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## Input and output models application in analyzing the real estate macroeconomic efficiency in China

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### ABSTRACT

Real estate is a crucial sector with a crucial role in promoting national economy's development because of its close connection with other sectors of national economy and its high contributed value for economic growth. So macro-controlling regulations made for real estate's long-term development should be suitable and efficient. The quantitative measurement of factors pushing real estate's rapid growth and industry's related effect can help people make a scientific analysis of real estate. Based on basic information about China's real estate, we have measured in detail the industry's related effect and analyzed real estate's influence on economic expansion and employment, combining with industry's dynamic development since 1997. In spite of analyzing real estate's macroeconomic efficiency, this paper also provide some suggestions for regulating real estate to restraint its irregular development, promoting national economy's development.

### KEYWORDS

Real estate; Input-output model; Macroeconomic efficiency; Industrial structure.



## INTRODUCTION

With the reforming of housing policy and land utilization in the 1980s when China carried out the policy of reforming and opening up, China's real estate achieved its previous growth. Entering into 90s, real estate ushered in the golden period of development, though later also experienced bubble burst and market adjustments lasting for five years. With the introduction of related policies and regulations in 1998, real estate become an important engine for the development of China's economy. Since then, real estate market and the whole industry enter the new stage of development. According to statistics, China's real estate's value added account of 4.88% of GDP during five years from 2004 to 2009. Taking capital formation factors into account, the average contribution rate to macroeconomic growth in the same period was 13.6%. With the booming of real estate, housing price keeps rising. In 2010, commercial housing price increased 23.2%. The soaring housing price must be regulated through government's macro control. Since 2010, government respectively conduct a macro control in two aspects, supply and demand to restraint the soaring price. Although regulation slow down price's growth, the price is still high, becoming an important problem of improving people's livelihood. Strict controlling of real estate's development is a myopia measure. How to correctly recognize real estate's position in national economy and guide the whole industry to develop healthily.

This paper studies real estate's influence on macroeconomic development and employment rate through input-output model and provides suggestions for promoting real estate's development and achieving a sustainable healthy growth of national economy based on China's real estate's reality.

## INDUSTRY ORIENTATION

In a broad sense, real estate involves in two parts of producing and providing service. According to International Standard Industrial Classification, real estate is classified to the tertiary industry, based on its serving function. The reality of China decides that producing activity should also be classified to real estate. In now-day, China hasn't finished industrialization and real estate's focus lies in development and investment, making operating and serving still be in original stage. So without considering real estate's development and investment, the assessing of serving and operating activities would lead to a large decrease of the total sum, which doesn't match up to the reality of China's real estate's wide expansion and shadows real estate's contribution to economic development. By studying not only real estate's development and investment but also its servicing market, this paper provides, based on China's reality, a comprehensive introduction of real estate's role in promoting macroeconomic development of China.

Input-output model referred in this paper is firstly introduced by Wasslly w. Leintief, whose basic theory is general equilibrium model. By using checker-board table to present every sector's input and output, we reveal the cost-and volume relation, input-output structure and industrial structure in manufacturing system, so that to analyze industry's current situation and future development.

### **The calculation of industrial related effect**

Based on the input-output model, the indicators necessary to be calculated in the analyzing of related effect in this paper are industrial input structure, industrial distribution structure and industrial orientation. And a industry's driving effect is the combination of its labor effect and motivational effect.

### **Indicators of industrial input structure**

The analyzing of industrial input structure is based on both direct consumption coefficient and comprehensive consumption coefficient. Direct consumption coefficient, as a part of complete consumption coefficient, reflects the dependence of an industry to others. Complete consumption coefficient presents the interdependent relation between two sectors, not just including direct consumption but indirect consumption. The formulation of calculating direct consumption coefficient:

$$a_{ij} = x_{ij} / x_j, i, j = 1, 2, \dots, n \tag{1}$$

$a_{ij}$  represents direct consumption coefficient; and  $x_{ij}$ , the direct consumption of  $i$  produced by the producing activity of  $j$ . The formulation of calculating complete consumption coefficient through direct consumption coefficient matrix is :

$$B = A + A^2 + A^3 + \dots = (I - A)^{-1} - I \tag{2}$$

$A$  represents direct consumption coefficient matrix;  $I$ , an identity matrix ;  $B$ , complete consumption coefficient matrix.  $B_{ij}$ , as the complete consumption coefficient, represents the complete consumption of  $i$  produced by producing activities of  $j$ .

**Indicators of industrial distribution structure**

The studying of industrial distribution is also base on both direct distribution coefficient and complete distribution coefficient. Direct distribution coefficient is the proportion of products provided by a sector to other sectors or the society. Complete distribution coefficient can reflect product’s direct and indirect users and study product’s complete sale direct. The calculating formulation of direct distribution coefficient is:

$$r_{ij} = x_{ij} / x_i, i, j = 1, 2, \dots, n \tag{3}$$

$r_{ij}$  is the direct consumption coefficient of  $i$ , in other words, the proportion of  $i$ ’s products consumed by  $J$  in  $i$ ’s total products.  $R_{ij}$  and  $j$  share a positive relation with  $i$ ’s supply. Using  $r_{ij}$  with amount of  $n \times n$  to compose a matrix as the direct distribution coefficient matrix  $R$ , the calculating formulation is :

$$H = (I - R)^{-1} - I \tag{4}$$

**Indicators of industrial orientation**

By calculating intermediate demand and produce solicitation coefficient, we can make a primary level diagnose in the real estate. According to this method, we can divide an industrial sector into four industrial groups,(shown in TABLE 1). The formulations of calculating inducing coefficient respectively based on intermediate input,intermediate demand and final demand are:

$$\sum_{i=1}^n \alpha_{ij}, j = 1, 2, \dots, n \tag{5}$$

$$D_i = \sum_{j=1}^n x_{ij} / x_i, i = 1, 2, \dots, n \tag{6}$$

$D_i$  represents the percentage of the intermediate demand of  $i$  in the total output  $x_i$ .

$$U_{ik} = \sum_{j=1}^n C_{ij} \times F_{ik} / \sum_{i=1}^n F_{ik} \tag{7}$$

$C_{ij}$  is the Leintief coefficient, in other words, the complete demand.  $F_{ij}$  represents the final demand of  $i$  in  $K$ .

Intermediate input is the percentage of goods and serving’s transformation value in producing, reflecting the proportion of every sector’s products as producing resources and consuming resources.

And the coefficient calculated by final demand comparing to production's inducing coefficient can reveal that industry relies on investment or output.

**TABLE 1 : Classification of industrial clusters**

classification of industrial type	low intermediate input(<50%)	high intermediate input(>50%)
low intermediate input(<50%)	basic final demand industry	basic intermediate product industry
high intermediate input(>50%)	final demand industry	intermediate product industry

### Accounting indicators of macroeconomic effect

#### Economic driving and impulsing force

The higher influence coefficient is, the larger the force to drive nation economic growth is, and this means that the industry is a leading industry. Response coefficient represents a sector's response to other sectors' demand. The higher response coefficient is, the higher other sectors' dependence to this sector is, so this industry is the dominant industry in national economy. The formulations of calculating influence coefficient and response coefficient are respectively :

$$\delta_j = \sum_{i=1}^n c_{ij} / \left[ \sum_{j=1}^n (\sum_{i=1}^n c_{ij}) \times \partial_j \right], j = 1, 2, \dots, n \quad (8)$$

$$\theta_i = \sum_{j=1}^n \omega_{ij} / \left[ \sum_{i=1}^n (\sum_{j=1}^n \omega_{ij}) \times \beta_i \right], i = 1, 2, \dots, n \quad (9)$$

#### The influence on employment rate

Building the model reflecting real estate's role in increasing employment :

$$L = f(Y) = \partial Y^\beta \quad (10)$$

Y presents real estate's value added; L, people employed in real estate ;  $\beta$ , employment elastic coefficient. the logarithms of formulation's two results can help us to get a linear model.

$$\ln L = \partial + \beta \ln Y + \varepsilon \quad (11)$$

Based on this model and historical datum, we can calculate real estate's direct employment elastic coefficient, or real estate's direct employment effect. And after getting other sectors' direct employment elastic coefficient, we can calculate the employment effect of the whole industry.

## THE DISCUSSION OF CALCULATING RESULTS

### Real estate's industrial related effect

#### The analyzing of industrial input structure

The calculating of real estate's annual direct consumption efficient enables us to know that the direct consumption efficient is usually above 0, which is also the back direct related relation. Some sectors such as financial, construction, business, serving, catering services, electrical equipment and machinery production, shares a close relation with real estate's back direct related relation. Particularly, financial, construction and business serving are main back related industries because they account to over half of real estate's direct intermediate input.

Since 2002 real estate and its back direct relation have further developed. In 2003, the macro-control policy of the bidirectional adjustment of supply and demand abolishes housing loan preferential

policies and strengthens credit management, causing the decrease of real estate's direct consumption in financial and construction, however, the increasing in business serving and catering services. And there is an obvious trend of the consumption in these industries surpasses that in construction since 2005. (The detail is shown in TABLE 2, 3)

**TABLE 2 : Close back direct related industries of China's real estate in 1997-2002**

1997			2000		
close back direct related industries	direct consumption indicator	percentage	close back direct related industries	direct consumption indicator	percentage
financial and insurance	0.0461	19.12%	financial and insurance	0.1247	32.05%
construction	0.0389	16.16%	construction	0.0800	20.55%
manufacture of non-metallic mineral products	0.0389	16.15%	social services	0.0384	9.86%
social services	0.0211	8.77%	manufacture of non-metallic mineral products	0.0351	9.01%
Manufacture of electronic machinery and construction materials	0.0090	3.73%	Manufacture of electronic machinery and construction materials	0.0151	3.87%
business	0.0087	3.59%	business	0.0100	2.57%
other manufactures	0.0080	3.32%	catering services	0.0100	2.57%
paper making and printing and manufacture of stationary	0.0069	2.87%			
catering services	0.0067	2.79%			

**TABLE 3 : Close back direct related industries of China's real estate in 2002-2005**

2002			2005		
close back direct related industries	direct consumption indicator	percentage	close back direct related industries	direct consumption indicator	percentage
financial and insurance	0.0775	28.82%	financial and insurance	0.0493	25.17%
construction	0.0405	15.06%	leasing industry and business services	0.0367	18.73%
leasing industry and business services	0.0369	13.75%	construction	0.0200	10.24%
accommodation and catering services	0.0144	5.35%	accommodation and catering services	0.0132	6.76%
manufacture of non-metallic mineral products	0.0119	4.41%	production and supply of electricity and heat	0.0105	5.37%
real estate	0.0096	3.55%	manufacture of non-metallic mineral products	0.0099	5.05%
transportation and storage	0.0093	3.45%	transportation and storage	0.0083	4.24%
manufacture of transport and communication facilities	0.0085	3.16%	manufacture of electronic machinery and materials	0.0062	3.18%
manufacture of electronic machinery and materials	0.0084	3.13%	real estate	0.0056	2.84%
manufacture of general and special equipment	0.0072	2.67%	manufacture of transport and communication facilities	0.0054	2.75%

### The distribution of real estate's industrial structure

According to the direct distribution coefficient, real estate shares an obvious forward direct relation with most industries. Public management and social organization, financial, retail trade and

social services are real estate's close forward direct related industries and annually they account to over half of real estate's intermediate consumption. These industries are also direct final sectors, to which real estate's final products flow.

In 2000, the increasing of real estate's direct distribution to business and social serving shows us that during this period business and service make a great development. Since 2002, real estate's influence on other sectors in national economy has expanded more widely than ever before. For example, chemical industry's direct consumption of real estate has rise from 2.25% in 2006 to 3.35% in 2007. (the detail is shown in TABLE 4,5). If taking product's indirect flow into account, almost all sectors are real estate's forward complete related sectors. However, financial, retail trade and chemical industry are real estate product's main final flow sectors.

**TABLE 4 : Close forward direct related industries of China's real estate in 1997-2000**

	1997			2000	
	direct distribution efficient	percentage		direct distribution efficient	percentage
lose forward direct related industries			lose forward direct related industries		
business	0.0780	25.77%	business	0.1022	32.83%
financial insurance	0.0732	24.20%	financial insurance	0.0593	19.05%
social service	0.0354	11.72%	social service	0.0406	13.05%
administrative agency and other industries	0.0274	9.06%	administrative agency and other industries	0.0262	8.42%
			real estate	0.0090	2.88%
			chemical industry	0.0080	2.58%

**TABLE 5 : Close forward direct related industries of China's real estate in 2002-2005**

	2002			2005	
	direct distribution efficient	percentage		direct distribution efficient	percentage
lose forward direct related industries			lose forward direct related industries		
public management and social organization	0.1002	35.49%	public management and social organization	0.0497	24.42%
wholesale and retail	0.0450	15.95%	financial insurance	0.0348	17.09%
financial insurance	0.0418	14.81%	wholesale and retail	0.0180	8.84%
other services	0.0167	5.90%	residential services and other services	0.0131	6.43%
real estate	0.0096	3.38%	leasing industry and business service	0.0111	5.48%
information transmission, computer services and software	0.0071	2.52%	information transmission, computer services and software	0.0082	4.01%
leasing industry and business service	0.0070	2.49%	manufacturing of communication equipment, computer and other electronic equipment	0.0057	2.78%
accommodation and catering services	0.0069	2.44%	real estate	0.0056	2.74%
			accommodation and catering services	0.0055	2.69%
			chemical industry	0.0051	2.52%

### Classification of real estate's industrial types

Annual real estate's intermediate investment and intermediate demand in china are not high and rank at end in every sector. And real estate belongs to basic final demand industry. The final demand inducing efficient has show that real estate has two properties of consumption and investment. In 2002

real estate's intermediate investment and intermediate demand and industrial driving effect all decrease and in the same period real estate's focus has transformed from investment to consumption. Although industrial estate and commercial estate, two sectors with strong driving force, remain a stable growth with a certain percentage, their proportion in total investment jumped to 15.11% in 2007. So, real estate's whole related effect kept decreasing before 2002.

## **Real estate's influence on macro economy**

### **Real estate's contribution to economic development**

According to the results of calculating its economic driving force and motivational force, real estate's influence coefficient and response coefficient are all below 1 and rank after 35 in sectors, reflecting that real estate has gained a great progress and made a direct contribution to national economy. However, to other industries it lacks strong driving and motivational force. The main cause for this situation is that real estate's intermediate input and intermediate demand are not high. As a final demand inducing industry with high value added, real estate's indirect contribution is not obvious. From its dynamic growth, since 1998 as a new economic growth point, real estate's investment and development has increased greatly, becoming the leading industry in national economy but not the pillar industry.

### **Real estate's influence on employment**

In 2009, the population employed in real estate accounts to 0.2% of total employees, nearly 1.91million. Until now it still remain creating jobs. The regression analysis of its driving employment model based on real estate's value added shows that its direct employment elasticity is 41.67%, reflecting that real estate's driving force in employment is relative stronger. (shown in detail in table 8). Besides real estate's driving role in promoting employment keeps becoming more and more important. Multiplying its employment elasticity with five responding sectors' average total related coefficient of five years, we can get real estate's respective indirect employment elasticity are 2.01%, 3.09% and 0.53%. So real estate's total driving employment force is 47.30%, reflecting that to large extent real estate can push employment's increase.

## **CONCLUSION**

Real estate shares a close relation with sectors in national economy. Although its industrial driving and motivational force is not strong, real estate, as an important sector in national economy, makes a great direct contribution to economic development and to large extent it has promoted the increase of employment. The macro-controlling regulations made for real estate's long-term development should be suitable to real estate's characteristics, so the calculating of its industrial related effect and macro economic effect coefficient has very important significance.

Based on the analysis in this paper, we think the regulation of real estate should pay attention to the following points: firstly, we should rationally make a correct judgment of real estate's orientation, promote its daily consumption and serving function, change the traditional model of depending real estate's investment to promote economic growth; secondly, introducing macro-controlling policies enable commercial and residential estates to develop coordinately; thirdly, pushing the combination of real estate and information industry, standardizing the regulation of real estate's market and whole industry and promoting real estate's healthy growth.

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