Research on the Relationship between Virtual Economy and Real Economy Development in China

YU Shang 1

1Major of Economics, College of Social Sciences and Humanities, Northeastern University, Boston, USA, 02115

Abstract: The development scale and degree of virtual economy should be adapted to the development level of real economy, and maintaining a moderate development proportion relationship between the two is the key to promoting sound and rapid economic development. Based on the perspective of economic development and the logistic model in population ecology, this paper constructs a regional virtual economy and real economy development model on the basis of the relationship between virtual economy and real economy development, studies the equilibrium and stability of the coordinated development of the two, and empirically studies the coordinated development ratio of virtual economy and real economy in China using the relevant data of the development of virtual economy and real economy from 1996 to 2008. The coordinated development relationship between virtual economy and real economy can reflect the evolution trend of economy. The coordinated development ratio can play a certain early warning role for the excessive expansion of virtual economy, and effective monetary and fiscal policies can be formulated according to the relationship between the actual ratio and the reasonable development ratio.

1. Introduction

Correctly handling the relationship between virtual economy and real economy, promoting the coordinated development of virtual economy and real economy, and effectively giving full play to the healthy development of virtual economy and promoting the growth of real economy are of great significance to maintaining the stable, sustained and rapid development of national economy [1]. Based on this idea, this paper has carried out relevant research on promoting the coordinated development of China's virtual economy and real economy. On the basis of defining the research category of virtual economy in narrow sense, this paper mainly analyzes the development of financial market and the relationship between the virtual part of real estate market and real economy [2].

The real economy is the foundation of the emergence and development of virtual economy, which has a negative effect on the real economy. Through the theoretical analysis of the transmission mechanism of virtual economy to real economy and its coordinated development mechanism with real economy, it is believed that the coordinated development of virtual economy and real economy is conducive to playing the role of "booster" of virtual economy to real economy development [3]. The excessive expansion of the virtual economy will easily lead to the accumulation of economic bubbles when it deviates from the real economy, and may lead to bubble economy, and the bursting of bubbles can lead to financial crisis and economic crisis. At the same time, it is believed that there is an internal coordination mechanism between the development of virtual economy and real economy and a recovery mechanism that deviates from the coordination state.

Based on the theoretical analysis of the mechanism of virtual economy and the mechanism of coordinated development between virtual economy and real economy, this paper makes an empirical
analysis of the coordination between virtual economy and real economy in China [4]. By analyzing the impact of China's virtual economy development on the real economy, it is concluded that the changes in the capital market and financial derivatives market composed of stock market, bond market and fund market have a relatively strong long-term effect on the overall development of the real economy, the impact of the development of the stock market on the social wealth effect gradually increases in the virtual economy system, and the expansion of loan scale and stock market scale has a significant impact on the expansion effect of real economy investment in the short and long term.

In recent years, with the further deepening of the virtualization of the global economy, various financial derivatives and innovative products have emerged and the scale of virtual assets has expanded rapidly. According to a series of relevant data published by the Bank for International Settlements, the total annual turnover of foreign exchange funds and financial derivatives worldwide reached about 3259 trillion US dollars in 2007, which is about 67 times the world's GDP in 2006. The global financial crisis caused by the U.S. subprime mortgage crisis in 2007 has not yet been completely eliminated, mainly due to the over-development of financial derivatives [5]. U.S. housing mortgage interest rates continue to rise and the real estate market continues to cool down, causing the capital chain to break down, eventually causing the real estate bubble to burst, thus causing the recession of the whole real economy. Looking at the history of world economic development, we can see that the frequent outbreak of financial crisis is always closely related to the excessive development of virtual economy. The important inspiration brought about by this financial crisis is to prevent the harm caused by the excessive development of virtual economy and reasonably maintain the harmonious development relationship between virtual economy and real economy [6]. At present, China's virtual economy is also in a period of high-speed development. Generally speaking, although the development degree and scale of China's virtual economy still have a certain gap compared with those of developed countries, it has already brought great and profound influence on various aspects of China's economic and social development.

There is a close relationship between the real economy and the virtual economy. Numerous facts also prove that the virtual economy is a double-edged sword, which has both positive and negative effects on the real economy. On the one hand, the virtual economy is rooted in the real economy, relies on the fertile soil provided by the real economy, is based on the development of the real economy, and serves the real economy [7]. On the other hand, the bad development of virtual economy will hinder its own healthy development and also inhibit the healthy development of entities. When the supply scale of the virtual economy matches the development demand of the real economy, the virtual economy can provide a wider financing channel for the development of the real economy, well transfer the risks of market operation, reasonably promote the optimal allocation of resources, and reduce the cost of the development of the real economy, so as to effectively guarantee the healthy development of the real economy and in turn further promote the development of the virtual economy. However, when the development of the virtual economy shows excessive expansion, there may be economic bubbles. Therefore, the development scale and degree of virtual economy should be adapted to the development level of real economy, and maintaining a moderate development proportion relationship between the two is the key to promote a country's sustained, healthy and stable economic development.

Based on the aforementioned research background, on the basis of existing research results, analyzes the development of China's main virtual economy market in recent years, discusses the relationship between the development of China's virtual economy and the real economy, focuses on the coordinated development of China's virtual economy and the real economy, explores the coordinated development ratio between China's virtual economy and the real economy, and hopes to provide decision-making reference for relevant departments in formulating targeted monetary and fiscal policies, as well as some reference for relevant virtual economy research.
2. Analysis of the Relationship between Virtual Economy and Real Economy in China

2.1. Stationary Analysis

Unit root test is a common basic method to study the stability of time series of economic and financial variables, and it is also the basic work of cointegration test and Granger causality test among variables. Because of the complexity and variability of variables in real economy, most of the time series of economic variables are nonstationary. Therefore, directly using the level value of economic variables to study the equilibrium relationship between economic phenomena is usually easy to lead to errors. Therefore, it is necessary to test the stability of economic variables before building the model. The unit root test methods mainly include DF test proposed by Dickey and Fuller (1979), ADF test (extended DF test) and PP test proposed by Phillips and Person (1988).

The following uses the commonly used ADF test method to analyze the stability of the time series of China's virtual economy and real economy. The ADF unit root method is used to test the stability of time series, that is, to test the mathematical model.

\[ X_t = \alpha + \rho X_{t-1} + \sum_{i=1}^d \beta_i \Delta X_{t-i} + \epsilon_t \]  

Using Eviews 5.0 software to test the ADF unit root of the time series data of the virtual economy stock, from the trend of the original series, the constant and trend items should be selected, and the lag items should be determined by SC HWART formula, and the test results are shown in Table 1 below.

| Variable | ADF-Value | P-Value | 1% Significant Level | 5% Significant Level | 10% Significant Level |
|----------|-----------|---------|----------------------|----------------------|-----------------------|
| \( f \)  | 14.758    | 1.000   | -3.788               | -3.012               | -2.646                |

From the above test results, it can be seen that the ADF value of the original time series is 14.75819, regardless of the confidence level of 1%, 5% or 10%, the ADF value is far greater than its corresponding critical value, and the corresponding probability value \( p \) is equal to 1.0000. Therefore, at the test level of 1%, 5% or 10%, we should accept the original assumption that there is a unit root in the time series of China's virtual economy stock between 1981 and 2008, that is, the time series of China's virtual economy stock is non-stationary. In order to further determine whether the time series is a single integer, the unit root test is performed on its first order difference sequence and the first order difference sequence is \( \Delta f \), and the test results are shown in Table 2.

| No cointegration hypothesis | Eigenvalues | Likelihood ratio | 5% threshold | P-Value |
|-----------------------------|-------------|------------------|--------------|--------|
| \( f \)                     | 14.758      | 1.000            | -3.788       | -3.012 |

2.2. Cointegration Test

Cointegration analysis is a statistical description of the long-term equilibrium relationship between non-stationary economic variables. It is a common econometric method to find out whether there is a long-term equilibrium relationship between variables by testing whether there is a stable linear combination relationship between non-stationary variables. This equilibrium relationship means that there is no internal mechanism to destroy equilibrium in the economic system. If some economic indicators are linked by some economic systems, they will be affected by common factors and have a consistent trend for a long time. Although these variables may deviate from the long-term equilibrium point in the short term due to seasonal factors or random interference, the internal equilibrium mechanism will be adjusted in the next period to restore it to equilibrium. The commonly used cointegration test methods mainly include the Engle-Granger test of two variables and the test of multivariate cointegration (Johansen test).
Before the cointegration test, the lag term of the cointegration test needs to be determined first. If the two statistical values reach the minimum value for different lag terms, the following likelihood ratio function (LR) is required to determine the optimal lag term of the model.

$$LR = -2\left(L_p - L_q\right)$$

Where the $L_p$ is log-likelihood function value of the whole model when the lag term is $p$ and $L_q$ is the log-likelihood function value of the whole model when the lag term is $q$ are represented. Under the original assumption that the lag term is $p$, the statistic has a $\chi^2$ asymptotic distribution, and the degree of freedom is the number of zero constraints imposed on model parameters from VAR(P) to VAR(Q). If the calculated adjoint probability is less than 0.05, the original hypothesis is rejected and the alternative hypothesis is accepted; if it is greater than 0.05, the opposite is true. According to the above method, the lag order is determined to be 2, that is, the lag is selected to test the cointegration relationship between the virtual economy and the real economy in China. Considering the trend of virtual economy and real economy, the deterministic trend of observation sequence is selected here and the cointegration equation (CE) has only intercept. At this time, the cointegration test results obtained according to the maximum characteristic root test method are shown in Table 3.

| No cointegration hypothesis | Eigenvalues | Likelihood ratio | 5% threshold | P-Value |
|-----------------------------|-------------|------------------|--------------|---------|
| None                        | 0.614       | 23.824           | 14.264       | 0.001   |
| At most 1                   | 0.057       | 1.466            | 3.841        | 0.226   |

3. Empirical Study on Coordinated Development of Virtual Economy and Real Economy in China

Since there is no relevant statistical data on virtual economy and real economy in our country so far, in order to quantitatively analyze the development relationship between virtual economy and real economy in our country, this paper takes industrial added value as an index to measure the development scale of the real economy, similar to the above and considering the availability of data. The sum of stock market value, bond balance and fund net value is the representative variable of the virtual economy. This paper selects the data from 1996 to 2008 to study the development relationship between the virtual economy and the real economy in China. The relevant data are from China Statistical Yearbook and China Securities and Futures Statistical Yearbook from 1997 to 2009. The growth equation of virtual economy in equation:

$$f(t) = \frac{M \beta}{1 + \left(\frac{M \beta}{f_0} - 1\right) e^{-\beta \alpha}}$$

Where $\beta = 1 + \lambda r$, and then $f(t)$ can be transformed into the logistic curve form:

$$f(t) = \frac{K}{1 + Ce^{-\sigma \alpha}}$$

Where $K = M \beta$, $C = K f_0$, $\sigma = \beta \alpha$, and Eq.(4) can be transformed into the final form:

$$\ln \left(\frac{K - f(t)}{f(t)}\right) = c - \sigma \alpha$$

According to the relationship model between virtual economy and real economy development and its derivation formula, the relevant parameters of the model are estimated by SPSS software, and the estimated results of the parameters of the virtual economy and real economy model are shown in Table 4.
As can be seen from Table 4, the development equations of virtual economy and real economy are well fitted, and the T test of parameters is significant, with $R^2=0.917$ for virtual economy and $R^2=0.975$ for real economy. Therefore, the final development equations of China’s virtual economy and real economy are as follows:

Real Economy:

$$f(t) = \frac{1092859}{1+53.89e^{-0.236t}}$$  \hspace{1cm} (6)

Virtual Economy:

$$f(t) = \frac{426042}{1+15.99e^{-0.145t}}$$  \hspace{1cm} (7)

According to equations (6) and (7), the trajectory of changes in China’s virtual economy and real economy from 1996 to 2008 and the forecast of its future development trend are shown in Fig. 1 and Fig. 2, respectively.

![Fig.1 China's virtual economy trends](image1)

![Fig.2 China's Real economy trends](image2)
As can be seen from Figure 1 and Figure 2, the real economic growth model can better simulate its evolution trend. The virtual economic model has a large gap between the simulated value and the actual value in 2007, which is due to the excessive expansion of China's stock market in 2007, leading to a large deviation. On the whole, the model can basically simulate the evolution trend of economy.

Compared with the balanced development of the virtual economy, the actual virtual economy was basically consistent with the equilibrium value from 1996 to 2002, which was lower than the average value from 2003 to 2006, that is, the virtual economy was relatively insufficient, but the actual virtual economy was much higher than the equilibrium value in 2007, the virtual economy expanded excessively, and then was suppressed in 2008 and returned to the equilibrium path. Relatively speaking, the actual value of China's virtual economy from 1996 to 2008 is basically consistent with the equilibrium value, with only a small deviation in a few years and generally in a coordinated development path.

Only when the virtual economy maintains a reasonable proportion with the real economy can it better promote sustained and rapid economic growth. Too high or too low a virtual economy is not conducive to the development of the real economy. Therefore, this paper believes that when both virtual economy and real economy grow according to Logistic model, the proportion of the two is the coordinated development ratio, assuming the coordination between virtual economy and real economy.

If the development ratio is k, the change of the coordinated development ratio k between the virtual economy and the real economy in China and the actual ratio value between 1996 and 2008 can be obtained from the above equation as shown in Fig. 3.

![Fig.3 The proportion of coordinated development of China's virtual economy and real economy and the trend of actual proportion](image)

As can be seen from Figure 3, from a certain point in time, the coordinated development ratio K is dynamically changing and varies according to the time and conditions. With the change of time, the value of K first rose to the highest point and then decreased, then stabilized and finally stabilized at about 2.56. From the comparison of the actual and balanced ratio between China and the real economy between 1996 and 2008, it can be seen that the ratio of virtual economy and real economy in China mostly deviated from the coordinated development ratio, showing the characteristic of deviating from the relationship, and only exceeded the reasonable development ratio in 2000 and 2007, the deviation was the largest in 2007, the rest was lower than the coordinated development ratio, and the deviation was the largest in 2005.

The change equation of coordinated development ratio can effectively get the proportional relationship between virtual economy and real economy, and can play a certain role in warning the development degree of virtual economy by setting reasonable fluctuation upper and lower limits. When the actual proportion exceeds the upper limit of the coordinated development proportion, tight monetary policy can be adopted to curb the excessive expansion of the virtual economic market and prevent the bubble from bursting. When it is lower than the lower limit of coordinated development...
ratio, loose monetary policy should be implemented to promote the development of virtual economy. Therefore, effective monetary and fiscal policies can be formulated by judging the relationship between the actual ratio and the coordinated development ratio.

However, the reasonable development ratio between the virtual economy and the real economy is affected by various environmental resources such as technology, information and national policies. When the resource environment changes, the evolution trajectory of the virtual economy and the real economy will also change accordingly, showing a piecewise logistic development model. Therefore, the coordinated development ratio is also changing at all times, not unchanging, but also showing the characteristics of segmentation.

Through the empirical analysis of the model of the relationship between virtual economy and real economy development in China, it can be seen that the relationship between virtual economy and real economy in China was in an unbalanced state most of the time from 1996 to 2008, reflecting the deviation between virtual economy and real economy, but most of them were in a relatively normal fluctuation range, exceeding the upper limit of the standard deviation of the coordinated development ratio only in 2007, mainly due to the excessive expansion of the stock market in that year. The proportion of coordinated development between virtual economy and real economy is not static, but varies according to the time and conditions. It is a dynamic change. From a certain point of time, under certain conditions, the proportion of coordinated development first rises, then falls, and then tends to be stable. Coordinated development ratio can play a certain role in early warning the excessive expansion of virtual economy, and effective monetary and fiscal policies can be formulated according to the relationship between actual ratio and coordinated development ratio.

4. Conclusion

Based on the existing research results of virtual economy, this paper analyzes the development of virtual economy in China, quantitatively studies the development relationship between virtual economy and real economy in China through econometric methods and the construction of development relationship model, and obtains the coordinated development ratio. The main conclusions are as follows. The development of virtual economy and real economy presents a multi-stage, dynamic and multi-parameter compound logistic model evolution trend. Under the mutually beneficial development conditions, there is a stable relationship between the coordinated development of virtual economy and real economy in China. The reasonable and coordinated development ratio between virtual economy and real economy is not static, but varies with different periods and conditions, and it is a dynamic change. From a certain point in time, under certain conditions, the proportion of coordinated development first increased, then decreased, and then stabilized. Coordinated development ratio can play a certain role in early warning the excessive expansion of virtual economy, and effective monetary and fiscal policies can be formulated according to the relationship between actual ratio and coordinated development ratio.

References

[1] Liu H, Jia T, Yuan C, et al. Research on irrational bubbles in the stock market based on the perspective of generalized virtual economy[J]. Kybernetes, 2012, 41(7/8):897-907.
[2] Ge R, Zhang L, Ma X. Research on the relationship between air quality and economy development in major cities of China[J]. Kybernetes, 2014, 43(8):333-361.
[3] Lehdonvirta V. Converting the Virtual Economy into Development Potential: Knowledge Map of the Virtual Economy[J]. Academic Emergency Medicine, 2011, 20(1):108–111.
[4] Zhang J, Deng S, Shen F, et al. Modeling the relationship between energy consumption and economy development in China[J]. Energy, 2011, 36(7):4227-4234.
[5] Zhu Q, Geng Y, Lai K. Environmental Supply Chain Cooperation and Its Effect on the Circular Economy Practice-Performance Relationship Among Chinese Manufacturers[J]. Journal of Industrial Ecology, 2011, 15(3):405-419.
[6] Wang M J, Luan W X, Zhang X X, et al. Analysis on areal relationship between regional environment and socioeconomy—taking the Chinese Yellow Sea coastal zone as a case[J]. Journal of Geographical Sciences, 2000(4):94-102.

[7] Choudhury M A, M. Ishaq Bhatti. Quantitative modeling of mathematical relationships in money, spending and the real economy: An evolutionary learning ethical view[J]. Kybernetes, 2015, 45(2):323-336.