

Input-Output Analysis of the Influential Effect of Chinese Financial Development to Economic Growth

Guo JuE , Li Qi, Xing Gong Qi

School of Management and School of Economics and Finance in Xi'an Jiaotong University, Xi'an, 710049

ABSTRACT *This paper has measured and calculated the forward effect and backward effect of the financial development on the basis of the data and basic principles of the Financial Input-Occupancy-Output Tables. It draws a conclusion that the directive effect of the financial development is weaker and demand following function is stronger step by step from 1997 to 2001, and gets the shadow prices of the financial assets occupancy and financing usage by setting up and solving linear programming model. This paper also puts forward some strategies and suggestions for using the financial assets logically and optimizing the resource allocation. .*

KEYWORDS: *Financial Input-Occupancy-Output Table ; forward effect ; backward effect ; shadow price*

1. Introduction

With China's entry to WTO, more and more foreign banks carry out credit transaction in China by using RMB according to international routines. Many insurance companies operate all kind of insurance businesses in China. Other non-banking financial institutions carry out financing and investment operations in China and input energy into our underdeveloped financial market, which impose huge impact on the management of Chinese financial and insurance institutions. It is urgent to establish an effective measurement system to scientifically estimate the influence of the financial development to economic growth. This paper aims to measure the influential effect of the financial sector to national economy in China and shadow price of the financial assets occupancy and financing usage in order to provide theoretical foundation t for financial regulation decision-making on the basis of 43-sector Financial Input-Occupancy-Output Tables sector of 1997, 2000 and 2001 in China.

Joseph Schumpeter studied on the mutual relationship between the financial development and economic growth in *economic development theory* published in 1911. Hugh T. Patrick analyzed the causality between economic growth and financial development through the financial concepts (such as Demand-Following and Supply-Leading)(Patrick , 1966). Goldsmith sheds light on the relationship between the economic and financial development by analyzing the time series data of thirty-five countries(Goldsmith , 1969). The result shows the economic development

Fund project: The project is supported by National Science Foundation of China (70273067 ; 7012001)

Guo Ju'e (1961-), Management School in Xi'an Jiao Tong University, 28 Xian Ning West Road, Xi'an, Shaanxi Provinces, P.R.China, female, Ph.D advisor, Professor, Major in Input-Output and financial management research, E-mail: guojue@mail.xjtu.edu.cn.

period usually follows fast financial development. But he cannot explain what is the causality between them. McKinnon's *Money and Capital in Economic Development* and Shaw's *Financial Deepening in Economic Development* (McKinnon, 1973) has formed the financial development theory. Its contribution lies in founding the theoretical analyzing model of the relationship between the finance and economy. The economists, such as Kapur, Mathieson, Galbis and Fry, built the logical and normative financial restraining models on the basis of the former models made by McKinnon and Shaw, and then developed the former financial development modes. Ross Levine controlled the other factors influencing economic growth systemically and found the new guidelines to measure the financial development level. He points out that there is the positive correlative relationship between the financial development and economic growth in the statistical sense (Levine, 1993). Stock market has been brought into analysis range in some recent research work (Levine and Zervos, 1998); (Rajan and Zingales, 1998); (Arestis et al., 2001). Some conclusions show stock market benefits the economic growth and others show its function is limited because of different guidelines and research methods. Merton and Levine analyzed the basic functions of the financial system and pointed out that mobilizing savings, resource allocation, company controlled by the supervisors, risk management, commodity and service dealing were the basic functions of the financial system. The functions can contribute to the economic growth through capital accumulation and technological progress (Merton, 1995); (Levine, 1997). Whether the mutual relationship between the financial development and economic growth accords to the Demand-Following or Supply-Leading assumption would be certified by the Granger causality test. All sort of conclusions have occurred and there was no definite conclusion about the causality between the economic and financial development.

The economists in China paid attention to the causality between the economic and financial development before 1990s and focused only on the level of macro qualitative analysis. After 1990s, the main research methods are to analyze the relationship between the financial development and economic growth through the statistical and econometric techniques from the aspect of financial structure. Tan RuYong believes that the development of bank has contributed to the economic growth in China (Tan, 1999). But development of stock market has some weak effect on the economic growth at most. Li Guang Zhong got a conclusion that development of the bank sector has inconspicuous effect on our economic growth and development of stock market has no effect on it after comparing different guidelines to measure the financial development level and economic growth with the empirical results of Tan Ru Yong (Li, 2002). Lin Yi Fu found only if financial structure matches the scale and structure of manufacturing or a higher bank centrality exists, it can satisfy the financing demand of the enterprises and contributes to the increase of manufacturing (Lin, 2003). Shi Xiang Dong and Wu Zhi thought there was a high correlativity between the financial development and economic growth, and this correlativity should be the mutual causality. In a word (Shi and Wu, 2003), the research techniques for studying the relationship between the financial development and economic growth are always empirical analysis methods, which derive from the

relevant research abroad or its transfiguration or improvement. The relevant theoretical research is very little. Although there are a lot of examples of the developing countries in the foreign empirical research, which are supported by the theoretical model after selecting relevant empirical analysis method, there are no empirical research result about Chinese data in public. Therefore, it remains a puzzle whether the empirical analysis method in the foreign financial development theory fits our country's condition before analyzing the economic growth mechanism of financial development's effect on the economic growth in China. What's more, there is no new breakthrough in the analysis techniques. This paper tried to utilize the new original research techniques to disclose the relationship between the financial development and economic growth through a lot of detailed information and the data in "43-sector Financial Input-Occupancy(financing) -Output Table in 2001" during the process of completing the project funded by national natural science foundation named "The interactive effect analysis of Financial Input-Occupancy-Output" in 2003. It also expects to bridge the gap between the existing techniques by using input-output analysis tools.

2. The mutual effect between financial development and economic growth

2.1 Brief Overview of the Financial Input-Occupancy-Output Model

Input-Output Table was originated by Nobel laureate, Wassily W.Leontief in 1973. It reflects the mutual quantitative relationship between the products input and output of all sectors in the national economy by using the balance sheet in the form of chessboard. Chen Xi Kang, the researcher in Chinese Academy of Sciences, found that the occupancy of the ground has great effect on the product of cropper and pointed out Input-Occupancy-Output techniques and the relationship between the output, occupancy and input. He also gave the methods to measure the total waste coefficients in the view of occupancy. But the technique only reflects the usage and consumption of all kinds of products in the economic system, occupancy circumstance of the work force and fixed assets. It cannot reflect the settlement for supporting the products flow, the destination of the fund and the allocation of the financial assets stock in national economy(Chen,1993). This paper affiliated the financial assets financing into the Financial Input-Occupancy-Output Table and works out 43-sector Financial Input-Occupancy(financing) -Output Table in 2001. It not only divides the financial sectors into four parts, such as banking, securities, insurance and other sectors but also supplies the loan financing item (the loan balance of each sector at the end of 2001), stock financing item (stock financing amounts at the end of 2001) and bond financing item (bond issuing amounts of each sector) from the financial market below the occupancy part into the Financial Input-Occupancy(financing) -Output Table . It reflects the financing conditions in the financial market of each sector in national economy and gives the structure and methods of Financial Input-Occupancy-Output Table , which includes the financial assets occupancy and financing usage. This can certify the realization ways and its concrete effect to the financial function from the angle of the resource allocation. It also provides a new

technical way to analyze the mutual relationship between the financial development and economic growth.

Financial Input-Occupancy(financing)-Output Table is made according to product sectors. But each financial industry does not simply equal to each kind of financial institution. Such as bond underwriting undertaken by banks belongs to the business of the securities sector. The production value of the service should be deducted from banking to securities sector, which can assure the relevant data of bank to represent bank-service value, such as deposit and loan business in the bank. Financial system structure has the changeability. Diversification and crossed-recombination of the financial products gradually lead to the complexity of the financial structure and the cross over of the financial functions. Financial Input-Occupancy(financing)-Output Table breaks the boundaries of the financial institutions and facilitates all kinds of financial services totally. The existing empirical work about the relationship between finance and economy focuses on the bank medium and economic growth, stock market and economic growth, bank medium, stock market and economic growth, financial development and enterprise financing strategy. The above techniques cannot explain what kind of financing structure can satisfy demand of the economic development. In order to measure the relationship between the finance and economic growth, the total information of banks, stock market, insurance market and bond market should be valued at the same time for certifying the functional effect of the different parts in the financial system. Financial Input-Occupancy(financing) -Output Table takes the financial development as the increase of the output of the financial institutions. The factual measurement of the relationship between finance and economy is as follows:

Table 1. The structure of Financial Input-Occupancy(financing) -Output Table

| Output Input | | | Intermediate use | | | Final demand | Total output |
|--------------------|-------------------|--|------------------|-------------------|-------------------------|--------------|--------------|
| | | | Non-Fin sectors | Financial sectors | Sum of intermediate use | | |
| | | | 1 ... 39 | 40...43 | | | |
| Intermediate input | Non-Fin sectors | 1 ... 39 | X_{ij} | T_{ij} | | Y_i | X_i |
| | Financial sectors | 40. Banking 41. Security 42. Other Fin Sector 43. Insurance | U_{ij} | W_{ij} | | Y_i^w | X_i^w |
| Value added | | | V_j | V_j^w | | | |
| Total input | | | X_j | X_j^w | | | |

| | | | | |
|-----------|-----------------------------|-------------------------------------|----------|------------|
| | Fixed Assets (net amount) | | g_j | g_j^w |
| Occupancy | Current Assets | Currency fund | l_{ij} | l_{ij}^w |
| | | Net amount Of Short-term investment | | |
| | | Net stock | | |
| | | Account receivable and other | | |
| Financing | Financial assets | | z_{ij} | z_{ij}^w |

Table 1 note: X_{ij} represents the quantity that non-financial sectors provide themselves with the products or service for middle usage; T_{ij} represents the quantity that non-financial sectors provide the financial sectors with the products or service for middle usage; U_{ij} represents the value that the financial sectors provide non-financial sectors with financial service. Banking provides the deposit and loan service and some intermediate business. Securities sector provides the investment dealing service of stock, bonds, futures and other securities. Insurance provides the insurance service, Trusteeship, financial management and financing-leasehold, etc. W_{ij} represents the quantity that financial sectors provide themselves with the products or service for middle-usage; this can show the relationship between input and output among the four financial sectors, such as deposit-loan business among banks, deposit-loan business made by the banking to non-bank finance, self-support business of the security companies, service accepted by the banks or trustee companies when dealing with the securities, etc.

2.2 The Forward Effect of the Financial Development

The product or service of other sectors should be consumed when some sectors provides other sectors with the product or service in Input-Output Table. Increasing effect of the total output and GDP in national economy caused by the financial products satisfying the demand of other sectors should be measured in a big way. It is called the forward effect. The forward effect of the financial sectors means the increase of the output of the financial sector will lead to the input to other sectors, which can increase the total output of national economy and GDP.. Its measuring formula is:

$$\text{Total output: } \Delta X = \Delta Y \cdot (I - H)^{-1}$$

$$\text{GDP: } \Delta G = \Delta Y \cdot (I - H)^{-1}V$$

Here, H is the distributive coefficient matrix. ΔY represents the row vectors of the final products of each investing sectors. V represents the diagonal matrix that is made of increasing value rates. Its elements on the main diagonal represent the ratio of

increasing value of each sector divided by total output. We measure the forward effect of the increasing value of the output in banking, securities sectors and insurance sectors in financial sectors on the total output of national economy and GDP on the basis of the data in the 43-sector Financial Input-Output Table of 1997, 2000 and 2001. The detailed measuring result is as follows:

Table 2. Forward effect of the increasing value of the output in financial sectors to the total output of national economy and GDP

| | | Unit: 100 million Yuan | | |
|--------------------------------|-----------|------------------------|--------|--------|
| | | 1997 | 2000 | 2001 |
| Increase of total output | Banking | 2.9967 | 3.0480 | 3.1153 |
| | Security | 3.0695 | 3.1081 | 3.0435 |
| | Insurance | 3.5774 | 3.7108 | 3.8964 |
| Increase of GDP | Banking | 1.4005 | 1.5241 | 1.5164 |
| | Security | 1.2383 | 1.3335 | 1.4617 |
| | Insurance | 1.4399 | 1.5363 | 1.5297 |

From table 2, we find the forward effect leading to economic growth of the each financial sector to the non-financial sector became obviously stronger since 1997. Although there is the difference between the absolute growth value of GDP brought by the forward effect of financial s per hundred million Yuan and the biggest forward effect of the industrial sector, it is on a higher level than that of the third industry. The forward effect of the banking and insurance sectors to the total output are increasing by degrees from the view of the actual circumstance of each financial sector. Shrinking of the stock market leads to the stagnation and the lower forward effect to the total output in 2001. But the forward effect of the securities to the GDP is not decreased. It is increased from 1.3335 in 2000 to 1.4617 in 2001. The forward effect of banking and insurance sectors to GDP is faint in 2001. The author believes that the reason must be the advance of the increasing value rate of the industries sensitive to the input of securities in 2001. The decreasing of the forward effect of other sectors to GDP cannot counteract the increase of the above industries, which lead to the decrease of the forward effect on the total output and increase of the forward effect to GDP.

2.3 The Backward Effect of the Financial Development

The backward effect of the investment of the financial sectors means that increase of investment leads to the demand in productions of other sectors, and then leads to the increase of the total output, GDP, work force and so on in the economy. This paper analyzes the backward effect of the output of the financial input to the increasing value of the national economy through Input-Output partial close model.

Its measuring formula of the backward effect of GDP is:

$$\Delta GDP = \Delta Y \cdot (I - A^*)^{-1} \cdot V$$

In which, ΔY represents the row vectors of the final production of each sector for investment, V represents diagonal matrix that is made of increasing value rates. I is the unit matrix. A^* is the direct consuming coefficient in the partial close model. Its measuring result is as Table 3.

The partial close model considers resident as a sector and includes it in quadrant. The lines of resident sector are the working reward in the monetary form. The lines of the resident sector are the consuming amount of all kinds of consumable and service. Therefore, we get the direct consuming coefficient matrix A^* :

$$A^* = \left(\begin{array}{cccc|c} a_{11} & \cdots & a_{1n} & & a_{1,n+1} \\ \cdots & \cdots & \cdots & & \cdots \\ a_{n1} & \cdots & a_{nn} & & a_{n,n+1} \\ - & - & - & - & - \\ a_{n+1,1} & \cdots & a_{n+1,n} & & a_{n+1,n+1} \end{array} \right) = \begin{pmatrix} A & H_c \\ H_r & h \end{pmatrix}$$

Here, H_r is the row vector of the labor reward coefficient of each sector. H_c is the row vector of the direct consuming coefficient of the production and service of each sector used by the resident. h is the payment coefficient of the Household sectors used by itself.

We can measure the extending complete needed coefficient matrix $(I-A^*)^{-1}$ on the basis of extending matrix A^* . It represents not only all kinds of direct or indirect demand brought by mid-input but also the direct and indirect demand for the output of each sector brought by the increasing of the residential labor reward and residential consuming demand. We can adopt the partial close model in order to represent the direct and indirect influence brought by the increasing of the residential income and enlarging the consumption as analyzing the backward effect of the financial investment. It is also an important factor to show the development of the financial sectors themselves and the mutual relationship between the financial sectors and other sectors.

Table 3. Backward effect of the investment of each financial sector to GDP in the partial close model

| | Unit: 100 million Yuan | | |
|------------|------------------------|----------|----------|
| | 1997 | 2000 | 2001 |
| Banking | 1.822416 | 1.806868 | 1.742515 |
| Security | 1.628914 | 1.369363 | 1.502077 |
| Insurance | 1.927482 | 1.687264 | 1.772587 |
| Other Fin. | 1.952307 | 2.086729 | 1.700974 |

From table 3, we can find the backward effect of financial sectors take on the depressive trend, which shows the different characters from the forward effect data. We can get a conclusion that supply-leading function is weaker and weaker with the stable growth of our economy since 1997, which is because backward effect is the

supply-leading function of economy provided by the increase of the output of the financial sectors to other sectors. There exist different academic meanings from the demand satisfying function represents by the forward effect. Patrickpointed out that supply-leading finance can contribute to the investment aiming at innovation before the sustaining development of the real economy. It can decrease the function of the supply-leading finance through economic growth and gradually boost the importance of the demand-leading finance until economy was led by demand- tracing finance(Patrick,1966). This paper has validated this viewpoint by the empirical test results of input-output technique.

3. The Shadow Price of the Financial Assets

Shadow price has another name called optimization planning price or efficiency price. It means the marginal contribution or marginal utility of the unit resource to the social target under the condition of the optimization distribution and rational use of the limited resource. Shadow price means the quantitative value of effect change when increasing or decreasing one unit resource or production under the condition of the limited resource or production. That is to say, shadow price is some kind of price evaluation as the resource achieves the maximum profit. But the evaluation is the special price aiming at the concrete problem. Its amount represents the scarce extent of certain resource (marginal measurement). The use of financial assets and the complicated relationship between input and output of each sector in national economy should be put into a linear programming model when measuring the shadow price of the financial assets. This paper supposes the input-output technique coefficient, financial assets occupancy and financing conditions (They are represented by occupancy coefficient and financing usage coefficient in the Input-Output Table), employment coefficient and capital coefficient are all unchanged in each linear programming. We established the linear programming model of Financial Input-Occupancy-Output in all kinds of economic movements under the condition of other resource is abundant except for the middle-input and financial asset resource of other sectors. In order to reduce the interference of the non-financial factors to the linear programming model of Financial Input-Occupancy-Output, we compounded each sector in all industries and set up the linear programming model with 19 sectors:

$$\text{Object Function: } \text{Max } z = \sum_{j=1}^{19} a_{vj} X_j \quad (j = 1, 2, \dots, 19) \quad (1)$$

Subjected to:

$$AX + Y \leq X \quad (2)$$

$$X^l \leq X \leq X^h \quad (3)$$

$$\sum_{j=1}^{19} G_j X_j \leq \sum_{j=1}^{19} g_j \quad (4)$$

$$\sum_{j=1}^{19} l_{ij} X_j \leq L_i \quad (i = 1, 2, 3, 4) \quad (5)$$

$$\sum_{j=1}^{19} z_{ij} X_j \leq Z_i \quad (i = 1, 2, 3) \quad (6)$$

In which, X is the total output of each sector. Y is the final usage of each sector (including net export). X^l and X^h is the lower bound and upper bound. L_i and Z_i are the flow asset occupancy and total amount of the financial assets respectively. a_{vj} are the increasing value coefficients of each sector. l_{ij} and z_{ij} are the direct occupancy coefficients and direct financing usage coefficients of the flow assets. Subjected conditions (2) is the restriction of the input-output. Subjected conditions (3) is the restriction of the total output. X^l , the lower bound of X , adopts the total output of each sector in the factual Input-Output Table. X^h , the upper bound of X , adopts the average increasing speed and adjusted data of total output of each sector. Subjected conditions (4)(5)(6) are the restriction of the fixed assets occupancy, flow assets occupancy and financing usage respectively. That is to say, the sum of the occupancy of each sector and financing amount will not exceed the total amount in that year.

We can get the shadow prices of the financial assets occupancy and each financing items in 2001 after we calculate the occupancy in 2001 and the financing parts through IO programming model. the shadow price of the occupancy assets is as follows: fixed asset's shadow price is 0.034919. The shadow prices of the financial assets of the currency and short-term investment are 0.028673 and 0.143212 respectively, which shows that the use efficiency of short-term investment is higher than that of currency. Shadow prices of each financing item: the shadow price of loan financing is 0.154122998, the highest, which shows the loan in that year is relatively scarce and the supply of it cannot match its demand. The shadow price of bond financing is 0.06600703. The shadow price of stock financing (marginal cost of financing) is zero. The remnant of the stock resource is 821085.906 thousand Yuan under the optimization distribution. This is because a mass shrinking of the stock value in the secondary stock market in 2001 leads to the decreasing of the financing demand in the first market. Financing through issuing and distribution stock is 1168.7 hundred million Yuan in the total year. It decreased 935 hundred million Yuan than that of last year. The withdrawing of the large funds leads to the scarcity of the stock financing demand. The author thinks we cannot get such a conclusion: the supply of the stock resource is full. It is the special phenomenon that the depression of the stock market in that year resulted in the relative surplus of stock financing, i.e. the special value under the special background. In fact, stock is the scarce resource. The shadow price of stocks may be the nonzero value in the normal circumstance. In a word, the efficiency of occupancy of the short-term investment is higher than that of currency

when financial occupancy of each sector occurs. Properly boosting the short-term investment occupancy has the distinct effect to increase GDP in that year. In financing area, it is the best choice of each sector to increase loan financing that has the biggest shadow price. Taking advantage of the financial resource can boost the effect of the financial development to the economic growth.

4 Conclusions

This paper analyzes the effect of the financial development to the economic growth by using the Financial Input-Occupancy-Output technique. It aims at overcome the disadvantages of former research techniques in functional analysis on the basis of measuring the forward and backward effect of the financial development through the Financial Input-Occupancy-Output principles. It shows the trend that the leading function of finance gradually decreased and demand-obeying function gradually increased from 1997 to 2001. Financial assets occupancy and financing usage conditions, such as currency, short-term investment can be shown through measuring the shadow prices in Financial Input-Occupancy-Output model .

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