Economy endowment is the comprehensive index of the model economy factors of production, comprehensive reflect an economy productivity level and international competitiveness, is a certain moment constant price an economy maximum value of social output, its specific meaning see the text (4-13) and figure 4-2 constant price social output and money supply growth rate relationship curve.

Social output is divided into consumption and investment. Consumption will improve people's living standards, and investment will increase the capital accumulation of various economic entities to increase the economic endowment.

3. Production function equation and inflation function equation

(1) Nominal price production function equation

$$y=A(L, N, \dots) * (.,.) K_p K_g F_1 I_p I_g, C_p C_g \quad (4-11)$$

Where y is the nominal price social output per unit time. Equation (4-11) defines the equation for the social output at nominal prices. $A(L, N, \dots)$ is the endowment function of the economy, reflecting the capital accumulation of the economy. $K_p K_g F_1 I_p I_g, C_p C_g (.,.)$ is a function of the social output factor of nominal price, reflecting the social demand of economy and is a function of the growth rate of money supply. Function $A(L, N, \dots)$ and functions $(.,.)$ are not independent of each other. Formula (4-11) can also be written as follows: $K_p K_g F_1 I_p I_g, C_p C_g$

$$y=a * F(dM/dt) \quad (4-12)$$

dM/dt This is the growth rate of money supply. $F() = (.,.)$ is a function of the nominal price social output factor. The physical significance of equation (4-12) is that the nominal price social output is equal to the economic endowment multiplied by the nominal price social output factor function, that is, the constant price social output is determined by the economic endowment and the current social demand.

(2) Invariant price production function equation

$$y' = A(L, N, \dots) * (G_1 I_p I_g, C_p C_g) \quad (4-13)$$

y' This is the social output per unit time. Equation (4-13) defines the equation for the social output at constant prices. $G_1 I_p I_g, C_p C_g(\dots)$ Is a function of the constant price social output factor, which is a function of the growth rate of social demand or money supply. Function $A(L, N, \dots)$ and functions (\dots) are not independent of each other. Formula (4-13) can also be written as follows: $K_p K_g G_1 I_p I_g, C_p C_g$

$$y' = a * G() dM/dt \quad (4-14)$$

Formula (4-14) is the defining equation of the constant price social output per unit time. Its physical meaning is that the constant price social output is equal to the economic endowment times the constant price social output factor function, that is, the constant price social output is determined by the economic endowment and the current social demand. Figure 4-2 The relationship curve between social output and money supply growth rate will indicate that economic endowment $A = A(L, N, \dots)$ is the upper limit of social output at constant price per unit time. $K_p K_g$

(3) Inflation rate function equation

$$H_1 p = (a, \dots) I_p I_g, C_p C_g \quad (4-15)$$

Where p is the inflation rate (the rate of consumer goods price rise). $H_1 I_p I_g, C_p C_g(A, \dots)$ is a function of inflation rate, which is a function of the growth rate of social demand or money supply, so equation (4-15) can be written as:

$$p = H() dM/dt \quad (4-16)$$

Equation (4-15), (4-16) is the defining equation of the inflation rate, whose physical significance is that the inflation rate is a function of the growth rate of social demand or money supply.

4. Heterogeneous currency quantity equation

The housing price of urban residents is formed by the competitive ranking of urban residents' monetary wealth, and the general commodity price is determined by the cost of goods. The two price formation mechanisms are different. To this end, this paper proposes the quantitative equation of heterogeneous currency:

$$M = \sum k_i P_i Q_i \quad (4-17)$$

k_i This is the money supply coefficient of the i commodity, the market price of the i commodity, and the sales volume of the i commodity. $P_i Q_i$ Figure 4-1 shows the growth rate of China's money supply M1, housing price growth rate and CPI growth rate since 1979. It can be seen that the rising rate of consumer consumer price index and the rising rate of consumer housing price are quite different. When the annual growth rate of consumer price index is lower than 2%, the growth rate of money supply can keep more than 10% per year, which supports the proposition

of the quantity equation of heterogeneous money.

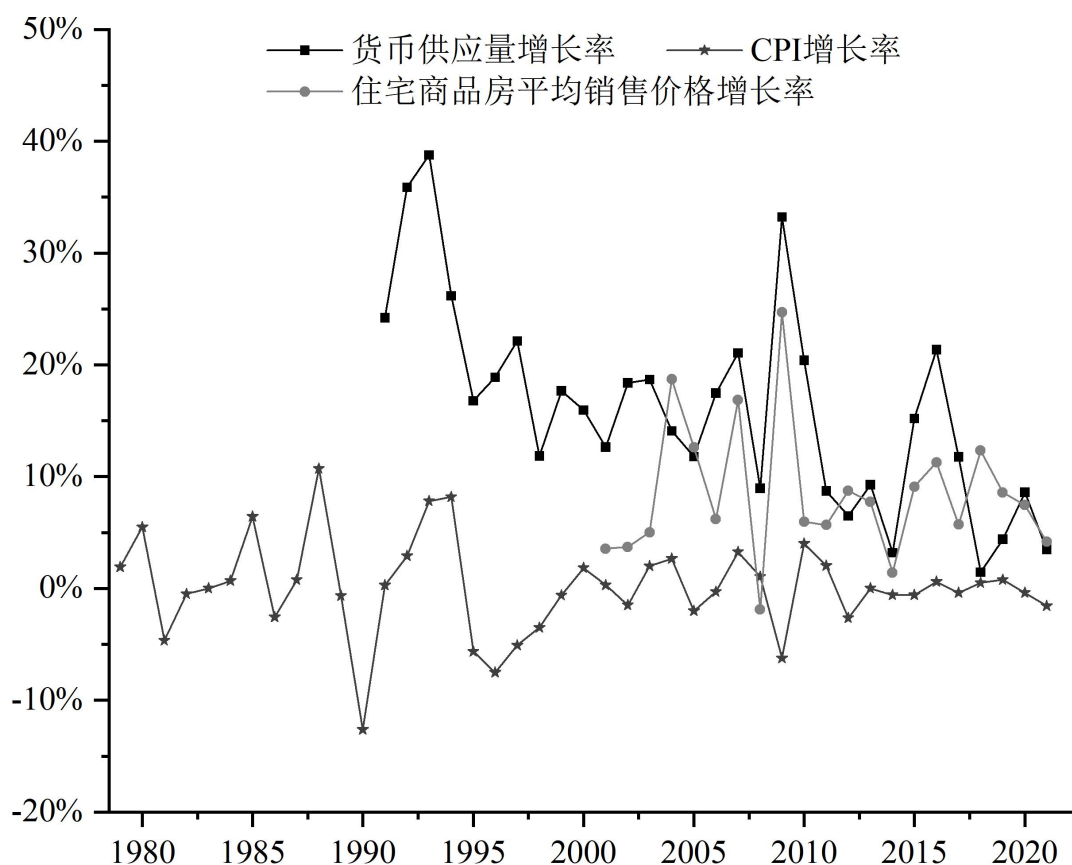


Figure 4-1 China's money supply, consumer price index and housing price growth rate from 1979 to 2020

The growth rate of money supply is the operating space of government investment and government monetary policy. When the annual growth rate of consumer price index is less than 2%, the growth rate of money supply can maintain more than 10% a year, which means that government investment and government monetary policy have relatively large space to operate.

(4) Optimization of the relationship curve between the three economic variables and the social demand

1. The relationship curve of the three economic variables

Figure 4-2 is a schematic diagram of the curve on the growth rate of nominal price social output and money supply, constant price social output and money supply growth rate and inflation and money supply growth rate according to equations (4-12), (4-14) and (4-16) respectively.

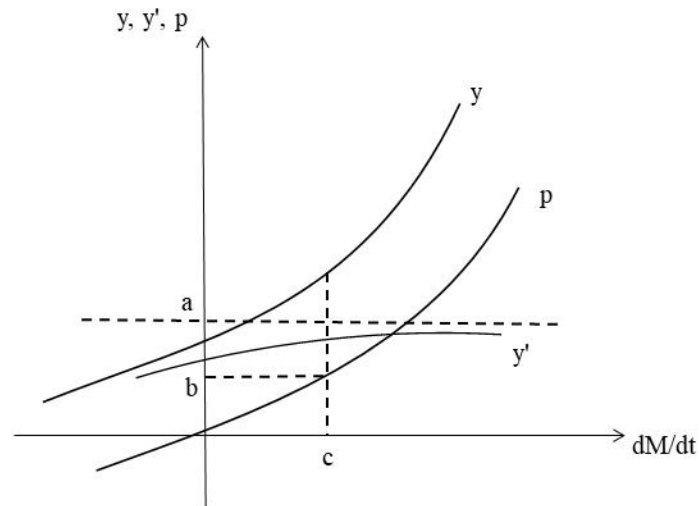


Figure 4-2, Schematic diagram of the relationship curve between nominal price output, constant price output, inflation rate and the growth rate of money supply

Figure 4-2 three curves is not according to the real economic data fit, but as Hicks according to the observation of market economy, think IS-LM curve has the characteristics of his thinks, this paper according to the three basic laws of the market economy assumptions and the observation of market economy that the above three curves as shown in Figure 4-2. The relationship curve of the proportion of capital accumulation to population, r and time, is also made in this way. The relationship curve of economic variables is the embodiment of the basic law assumption.

(1) Growth rate curve of social output and money supply at constant price per unit time

The trend of this curve is that the greater the social demand of nominal price brought about by government investment and monetary policy, the higher the resulting growth rate of money supply, and the higher the social output per unit time of constant price. However, there is an upper limit a on this curve. No matter how much the nominal price social demand brought by government investment and monetary policy is, and therefore how high the growth rate of money supply is, the social output per unit time will not exceed a , that is, $<A.y'$

The value of a is the maximum constant price social output per unit time at a specific time of the economy, which is the economic endowment expressed by Equation (4-10).

(2) The relationship curve between the inflation rate and the growth rate of money supply

The trend of this curve is that the greater the nominal price social demand brought about by government investment and monetary policy, the higher the growth rate of money supply, and the higher the inflation rate. There is a threshold b for the inflation rate. When the inflation rate is less than the threshold b , the increase in social demand brought about by government investment and monetary policy will mainly bring about the increase in the utilization rate of labor and capital accumulation, resulting in the increase of social output at constant price. When the inflation rate is

greater than the threshold b , the accumulation of labor and social capital has been fully utilized, and the increase of social demand for nominal price brought about by government investment and monetary policy will not mainly increase the utilization rate of labor and capital accumulation, but mainly bring inflation. Inflation brings economic instability. The higher the inflation rate, the more unstable the economy is.

The growth rate of money supply corresponding to the inflation rate threshold is the value of c , and c is the critical point of the growth rate of money supply that triggers inflation.

(3) Growth rate curve of social output and money supply at nominal price per unit time

The trend of this curve is that the greater the social demand of nominal price brought about by government investment and monetary policy, the greater the social output of nominal price is. When the growth rate of money supply brought by government investment and monetary policy is higher than the c value, the social output at the nominal price will include the inflated part of inflation. The higher the growth rate of money supply, the higher the inflation rate, and the greater the inflated part.

The b value can be used as the policy target of the government to control inflation, and ensure that the inflation rate caused by the increase of nominal price social demand caused by government investment and monetary policy does not exceed the b value.

2. Optimization of social demand for $(I_p + C_p + I_g + C_g)$

Although Figure 4-2 The independent variable of the relationship curve of the three economic variables is the growth rate of money supply, in fact, the social demand $(I_p + C_p + I_g + C_g)$ affected by government policies determines the growth rate of money supply, but the social demand is not a single variable but a multivariable, which produces the optimization problem of social demand.

$I_p + C_p + I_g + C_g$ On the optimization between private sector investment and consumption $(I_p + C_p)$ and government investment and spending $(I_g + C_g)$, this is done through government monetary policy (interest rate, loan qualification review and loan size control). When the inflation rate is higher than the policy target b , in addition to directly reducing investment and spending $(I_g + C_g)$, the government can also raise interest rates to curb private sector demand through monetary policy to bring the inflation rate back below the policy target b . When the inflation rate is lower than the policy target b value, the government can not only directly increase investment and expenditure, but also stimulate the demand of the private sector by lowering the interest rate to improve people's lives and improve the economic endowment, but ensure that the inflation rate does not break the upper limit of the policy target b value. When the monetary policy interest rate is close to zero and the inflation rate is still below the policy target b , the government can increase social demand only by increasing government investment and spending to improve people's lives and increase economic endowment.

$I_g + C_g$ As for the optimization between government investment and expenditure () specific projects, this paper advocates the government's comprehensive ranking of investment and expenditure projects according to its own value proposition. Samuelson (2010) believes that the utility of consumer goods is a kind of satisfaction that reflects consumers' ranking of goods and services. Drawing on Samuelson's definition of the utility of consumer goods, this paper believes that the government's ranking of specific projects for its investment and expenditure should reflect its own value proposition. For example, if the government focuses more on the backward areas and low-income people, it can give priority to the projects supporting the backward areas and low-income people.

In short, the optimization of private sector investment and consumption, government investment and expenditure is a very complex and comprehensive problem with a certain subjective color, and there is no objective and only solution. Drawing on Friedman's attitude on deductive economics and empirical economics, this paper advocates the optimization problem, including the following three points: first, comprehensively evaluate the economic benefit and social efficiency of government investment and expenditure projects, both efficiency and fairness; second, the projects that can directly achieve profits are invested by the private sector to select the best operating subject through market competition; third, there is not a clear boundary between private sector investment and government investment, ensuring all institutional economic subjects.

(5) The closed model is relaxed to include international trade but manage cross-border flows of private capital

1. Model description

The previous closed model is relaxed to include state-dominated international trade with other economies, but the government also increases the cross-border flow of private sector capital management, foreign investment and financing.

This article defines the free international trade between countries and refers to the completely voluntary trade between countries that is not forced and restricted by any third party. Trade agreements between countries are not mandatory or restrictive, but are voluntary. The free international trade of this paper satisfies the basic law of Section 3 of this paper. Hypothesis 1 " In the free market economy system without the coercion or restriction of any third party, Pareto optimization competitive equilibrium with the limited exchange of non-investment goods, which increases the utility of the assets of the transaction subject."Conditions, so the above free international trade exists in Pareto optimization competitive equilibrium.

$$\Gamma = \llbracket N, \{X_i\}_{i \in N}, \{f_i(x)\}_{i \in N} \rrbracket \quad (4-18)$$

$$N\{1, \dots, N\} N_{X_i} \in X_i \in R^{n_i} X = (x_1, \dots, x_N) \in X = \prod_{i \in N} X_i \in R^N \left(n = \sum_{i \in N} n_i \right) i \in N f_i$$

Formula = is the number of countries participating in international trade, is limited value; i is the serial number of national subjects; is the international trade collection between the first national subjects and other countries; each. For the collection of international trade between all countries and other countries; (x) for the exchange of i countries with other international subjects, $(x) > 0$, any f_i

$$\sum_{i \in N} f_i(X_i) \cong \sum_{i \in N} f_i() X^p \quad (4-19)$$

$X^p = (X_1^p, \dots, X_n^p) \in X$ Optimize competitive and balanced international trade for Pareto.

That is, (4-18), the Pareto optimization competitive equilibrium is expressed in the free international trade formula (4-19).

Formula (4-18) describes the international trade consisting of the country, but the real international trade is carried out between a single economic subject. This paper proposes that the government should align the interests of various microeconomic subjects in China with the interests of the country by formulating exchange rate and tariff policies.

$$P_i - T_e \leq P_{if}/E \quad (4-20)$$

$$P_i - T_i \geq P_{if}/E \quad (4-21)$$

$P_i P_{if} T_i T_e$ The formula is the domestic price of commodity i , the foreign price of commodity i , E is the exchange rate determined by the government, the import tariff imposed by the government on the commodity, and the export subsidy of the government on the commodity (the export tariff imposed is negative), assuming that other costs such as transportation are zero.

If formula (4-20) is established, the domestic microeconomic entities will increase the utility of national assets; if formula (4-21) is established, the domestic microeconomic entities will increase the utility of national assets. If the government forbids the export of a commodity, infinite export duties are imposed on the commodity; if the government forbids the import of a commodity, infinite import duties are imposed on the commodity.

In this way, the government makes the interests of individual domestic economic subjects consistent with the overall interests of the country through the exchange rate and tariff policy, and transforms the international trade between individual economic subjects into international trade with the country as the main body.

2. Daily exchange rate management

The exchange rate is the price of the foreign exchange as an investment product. According to Appendix 1, where there is no stable equilibrium solution to investment prices, exchange rates are inherently unstable. However, the international trade needs a stable exchange rate, otherwise

the import and export enterprises will bear a relatively large risk of exchange rate fluctuations, and hinder the development of international trade. The government can realize the stability of the exchange rate of its own currency through the open operation of the central bank in the international foreign exchange market. The specific approach is as follows: the government determines an exchange rate to maintain the international trade surplus and maintain a certain amount of foreign exchange reserves. If the trade surplus falls or the foreign exchange reserves fall beyond the normal range, the domestic currency will be devalued in a gradual or abrupt way to bring the trade surplus or foreign exchange reserves back to the normal range. Similarly, if the trade surplus continues to rise or the foreign exchange reserves continue to rise beyond the normal range, the domestic currency is appreciated in a gradual or abrupt way to bring the trade surplus or foreign exchange reserves back to the normal range.

3. The impact of free international trade on economic endowments and the tipping points of inflation

Such free international trade will optimize the asset structure of the closed model economies, promote the industrial technology upgrading in the private sector, and improve the economic endowment, namely

$$a_e > a \tag{4-22}$$

a_e In the economic endowment after the implementation of free international trade. For the same reason, free international trade will raise the tipping point of money supply growth that triggers inflation, i. e

$$c_e > c \tag{4-23}$$

c_e This is the critical point for the growth rate of money supply triggering inflation after the implementation of free international trade.

4. Managing private capital flows across borders is a prerequisite for the model

The previous closed model economy government relies on currency issuance and liabilities to invest and spend to reduce external costs in the private sector, essentially because the government gives subsidies to the private sector. The transfer of private sector wealth to foreign countries through cross-border capital flows will lead to the loss of national wealth, in the specific form of causing the depreciation of the domestic currency, reducing the international purchasing power of the domestic currency, and reducing the real living standard of domestic residents. Reflected in the tipping point of economic endowment and inflation, the transfer of private sector wealth abroad will reduce the domestic economic endowment and reduce the critical point of the growth rate of money supply that triggers inflation. In severe cases, the government-managed market economy will be unable to realize the virtuous logical cycle of government investment and expenditure and the international competitiveness of the private sector. Therefore, the management of the cross-border flow of private capital, foreign investment and financing is the prerequisite for

the establishment and existence of a government-managed market economy.

After the government manages the cross-border capital flow of the private sector, the wealth of the private sector cannot be lost abroad, but flows to the housing of urban residents, so that the increase of money supply leads to the rise of the housing price of urban residents, which is one of the important reasons for the heterogeneous equation of money quantity.

5. Mercantilism has a certain degree of rationality

Experience is an important way to gain knowledge (Arrow, 1971). The government of any country wants to retain more industries, so each country wants its currency to have a low exchange rate, protect the domestic market through import tariffs, and impose export subsidies to occupy more global markets. This means that the exchange rate and tariff policies of various countries are a conflict of interest and a non-cooperative game between countries. This means that mercantilism has some rationality.

China became the world industry center, one of the most important reason is that the government investment economic infrastructure reduces the external cost of the private sector enterprise (save transportation time and cost) and family living expenses (low education medical cost), reduce the production cost of domestic products, improve its international competitiveness.

Countries should conduct international trade negotiations, compromise and reach an agreement on the exchange rate and tariff policies to achieve win-win results.

(6) A new economic theoretical framework

The model in this paper is different from the basic assumptions of market economy of the neoclassical and Keynesian models, and has different assumptions about the relationship curve of economic variables, forming different economic theoretical frameworks.

1. Different basic law assumptions and the relationship curve assumptions of economic variables

The neoclassical school believes that the free market economy without government intervention can realize the competitive equilibrium (general equilibrium) by itself, which is the basic law assumption of the neoclassical school about the market economy. Solo model believes that the relationship curve between the proportion of labor and capital accumulation r and time will be stable and reach the long term value, and realize the full utilization of labor and capital accumulation. This is the assumption of the neoclassical school on the relationship curve of economic variables. Based on these two assumptions, the neoclassical school advocated that the government did not interfere in the market economy.

The Keynesian school believes that government expenditure and monetary policy can realize the optimal solution of market economy, which is the basic law assumption of Keynesian doctrine about market economy. The intersection point of the two Hicks IS-LM

curves is the equilibrium interest rate point, and the equilibrium interest rate point corresponds to the equilibrium social output, which is the assumption of the Keynesian school on the relationship curve of economic variables. The policy goal of the Keynesian school was to find the best government investment and spending.

The third section of this paper expounds the three basic law assumptions about the mutually independent market economy. The characteristics of the three economic variables relationship curves in Figure 4-2 are the assumptions of the economic variables relationship curves in this paper. The government policies advocated in this paper include monetary issuing finance, managing private sector cross-border capital flows, optimize the relationship between monetary policy and fiscal policy, optimize the government investment and spending specific projects, optimizing the market competition incentive mechanism to increase capital accumulation, finally to ensure the inflation rate meet the policy target of social demand, to realize the long-term sustainable, stable and high quality development of model economy.

2. Manage the market economy with a virtual monetary system according to law

The government manages the market economy with a virtual monetary system according to law. The government optimizes the relationship between the private sector investment and consumption and the investment and expenditure of the government sector through monetary policy, and achieves the maximum social demand through the government investment and expenditure under the premise that the inflation rate complies with the policy objectives.

The growth of government money supply needs to be accompanied by the increase of economic endowment, that is, the increase of social productivity, otherwise it will lead to inflation. The continued growth of the money supply will lead to a sustained rise in housing prices in big cities. Model economies are protected from a financial crisis.

3. We will improve government investment and spending projects

Government investment and expenditure projects should be both efficiency and fairness, efficiency ensures long-term sustainable and high-quality economic development, and fairly realize the government's unique value proposition. Monetary policy, government investment and expenditure and fiscal policy can smooth economic fluctuations to the greatest extent, maximize the potential of the economic growth, and achieve long-term sustainable, stable, high-quality development of the economy.

4. Manage private sector capital flows across borders

Managing the cross-border flow of private sector capital, outbound investment and financing to ensure that the wealth of the economy is not lost abroad is the premise for the establishment and existence of the model economy.

5. We will optimize various market competition systems

Appendix 2 The discussion on commodity production competition shows that market competition is ultimately the competition of knowledge, and knowledge is the endogenous variable of each economic subject. The government should optimize all kinds of market competition system, such as higher education entrance examination system, various system of enterprise fair competition system, government recruitment system, scientific and technology research, evaluation system, motivate the economic subject to improve their capital accumulation, economy endowment long-term sustainable stable high quality growth.

China's college entrance examination is one of the most successful market competition systems, which profoundly affects the pre-education population of each university, encourages them to invest in their own knowledge, and improves the knowledge accumulation of the economy population $L = \int I_t dt$ China has made great achievements in economy and scientific research over the past 40 years, and the restoration of the college entrance examination system is one of the indispensable links.

6. Good government and effective government

The relationship between government and market, for government and effective government are discussed by many domestic economists (Yifu Lin Yifu, 2011,2014; Tian Guoqiang, 2016,2017). The five points mentioned above in this paper are the five aspects of realizing effective government and effective government.

5. Model interpretation of several important economic realities

Economic theory is a logical system constructed by people in order to analyze and explain the law of economic development. Different schools of economic theory have different basic law assumptions about the market economy, and have different explanatory perspectives on economic activities. The following is the explanation of several important economic realities in this paper.

(1) Per capita GDP varies significantly among different countries

$K_p K_g I_p I_g, C_p C_g$ According to the International Monetary Fund (IMF), the per capita GDP of the US in 2021 is us \$69,231.40 per person, and China's per capita GDP is US \$12,358.8 per person. The US is 5.6 times that of China, and the US is significantly high. The explanation of this paper is that according to the equation of constant price production function (4-13), the economic endowments of different countries $A = A(L, N, \dots)$, and the social demands brought by government investment and monetary policy are different (\dots), which leads to different social output per capita at constant price. The level of science and technology in the United States is significantly higher than that of China, the per capita population of the United States, the accumulation of knowledge of the private sector and the accumulation of the government sector is significantly higher than that of

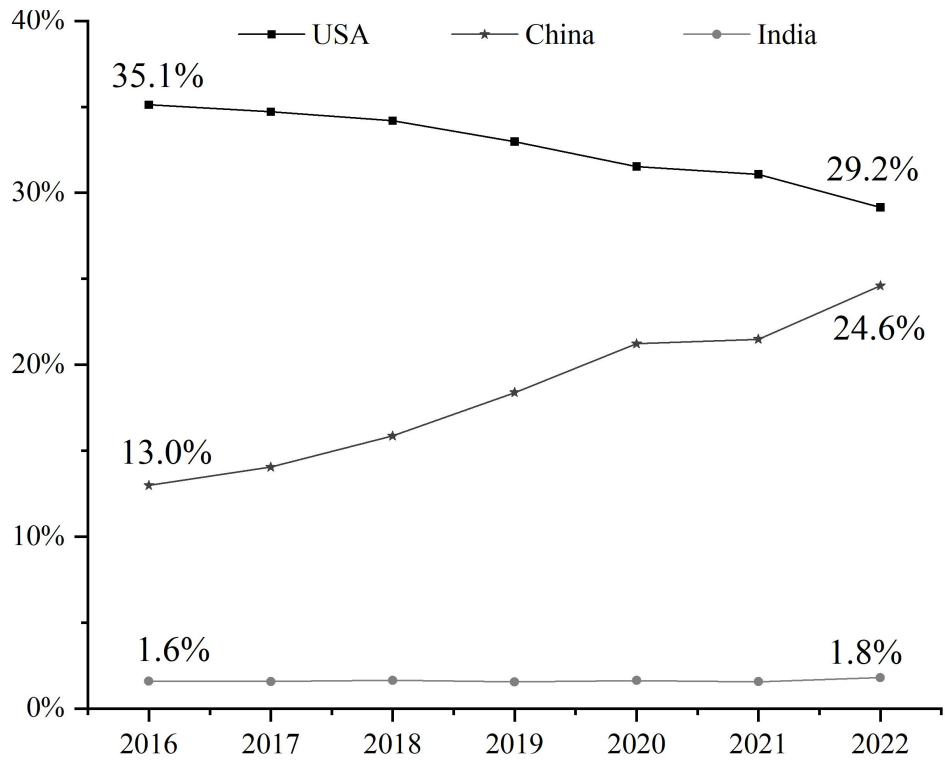
China, which is the reason why the per capita GDP of the United States is significantly higher than that of China. Therefore, different economic endowments and different government investment and monetary policies are the reasons for the differences in per capita GDP.

(2) Significant differences in economic growth between China and India

China and India have similar population sizes. In 1979, China's per capita GDP was 82% of India, and in 2020, China's per capita GDP was 5.48 times that of India. During this period, China's economic growth rate was significantly higher than that of India. The explanation of this article is as follows: (1) China's college entrance examination system and the expansion of university enrollment have cultivated a large number of knowledge labor force and improved the accumulation of knowledge by the population.(2) The government has invested heavily in economic infrastructure and scientific and technological research, which has improved the capital accumulation of government departments.(3) Government capital accumulation improves social productivity, constitutes subsidies to the private sector, improves the international competitiveness of the private sector, and attracts international industries to transfer to China, which ultimately improves the capital accumulation of the private sector. These three points are one of the important reasons why China's economic growth has been better than that of India over the past 40 years. China's economic growth is significantly better than India means that China's past government investment and monetary policy have had significant results.

(3) natural index changes in the US, Chinese mainland and India

The Nature Index (Nature Index), first published in 2016, is based on the number of papers published in the world's top journals (82 natural science journals such as Nature series, Science and Cell), reflecting the high-quality scientific and technological research output of all countries in the year. From 2016 to 2022, the share of China's natural index grew rapidly. Science and technology is one of the most core elements of economic endowment. The rapid growth of China's natural index share lays a good foundation for the rapid growth of economy's endowment and economic growth potential in the future. This paper explains this economic reality as: the Chinese government's large investment in universities and research institutes has brought a rapid increase in high-quality scientific papers of Chinese scientists, and the effect is significant.



Figure

5-1 Natural Index chart of the US, China and India from 2016 to 2022

(4) The impact of developed country government investment on social output, private investment and employment

Adb et al.(2016) analyzed the effect of government public investment with data from 17 OECD countries from 1985 to 2013, and concluded that government investment increased social output in both the long term and the short term, stimulate rather than inhibit private sector investment, and reduce social unemployment. The explanation of this article is that under the condition that inflation rate is within the scope of policy target, government investment is stimulus effect rather than crowding out effect, and government investment improves social output.

(5) China's economic growth is stable

As can be seen from Figure 5-2, since 1978, China's economic growth has been stable, with no financial crisis or economic crisis ever. China has essentially governmental monetary institutions, the basic guarantee inflation rate within the scope of the policy target under the premise, the government a lot of investment in science and technology research, economic infrastructure, schools and hospitals and other social public service agencies, etc., effectively reduce the external cost of the private sector, improve the international competitiveness of the private sector, make advanced international industry transferred to China, China's economy so not only realized the relatively high growth rate has never broken out the financial crisis and economic crisis.

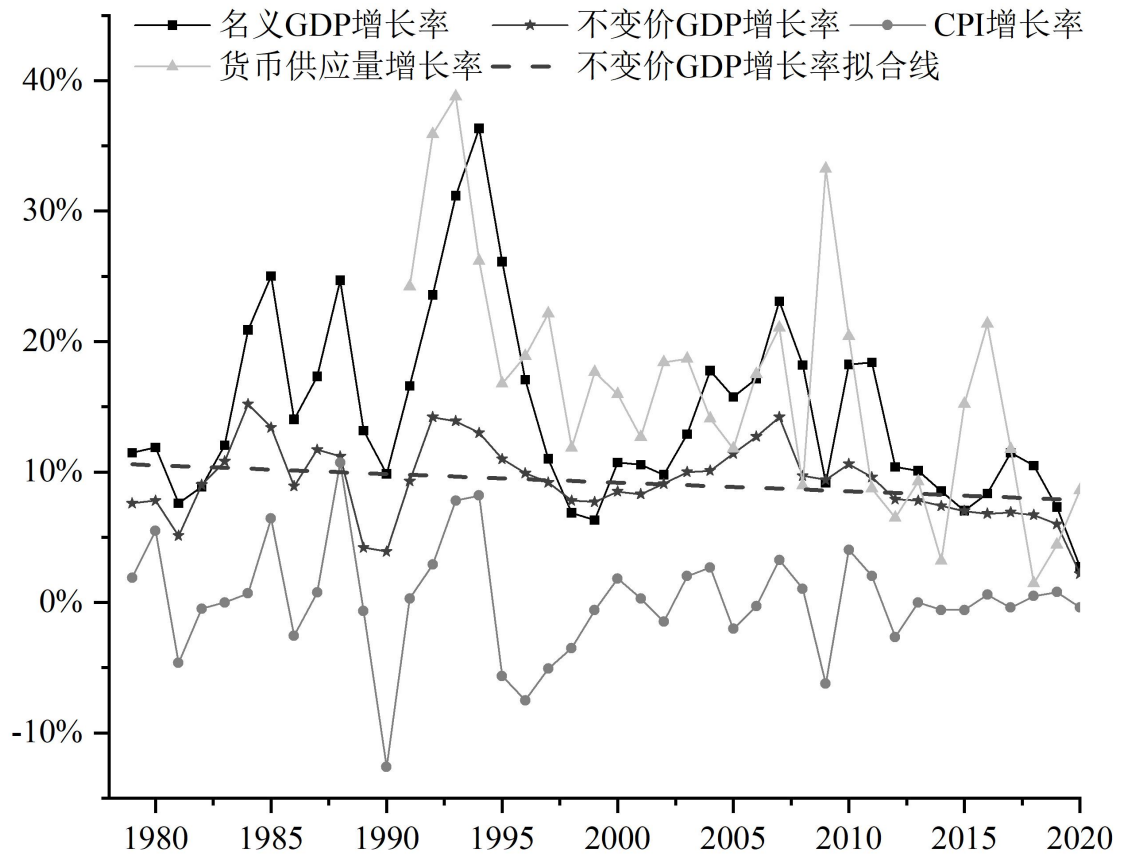


Figure 5-2 Economic growth rates from 1979 to 2020

6. Interpretation of the model for some important theoretical problems

In this paper, the interpretation of several important economic theory problems is quite different from the mainstream economic theory models.

(1) Financial crisis, economic crisis and economic fluctuations

The neoclassical school believes that the free market economy can achieve optimal development under ideal conditions without economic fluctuations such as financial crisis and economic crisis, which is that the real information is imperfect, information transmission friction and government policies lead to economic fluctuations such as financial crisis and economic crisis.

This paper holds that the free market economy cannot achieve optimal development, and it is inevitable for financial crisis and economic crisis due to the maturity mismatch of debt. In free market economy, labor surplus and capital accumulation are underutilized. The government can avoid the financial crisis through the

governmental monetary system, and the government investment and monetary policy can improve the utilization rate of labor force, smooth the economic fluctuations and improve the economic endowment.

(2) Short-term convergence or upper limit of economic output

The neoclassical school thought that free economic activities would achieve a competitive equilibrium, and that the social output was convergent.

This paper holds that there is a constraint relationship between government investment and monetary policy and the inflation rate. If government investment and monetary policy exceed a certain range, there is an upper limit on economic output in any certain period.

(3) Long-term and monotonous growth of economic output.

Romer assumes based on the Solo model that R & D investment in the private sector will increase the scale of output, but the output to R & D input is still decrease in scale. This both ensures the short-term convergence of the neoclassical model and explains the long-term monotonous and sustained growth of the American economy driven by research and development.

This paper holds that new knowledge brings new products or reduces the cost of old products to promote the monotonous and continuous growth of economy, that is, knowledge growth drives the continuous and monotonous growth of economy, and economic growth has no boundary.

(4) The gap between the rich and the poor in other countries does not converge

According to the neoclassical Romer model, the per capita output gap between developed countries and developing countries is increasing, because the gap between developed countries and developing countries in science and technology level is widening, and the economic endowment gap between developed countries and developing countries is widening. The proposition of this paper is roughly consistent with Romer. The difference lies in that Luo defaults that science and technology are the endogenous variables of the private sector, while this paper holds that science and technology are the endogenous variables of all economic subjects.

(5) The capital return of high-tech oligopoly enterprises is higher than the average social interest rate

According to the neoclassical general equilibrium theory, the return on capital of enterprises will be balanced with the average social interest rate. However, the return on capital of technology giants such as Microsoft in the United States is significantly higher than the interest rate of the American market. Therefore, Bob and Mankun introduced the enterprise market power assumption based on the

neoclassical model of Solo, believing that the market power of enterprises enables enterprises to obtain higher income than the average market interest rate.

This paper holds that the Bertrand competition is the main form of enterprise competition, and the knowledge advantage of competitive enterprises to competitors is an important source of profits. The greater the knowledge advantage, the higher the return on capital. American high-tech giants return capital much higher than the average market rate because they have huge research and development advantages over their competitors.

(6) Exchange-rate stability

Gluckman believes that there is a stable equilibrium solution to the exchange ratio between the two currencies. This paper holds that the exchange rate is the unstable and balanced solution of the price of investment goods, and advocates that the central bank should in the stable exchange rate in the international foreign exchange market to ensure the smooth progress of international trade.

(7) Management of cross-border capital flows in the private sector

The neoclassical school believes that the optimization of individual economic entities is the optimization of national economies and the global whole. This paper holds that the interests of individual economic entities in the private sector may be inconsistent with the overall interests of the country, and advocates the management of cross-border capital flows and outbound investment and financing in the private sector to ensure that a country's wealth does not go abroad.

(八) Design and improvement of the social system

Various models of neoclassical school and Keynesian school generally assume the homogeneity of microeconomic subjects, so they generally do not involve the design and improvement of social systems that affect the behavior of microeconomic subjects. In this paper, the assumption of the model on the microeconomic subject is heterogeneity, and each economic subject has its own unique capital accumulation. Therefore, this paper believes that one of the most important problems of economic theory is to encourage them fairly and justly to improve their own capital accumulation to improve the market competitiveness.

VII. A new Economic Theoretical Framework (Summary)

(1) Economic theory is a logical system subjectively constructed by people to analyze and explain the law of economic development. Different schools of economic theory have different assumptions about the basic laws of market economy, and have

different perspectives on explaining the laws of economic activities, which constitute different economic theoretical frameworks.

The neoclassical school believes that the free market economy without the government intervention can achieve the competitive equilibrium (general equilibrium) by itself. The Keynesian school believes that government spending and monetary policy can achieve the optimal solution of the market economy. This paper holds that it is difficult for free market economy to realize full utilization of labor force, and government policies can realize long-term sustainable, stable and high-quality development of market economy.

(Ii) Over the period from 1921 to 1939 and 19 years, the British unemployment rate remained above 10%. Based on this economic reality, this paper believes that the hypothesis of the framework of neoclassical school and Keynesian school of economic theory on the optimal equilibrium of market economy is too strong.

(3) The economic theoretical framework of the model in this paper gives a logical and consistent explanation of China's remarkable achievements in economy and scientific research over the past 40 years, as well as several other important economic reality and theoretical problems.

Viii. Policy suggestions

According to the basic assumptions of the law of market economy, the assumptions of the relationship curve of economic variables and the various economic laws or constraints, this paper puts forward the following policy suggestions.

(1) Let the free market become the most important means to optimize the allocation of social stock assets.

1. Remove all obstacles affecting the free flow of production factors such as labor force, and realize the free competition of production factors such as labor force to the maximum extent. One of the most important reasons for the great success of China's reform and opening up is the lifting of controls on the flow of factors of production such as labor force.

2. When the right to use public resources, such as land, space, ocean and minerals, is transferred to the private sector, it should be auctioned.

(2) Optimize the relationship between private sector investment and government sector investment

1. Projects that can directly achieve profits are invested by the private sector, so that the best operating entities can be selected through market competition.

2. Projects that are meaningful to improve economic endowment but should not be invested by the government and give full play to the advantages of relatively sufficient monetary and financial funds.

3. In practice, there is not necessarily a clear boundary between private sector investment and government investment, and fair competition among various institutional and economic entities should be ensured.

(3) Make full use of the government investment policy space to maximize people's lives and increase economic endowment.

1. Establish the belief that knowledge is the first productive force, continue to expand the scale of university doctoral students and professors, let China upgrade from ordinary labor dividend, engineer dividend to scientists dividend; let China eventually become a global science and technology research center and a global high-tech industry center.

2. Exemption social security contributions, reduce enterprise costs, and improve the international competitiveness of domestic enterprises. Social security expenditure is the government expenditure, and the government finance is balanced by monetary issuance.

3. When conditions are ripe, free medical care and free education will be implemented, affordable housing and characteristic communities, leisure and entertainment facilities, and targeted poverty alleviation will be continued to achieve common prosperity of the whole society.

(4) Improving international economic policies

1. Managing the cross-border capital flows, foreign investment and financing of the private sector to ensure that the social public wealth is not lost to go abroad is the premise for the establishment of the government-managed market economy.

2. Formulate reasonable exchange rate and import and export tariffs, improve the international competitiveness of domestic enterprises, promote the upgrading of domestic industrial technology, and improve the economic endowment.

. Abstract: This paper proposes a theoretical framework : government-managed market economy.It discusses the mathematical scientific methodology and assumption and builds a government-managed model by improving the underlying assumptions of Neoclassical and Keynesian.This model believes that the market economy does not have an optimal equilibrium without government intervene, which is different from the models of Neoclassical and Keynesian school .Government policies can reduce unemployment rate, improve the society 's well-being and the economy 's endowments Model economy can avoid financial crises and smooth economic fluctuations to the greatest extent, but controlling the cross-border flows of private sector capital is a prerequisite for the establishment and existence of the model.This paper gives a completely different explanation from the mainstream economic theory for China's

remarkable achievements in economy and scientific research in the past 40 years and some other important economic realities and theoretical issues.

Keywords: Methodology; underlying assumptions; Mathematical model; Government-managed economy; Economy's endowments ; Cross boarder capital flow ; Economic theory framework.

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appendix

Appendix 1 There is no competitive equilibrium in the exchange of investment goods and commodities

Whether there is a competitive balance in the exchange of investment goods is a subjective judgment question. Only when the objective question of the exchange of investment goods and commodities is clearly defined, can this question be answered. This paper defines the investment goods as: the infinite number of goods exchanged is the investment goods. Samuelson (2012) defines utility as a kind of satisfaction that reflects the ranking of goods and services by consumers. To expand Samuelson's definition of utility from consumer goods to investment goods, this article defines the utility of investment goods as: investment goods utility is a kind of satisfaction, which reflects the investor's rating and ranking of a certain investment goods.

This paper assumes that different investors have different subjective value judgments of the same investment product, and the same investor has different subjective value judgments of the utility of the same investment product at different times, that is, the investors' subjective value judgment of the utility of an investment product changes dynamically.

According to the above definition and assumption of investment goods trading, this paper believes that there is no competitive equilibrium in the exchange of investment goods, and the process is elaborated as follows:

Because different investors have different subjective judgments of the value of the same investment product, and the same investor has different subjective value judgments of the utility of the same investment product at different times, the supply curve and demand curve of the investment product at different times are different, and the transaction price is different, as shown in Figure 1-1.

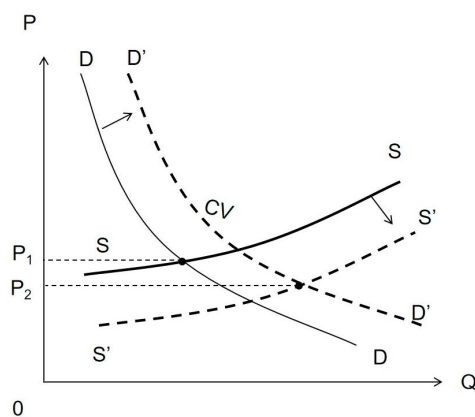


Figure 1-1 Demand and supply curve for investment products

In this way, there is no equilibrium price for the transaction of investment goods. When the transaction price of investment goods deviates from its equilibrium price, the market exchange can bring the deviated transaction price back to the equilibrium price. In economic reality, the exchange of investment commodities such as stocks, foreign exchange and gold is more in line with the situation in Figure 1-1, so this appendix believes that there is no competitive equilibrium in the exchange of investment commodities.

Appendix 2 There is no Pareto optimization competitive equilibrium in commodity production

Just like the question of whether there is a competitive equilibrium in the exchange of investment goods, whether there is a Pareto optimization competitive equilibrium in commodity production is a subjective question. Only when the objective question of commodity production is clearly defined can this question be answered.

The Arrow and DeBlasi model on the existence of an optimized competitive equilibrium for commodity production is that the production of each commodity meets the requirements of a closed convex subset.

The convexity (convex) of a single product production function, as shown in Figure Appendix 2-1, is expressed mathematically as:

$$f(\lambda x_1 + (1-\lambda)x_2) \geq \lambda f(x_1) + (1-\lambda)f(x_2) \quad (2-1)$$

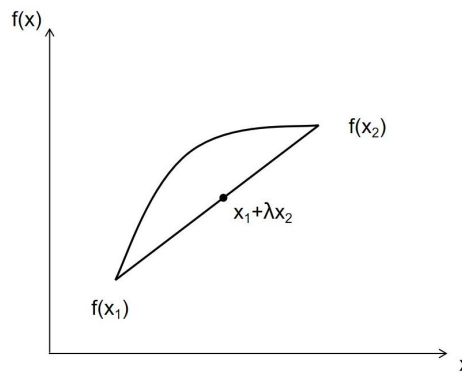


Figure 2-1 Production function curve of an individual product

Suppose there are two manufacturers, manufacturer 1 and manufacturer 2, using raw materials and producing goods $f_1(x)$ and $f_2(x)$ respectively, and the combined production function of the two manufacturers is $f(x)$. When the products of manufacturer 2 cannot be sold at a

certain time, the combined production function $f()$ of the two manufacturers suddenly falls down as shown in Appendix Figure 2-2. $x_1 + x_2$

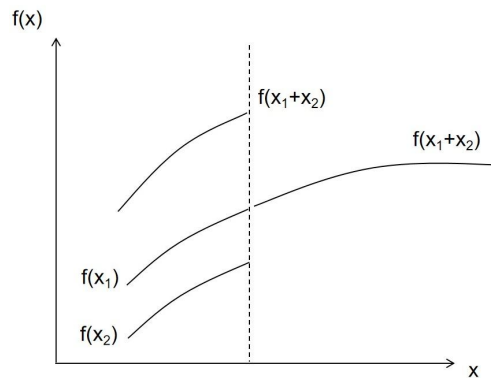


Figure 2-2 The production function curve of two products

$x_1 + x_2$ In this case, the combined production function $f()$ of the two manufacturers does not meet the convexity requirements. Expand the two manufacturers to n companies, and as long as one manufacturer cannot sell the product, the total production function curve of the product does not meet the requirements of convex subset. In this way, as long as the commodity production competition does not sell the product, the commodity production function curve does not meet the requirements of convex subset.

The following analysis of three typical commodity production competition model points out that the commodity production competition can not be sold.

The mathematical model of commodity production competition expresses an ideal state of competition for commodity production. There are many mathematical models of commodity production competition. Here we discuss three typical competition models of commodity production, price collusion, Guno competition and Bertrand competition. To estimate the realistic state of commodity production competition through these three typical ideal states of commodity production competition.

Price collusion commodity production mathematical model is collusion control production between manufacturers to maximize the profit of the manufacturer, bert land commodity production competition mathematical model is every manufacturer with the most likely to compete to get all market share, the old commodity production competition model to rival output for given conditions to seek their best production in order to maximize their profits. Next, we derive the best product sales and profit of N manufacturers in price collusion, Guo competition and Bertrand competition under certain ideal conditions.

(1) N manufacturers' price collusion mathematical model of the optimal price, optimal sales volume and optimal profit of each manufacturer.

The ideal assumes that the marginal unit cost of each manufacturer is a constant c , and the

demand function of the commodity is a linear function:

$$P = P_0 - \lambda Q \quad (2-2)$$

The price collusion production volume is the same for each manufacturer:

$$Q_1^* = Q_2^* = \dots = Q_n^* \quad (2-3)$$

The total collusion production is:

$$Q^* = nQ_1^* \quad (2-4)$$

The profit of the first manufacturer is:

$$\pi_1 = (P - c)Q_1 \quad (2-5)$$

Put formula (2-2) into formula (2-5) to:

$$\pi_1 = (P_0 - \lambda nQ_1 - c)Q_1 \quad (2-6)$$

Plot manufacturers according to the principle of profit maximization, so there is

$$\frac{\partial \pi}{\partial Q_1} = P_0 - 2\lambda nQ_1 - c = 0 \quad (2-7)$$

Solving the price collusion mathematical model, the optimal output of each manufacturer is:

$$Q_1^* = Q_2^* = \dots = Q_n^* = (P_0 - c) / 2n\lambda \quad (2-8)$$

The optimal price of the price collusion mathematical model with (2-8) in (2-2) is:

$$P^* = P_0 - \lambda nQ_1^* = (P_0 + c) / 2 \quad (2-9)$$

Therefore, the optimal profit of each manufacturer in the price collusion mathematical model is:

$$\pi_1^* = \pi_2^* = \dots = \pi_n^* = (P_0 - c)^2 / 4n\lambda \quad (2-10)$$

Price collusion commodity production model summary: in the ideal conditions of price collusion commodity production mathematical model, with the increase of the number of competitors n , each manufacturer's optimal sales and optimal profit will be inversely proportional to n , the specific formula for equation (2-8) and (2-10), namely each manufacturer only get the overall profit, and the overall profit (-) is fixed. $1/n P_0^2 c^2 / 4\lambda$

(2) N manufacturers compete to optimize the price, sales volume and profit of each manufacturer in the competitive commodity production model.

Ideal assumes that the marginal unit cost of each manufacturer is the same and constant c , and the demand function of the commodity is a linear function:

$$P = P_0 - \lambda Q \quad (2-11)$$

Let the production rate of each producer be respectively: Q_1, Q_2, \dots, Q_n

The total output is:

$$Q = Q_1 + Q_2 + \dots + Q_n \quad (2-12)$$

The profit equation for each manufacturer is respectively:

$$\pi_1 = (P - c_1)Q_1 \quad (2-13)$$

$$\pi_2 = (P - c_2)Q_2 \quad (2-14)$$

$$\dots$$

$$\pi_n = (P_0 - c)Q_n \quad (2-15)$$

Add (2-11), (2-12) (2-13), (2-14), (2-15)

The correlation function of profit and output for each manufacturer:

$$\pi_1 Q_1 Q_2 \dots Q_n = (P_0 - \lambda(Q_1 + Q_2 + \dots + Q_n) - c)Q_1$$

$$\pi_2 Q_1 Q_2 \dots Q_n = (P_0 - \lambda(Q_1 + Q_2 + \dots + Q_n) - c)Q_2$$

$$\dots$$

$$\pi_n Q_1 Q_2 \dots Q_n = (P_0 - \lambda(Q_1 + Q_2 + \dots + Q_n) - c)Q_n$$

Each manufacturer adjusts its production according to its own profit maximization principle, so there is

$$\frac{\partial \pi_1}{\partial Q_1} P_0 - c - \lambda(Q_1 + Q_2 + \dots + Q_n) = 0$$

$$\frac{\partial \pi_2}{\partial Q_2} P_0 - c - \lambda(Q_1 + 2Q_2 + \dots + Q_n) = 0$$

...

$$\frac{\partial \pi_n}{\partial Q_n} P_0 - c - \lambda(Q_1 + Q_2 + \dots + 2Q_n) = 0$$

The maximum output of each manufacturer is:

$$Q_1^* = Q_2^* = \dots = Q_n^* = P_0 - c / (n+1)\lambda \quad (2-16)$$

The best price for the guno competition is:

$$P^* = P_0 - \lambda n Q_1^* = P_0 - \lambda n \frac{P_0 - c}{(n+1)\lambda} = \frac{P_0 + cn}{n+1} \quad (2-17)$$

The best profit for each manufacturer is:

$$\pi_1 = \pi_2 = \dots = \pi_n = \pi_N = P^* Q_1^*$$

$$= (P_0 + cn)(P_0 - c) / (N + 1)^2 \lambda$$

$$= \frac{1}{n} (P_0 + cn)(P_0 - c) n / (N + 1)^2 \lambda \quad (2-18)$$

Summary of guno competitive commodity production model: In the guno competitive commodity production model of n manufacturers under the above ideal conditions, the optimized profit of each manufacturer decreases inversely proportional to the approximate n with the increase of manufacturer n, which is calculated as formula 2-19:

$$\lim_{n \rightarrow \infty} (P_0 + cn)(P_0 - c) n / (N + 1)^2 \lambda = (P_0 - c) / \lambda \quad (2-19)$$

$\frac{1}{n}$ When n is large enough, each vendor only obtains an approximately the overall profit that does not change with n. because $\lim_{n \rightarrow \infty} (P_0 + cn)(P_0 - c) n / (N + 1)^2 \lambda = (P_0 - c) / \lambda$

(3) The balanced price, balanced sales volume and balanced profit of the N manufacturers' Bertrand competitive commodity production model.

The Bertrand competition model is that each manufacturer competes with the most likely low

price to gain the total market share. Ideally, the marginal unit cost of N manufacturers is constant respectively:

$$c_1 \leq c_2 \dots \leq c_N \quad (2-20)$$

The demand function of the commodity is a linear function:

$$P = -P_0 \lambda Q \quad (2-21)$$

The equilibrium price of the market is the marginal cost of the second manufacturer:

$$P^* = c_2 \quad (2-22)$$

The production equation of the first manufacturer obtained by substituting the equation (attached 2-18) into the equation (attached 2-17) is:

$$c_2 = -P_0 \lambda Q_1^* \quad (2-23)$$

The best output of the first manufacturer is:

$$Q_1^* = (P_0 - c_2) / \lambda \quad (2-24)$$

The best profit for the first manufacturer is:

$$\pi_1 = (c_2 - c_1)(P_0 - c_2) / \lambda \quad (2-25)$$

Other manufacturers have zero output and zero profits.

Summary of competitive commodity production model: In the mathematical model of Bertrand competition of n manufacturers under the above ideal conditions, the manufacturer with the first lowest cost obtains the total market share, the balanced selling price of the market is the cost of the manufacturer with the second lowest cost, and the unit profit of the manufacturer with the first lowest cost is (-). In the Bertrand's competitive commodity production model, manufacturers with high production costs cannot sell their products. $c_2 c_2 c_1$

In price collusion and old competition mathematical model, when the manufacturer n is large, manufacturers must not meet $1/n$ overall profit and price in order to get more market share and profit, so the price collusion and the old competition manufacturers output and profit optimal solution is not stable, namely the price collusion and the old competition two commodity production model cannot maintain for a long time, eventually the two commodity production competition model will berland competition.

But the Bertrand competitive equilibrium is also an ideal situation. The real competition of commodity production does not appear the ideal state of Bertrand competition equilibrium, but the mixed state of Guo competition and Bertrand competition. As for what kind of mixed state is determined by the comprehensive situation of the specific goods. However, one thing is certain: the manufacturers with weak competitiveness will not sell their products, that is, the production function curve of the product will not meet the requirements of convex subset, and can not realize the optimization of competitive equilibrium.

In the physical sense, the competition of commodity production in the market economy is a survival of the fittest mechanism, and it is inevitable that the products with weak competitiveness

cannot be sold out, and it is impossible to realize the competitive equilibrium of Pareto optimization.

Considering the above, this appendix considers that the competition in commodity production cannot achieve Pareto optimization.

This appendix also has an important conclusion on the commodity production competition analysis: social demand determines social output.