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## Tax rate fluctuations of China's construction industry and real estate industry: a computable general equilibrium analysis

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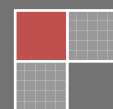
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### ABSTRACT

Construction and real estate tax policy can affect the overall socio-economic. We design a computable general equilibrium model to identify the construction industry and real estate industry. According to the 42 departments of China's 2007 input-output table, the corresponding social accounting matrix is worked out, and the model is used to analyze the effect of adjusting the tax rate of construction and real estate on economic development. The simulation shows that reducing tax rates can promote economic development.

### KEYWORDS

Computable general equilibrium model; Input – output; Social accounting matrix; Tax rate.



INTRODUCTION

With the progress of the reform and opening-up policy, China's economy has maintained steady and rapid pace of development. At the same time, China's construction and real estate industries developed rapidly. In the past 10 years, the building construction area and the housing area have a great growth. In 2012, the building construction area was 5.73 billion square meters, of which 4.289 billion square meters were the housing area, with growth of 13.2% and 10.6%, respectively, compared with 2011. Moreover, the real estate investment has increased from 3.6232 trillion yuan in 2009 to 7.1804 trillion yuan in 2012, about 2 times growth in 4 years<sup>[1]</sup>.

At present, the rapid growth of Chinese real estate industry has caused widespread concern of the Chinese government. The government adopts new policies to control the increasingly high prices<sup>[2]</sup>. Under the conditions of the market economy, tax policy is a combination of policy tools that cannot be ignored. We specified the tax computable general equilibrium (CGE) model and studied the effects of construction tax and real estate capital tax policy on the national economy. Based on gains and losses, the government can make further targeted complementary measures. The result shows that raising or lowering individual tax rates in an industry to promote the coordinated development of the national economy, is not a good way of economic regulation, should also pay attention to the promotion of production and consumption.

COMPUTABLE GENERAL EQUILIBRIUM MODEL OF CONSTRUCTION INDUSTRY AND REAL ESTATE INDUSTRY

Basic structure

Computable general equilibrium model is a based on neoclassical microeconomic theory and internally consistent macroeconomic model<sup>[3]</sup>. It can simultaneously consider the behavior and interaction among multiple markets, among a number of economic entities which have optimization behavior and between the economic entities and market<sup>[4]</sup>. The domestic and foreign researches on CGE model of tax policy are abundance. The research scholars who first introduced the CGE model in housing policy are Luk<sup>[5]</sup>etc.. Hofe<sup>[6]</sup>, Kim and Ju<sup>[7]</sup> analyzes the impact of changes in the housing market on the macro economy. At present, scholars use the CGE model for the relationship between architecture and real estate tax policy and the national economy and its various departments have been some studies, but the overall need further. For the current development of China's real estate industry, a CGE model is constructed for construction industry and real estate industry to analyze the impact of the construction rate and real estate tax rate change on the Chinese economy.

This model is characterized by: (1) the income comes mainly from the held capital and labor, the two initial factors. (2) The description of production activities is a multi-layered structure of nested models. (3) Sources of government revenue include production tax, income tax, import tariffs, and energy taxes. The government part of its total tax revenue at a certain propensity to save for savings, the rest of at the propensity to consume for consumer products. (4) The model uses the Armington assumption and small country assumptions<sup>[8]</sup>. (5) In the equilibrium condition, the market clearing includes product clearing and factors clearing. The model used "neoclassical closure" rule<sup>[9]</sup> (see Figure 1).

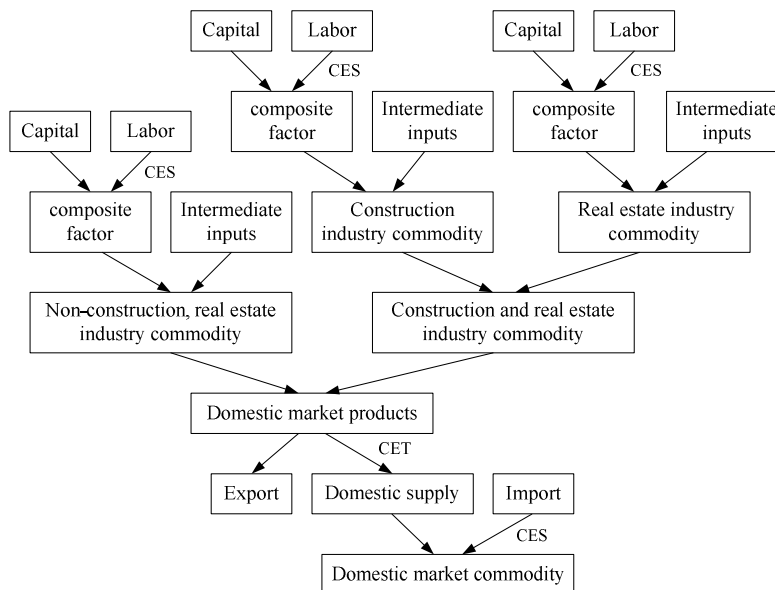


Figure 1 : CGE model structure

Model content

The model of this paper is mainly composed of four modules, respectively, production, price, institution and system. Endogenous variables in the model are written in capital letters, parameters and exogenous variables are expressed by

lowercase or Greek letter said. The subscript indexes are figured by lowercase letters,(Wherein, a represents the active, a=1,2,3; c represents commodities, c=1,2,3; f represents the production factors, i represents family). A detailed description of the variables is in TABLE1.

Lofgren et al<sup>[10]</sup> put forward the general form of the open CGE model; the model used is primarily on the basis of it and made the necessary modifications and extensions. The specific content is equation (1) to equation (29) below.

**Production**

$$QVD_a = \alpha_a^f [\delta_a^f K_a^{\rho_a^f} + (1 - \delta_a^f) L_a^{\rho_a^f}]^{1/\rho_a^f} \tag{1}$$

$$QP_{ac} = iac_{ac} * QI_{ac} \tag{2}$$

$$PI_a = \sum_c iac_{ac} * PP_c \tag{3}$$

$$QD_a = \alpha_a [\delta_a QVD_a^{\rho_a} + (1 - \delta_a) QI_a^{\rho_a}]^{1/\rho_a} \tag{4}$$

$$QD_2 = iac_2 * QQ_a \tag{5}$$

$$QQ_a = iac_a * QX_c \tag{6}$$

$$QX_c = \alpha_c^t [\delta_c^t QE_c^{\rho_c^t} + (1 - \delta_c^t) QD_c^{\rho_c^t}]^{1/\rho_c^t} \tag{7}$$

$$\frac{QE_c}{QD_c} = \left( \frac{PD_c}{PE_c} \frac{1 - \delta_c^t}{\delta_c^t} \right)^{\frac{1}{1 - \rho_c^t}} \tag{8}$$

$$Q_c = \alpha_c^q [\delta_c^q QM_c^{\rho_c^q} + (1 - \delta_c^q) QD_c^{\rho_c^q}]^{1/\rho_c^q} \tag{9}$$

**TABLE 1 : Variable description of the variables in CGE model**

Endogenous variables		
K <sub>a</sub> : Capital requirements	QD <sub>c</sub> : Domestic supply	PD <sub>c</sub> : Domestic prices
L <sub>a</sub> : Demand for labor	QE <sub>c</sub> : Export	PE <sub>c</sub> : Export prices
QD <sub>a</sub> : Outputs	QM <sub>c</sub> : Import	PM <sub>c</sub> : Import prices
QVD <sub>a</sub> : Composite factor	QX <sub>c</sub> : Domestic market product	PI <sub>a</sub> : Intermediate input price index
QI <sub>a</sub> : Intermediate inputs	Q <sub>c</sub> : Domestic market commodity	PP <sub>c</sub> : Industry commodity price
QP <sub>ac</sub> : Industry commodity	QQ <sub>a</sub> : Construction and real estate industry output	PQ <sub>c</sub> : Domestic commodity prices
YI <sub>i</sub> : Family income	PQQ <sub>a</sub> : Construction and real estate prices	PX <sub>c</sub> : Total domestic output prices
YIF <sub>f</sub> : Household factor income	QH <sub>c</sub> : Household consumption	YE: Corporate income
EE: Corporate expenses	YIF <sub>k</sub> : Corporate capital income	YG: Government revenue
EG: Government expenses		QG <sub>c</sub> : Government expenses
EI <sub>i</sub> : Household expenditures		
Parameters and exogenous variables		
iaca <sub>c</sub> : Input-output direct consumption coefficient	e: Exchange rate	
iac <sub>a</sub> : Industry direct consumption coefficient	th <sub>i</sub> : Family income tax rate	
icc <sub>c</sub> : Products direct consumption coefficient	tm <sub>c</sub> : Import tariff rates	
pwm <sub>c</sub> : World prices of imported goods	tr: Corporate income tax	
te <sub>c</sub> : Energy tax rate	rs: Foreign savings	
pwe <sub>c</sub> : World prices of export goods	ks: Capital endowment	
tf <sub>ig</sub> : Transfer of government to family	ls: Labor endowment	
tf <sub>ie</sub> : Transfer of enterprises to family	te <sub>c</sub> : Export tariffs	
tf <sub>eg</sub> : Transfer of government to enterprises	sh <sub>i</sub> : Household savings rate	
gs: Government Savings		

$$\frac{QM_c}{QD_c} = \left( \frac{PD_c}{PM_c} \frac{1 - \delta_c^q}{\delta_c^q} \right)^{\frac{1}{1 - \rho_c^q}} \quad (10)$$

**Price**

$$PM_c = pwm_c(1 + tm_c)e \quad (11)$$

$$PE_c = pwe_c(1 - te_c)e \quad (12)$$

$$PQ_c = \frac{PD_c * QD_c + PM_c * QM_c}{Q_c} \quad (13)$$

$$PQQ_a = iac_2 * PD_2 + iac_3 * PD_3 \quad (14)$$

$$PX_c = icc_1 * PD_1 + icc_2 * PQQ_a \quad (15)$$

**Institution**

$$YI_i = \sum_i YIF_{if} + tf_{ie} + tf_{ig} \quad (16)$$

$$EI_i = \sum_i PQ_c * QH_c + th_i * YI_i \quad (17)$$

$$YE = YIF_k + tf_{eg} \quad (18)$$

$$EE = tr + \sum_i tf_{ie} \quad (19)$$

$$YG = th_i * \sum_i YI_i + tr + \sum_c tm_c * pwm_c * QM_c * e + te_c * \sum_a QD_a \quad (20)$$

$$EG = \sum_c QG_c * PQ_c + \sum_i tf_{ig} + tf_{eg} + tf_{ig} * e \quad (21)$$

**System constraint**

$$YI_i = EI_i + sh_i * YI_i \quad (22)$$

$$YG = EG + gs \quad (23)$$

$$I = gs + \sum_i sh_i * YI_i + rs * e \quad (24)$$

$$YE = YIF_k + tf_{eg} \quad (25)$$

$$Q_c = \sum_c QI_c + \sum_i QH_i + QG + I \quad (26)$$

$$\sum_a K_a = ks \quad (27)$$

$$\sum_a L_a = ls \quad (28)$$

$$\sum_c pwm_c * QM_c + tf_{ig} = \sum_c pwe_c * Qe_c + rs \quad (29)$$

DATA PROCESSING

Social accounting matrix

Data is the core issue for establishing CGE model for policy simulation. Social accounting matrix (SAM) is a national accounting matrix representation, which is benchmark data sets can be able to meet the balance, closed and consistency for a CGE model<sup>[11]</sup>.

According to the 42 departments of China's 2007 I/O table, production activities accounts are divided into six sectors, including primary industry, secondary industry, tertiary industry, the energy industry, the construction industry and the real estate industry. Other accounts include the residents, the increase in value (labor compensation and depreciation of fixed assets), operating surplus of enterprises, government, investment, foreign and tariffs<sup>[12]</sup>. TABLE 2 shows the balance of China 2007 macro SAM.

TABLE 2 : Macro social account matrix of China in 2007(100 million)

	Production activities						reward s	Asset	Surplu s	Residen t	Gov.	Capita l	Foreign n	Tar - iff	Total
	Pri.	Sec.	Ter.	Energ y	Constr .	R.E.									
Pri.	6877	12721 5	2549	2	259	1			11156	342	2042	666		15110 9	
Sec.	9776	28352 0	40455	9585	37069	894			35620	0	262758	81102		76077 9	
Prodn Ter.	3087	39799	34963	3112	9390	1185			38283		3827	13267		14691 3	
Act. Energy	472	19687	3098	12301	857	64			2997	0	5	97		39578	
Constr	11	148	1051	12	598	180			932	0	59608	409		62949	
R.E.	10	1033	2453	16	36	132			7565	0	3406	0		14651	
rewards	12704 4	36101	35533	2488	7405	1339								20991 0	
Asset depreciation	1430	13293	11255	4093	776	6284								37131	
Surplus	0	33524		5273	4532	2678								46007	
Resident							209910	3713 1						24704 1	
Gov.	48	23953	9567	1256	1801	1894			3185				143 3	43137	
Capital									46007	147303	4279 5	95541		33164 6	
Foreign	2328	18127 8	5828	1427	221	0								19108 2	
Tariff	26	1228	161	13	5	0								1433	
Total	15110 9	76077 9	14691 3	39578	62949	1465 1	209910	3713 1	46007	247041	4313 7	331646	191082	143 3	

Parameter set and estimated

The elasticity of substitution and elasticity of conversion between the various inputs and outputs in CGE model are mainly referred to Lofgren's<sup>[13][14]</sup> value and they are combined with the sensitivity test setting. The various tax rates, income and expenses are set to the current value of 2007. The GAMS software is implemented to the program expression and solving of CGE model, the values of the parameters in the model are calculated by SAM and are substituted into the GAMS program to verify their correctness.

SIMULATION AND ANALYSIS OF TAX POLICY

Considering that the tax to the construction industry and real estate industry has a more important impact on society and the economy, we raise or reduce the construction and real estate tax rates, and then analyze the impact of different tax rates on the development of the construction industry and real estate industry and the entire social and economic, and hope that it can provide the basis for government departments to constitute real estate-related policies.

### Impact analysis of the production sector

After adjusting the tax rate of construction and real estate, the impact on the level of output and output prices of the various productive sectors is shown in TABLE3. Therefore, the increase of tax rate of construction or real estate by 1% have different degrees of inhibition to the output of various departments, the tax rate down 1% that promote the outputs of the various departments on different levels, and also the impact on the construction industry and real estate relatively is larger. Changes in the tax rate of real estate industry have no effect on output prices, and the impact of construction industry rate on prices is also relatively small. The result can explain that the inhibition of the construction industry and real estate industry brings a certain degree decline overall socio-economic.

### Macro impact analysis

TABLE 3 : Output level and change of price rate of various productive sectors(%)

		Primary industry	Secondary industry	Tertiary industry	Energy industry	Construction industry	Real estate
Building tax	output level	-2.03	-2.46	-2.11	-2.8	-5.51	-4.7
increased by 1%	output price	0	0.04	0	0.01	0	0.03
Building tax	output level	2.3	2.61	2.38	2.88	6.01	4.99
reduced by 1%	output price	0	-0.04	0	-0.01	0	-0.03
real estate taxes	output level	-0.23	-0.25	-0.23	-0.29	-0.53	-1.5
increased by 1%	output price	0	0	0	0	0	0
real estate taxes	output level	0.26	0.29	0.25	0.31	0.55	1.12
reduced by 1%	output price	0	0	0	0	0	0
Two taxes in	output level	-2.27	-0.28	-2.37	-2.89	-5.85	-5.51
creased by 1%	output price	0	0.03	0	0.02	0	0.01
Two taxes in	output level	2.55	2.96	2.64	3.23	6.53	6.2
increased by 1%	output price	0	-0.03	0	-0.01	0	-0.01

TABLE 4 : Economic variables changes

	Building tax		Real estate tax		Two taxes	
	increased by 1%	reduced by 1%	increased by 1%	reduced by 1%	increased by 1%	reduced by 1%
Output	-2.6	3	-0.29	0.28	-2.88	3.21
Construction, real Estate output	-5.21	5.8	-0.6	0.63	-5.77	6.48
Demand	-2.59	2.86	-0.29	0.3	-2.84	3.17
Imports	-2.8	3.13	-0.3	0.33	-3.1	3.45
Exports	-2.1	2.22	-0.23	0.25	-2.3	2.46
Transferred in	-2.27	2.55	-0.24	0.26	-2.54	2.86
Transferred out	-2.5	2.76	-0.26	0.28	-2.77	3.11
Investment	-2.91	3.22	-0.35	0.36	-3.26	3.61
Value added	-2.56	2.83	-0.31	0.33	-2.86	3.17
Residents consumption	-2.58	2.87	-0.3	0.31	-2.88	3.24
Government consumption	-1.33	3.25	-0.16	0.18	-1.48	1.66
Corporate income	-2.53	2.78	-0.26	0.31	-2.75	3.11
Residents' welfare	-341241	378345	-39223	42316	-377952	423437

Raising the tax rate of construction or real estate, the cost of a variety of related products will increase. On the one hand, it will reduce the demand for such products; on the other hand it will encourage enterprises to increase output

efficiency to a certain extent. TABLE 4 lists several changes in key economic variables, which can be seen that raising the tax rate of construction or real estate will have a negative impact overall economy, especially on the construction industry and real estate industry. These effects include the reduce of enterprise in real income, the decline in the level of consumption of the residents and the government, which significantly affect labor and capital investment, cause important impact on the import and export, and the level of welfare of the residents will also show a corresponding decrease. Conversely, reducing its tax rate will promote the development of the macroeconomic. It is a certain extent explained that the development trend of the future should not increase tax to inhibit the development of relevant industries, but rather by lowering taxes, while promoting the production and consumption, thereby enable economic and social access to healthy development.

## CONCLUSION

Construction industry and real estate industry have achieved a rapid development; at the same time, it puts forward higher requirements for energy and related industries. Under the conditions of market economy, the use of tax measures to appropriate adjust the price of the related industries, on the one hand, it can effectively regulate the development of the industry through the market price mechanism, but on the other hand, it will also bring impact on social and economic development because of the impact on various industries. From the simulation results, to improve an industry rate alone is not a good economic regulation. Therefore, when seeking industrial restructuring through taxes and other economic instruments, we must make a comprehensive assessment of it to the combined effects of economic activities, and then frame targeted complementary measures to ensure the level of economic and social life simultaneous growth.

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