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Impact of Change in Food Consumption Pattern on Agricultural and Food Productions in China

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Abstract: Base on a standard general equilibrium model for China Marco-economy, this study estimated the impact on agricultural product and food market caused by the changes in consumption patterns to more meat and less grain by household group, including rural and urban household, constrained by the fixable amount of total available water. The change in consumption patter for household group would achieve a higher level in the household's welfare and not make water scarcity become more serious. These findings were against some existed studies stating that this change would exacerbate water scarcity. Previous studies in China supported our findings and mentioned that the water dependency of meat production is less than grain production because of pork, which would not employ much water into productive process, accounting about 75% of total consumption of meat products. In detail, when this change only occurred in rural household rather than in urban household, both rural and urban household would be benefited with more increment in welfare. Nevertheless, the decline in grain demand would suppress almost all of the agricultural and food production as well as their import and export with the only a few exceptions of livestock, meat and processing of forage.

Key words: food consumption; agriculture; food product; China; CGE model
JEL codes: D58, E27, Q11, Q25

1. Introduction

Many studies state that water availability is a major constraint for China's production of grain and other food. An official survey reported a change in both rural and urban household consumption patterns to more meat and less grain: from 1992 to 2002, the demand of meat had increased by 33.45% and the demand of grain had decreased by 8.59% (Zhang et al., 2008). Surveys have found that changes in household food consumption are occurring more rapidly and on a larger scale in China's major cities than in rural areas. Therefore the meat production that believed to employ more water than grain production had increased. However, systematic analyses of the above issues are rarely found in the literature. The hypothesis is that the growth of meat production would consume more water than before, and would worsen water scarcity and finally the gap between water demand and supply would be increased due to the fixed volume of total available water. In this study, we construct a general equilibrium model for China to consider above hypothesis and measure the impact on the agricultural economy, food industry and rural and urban households.

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2. Effect of Changes in Food Consumption Patterns on Water Scarcity

China is one of the 13 countries in the world with the most severe water scarcity; the total supply is less than 2 156 000 L per head per year, which is less than a quarter of the average world supply (Xie, 2009). A study stated that annual water shortage in agriculture amounts to 30×10^{10} m^3 in China (Fan et al., 2012). Liu and Savenije (2008) reported that the per capita water requirement for food has increased from 225 $m^3cap^{-1}y^{-1}$ in 1961 to 860 $m^3cap^{-1}y^{-1}$ in 2003. This increase is largely due to the increased share of meat products within individual/household diets in recent decades. Therefore, they believed that changes in food consumption patterns could exacerbate the problem of water scarcity.

3. Methodology: A Computable General Equilibriu M (CGE) Model

(1) Previous CGE models of agricultural production

By relying on Social Accounting Matrices (SAM), CGE models aggregate industries and products to a high level (Palatnik & Roson, 2012). Based on an extension CGE model, including bio-fuel sectors, Okiyama and Tokunaga (2010) identified policies that promoted and popularized bio-fuels as favorably contributing to farmers' incomes in Thailand. This model was also used to examine the effects of expanding grain-based fuel ethanol production in China on the Chinese economy (Ge & Tokunaga, 2011).

(2) Modeling framework and data

The basic data for this analysis comes from the SAM of China's macro-economy (see appendix 3). The data sources include "Input-Output Table of China-2007" (NBS, 2009) and a series of yearbooks provided by China's official departments (NBS, 2013). The model is a standard CGE model as defined by Hosoe et al. (2010). The market structure for each product is presented in Figure 1. The sectors were spilt by focusing on five agricultural goods and 12 food products (see appendix 1). Households are split into rural and urban groups. Direct tax, enterprise, and stock change are added (all functions are listed in appendix 2).

A water block is introduced to model the water constraint. Water supply in study is represented by "production and distribution of water" from Input-Output Table of China 2007. The row "WAT" captures the water demand of different sectors. Total amount of water supply equal the summation of water demand of each sector. To fix the total amount of water supply, we introduce an endogenous valuable "water gap" (see "water block" in appendix 2) to describe the gap of water demand and supply, and the value of "the water demand of stock change" (see appendix 3, the cell "WAT-STC") to present the initial amount of it, what assume that external water resource is always available. Because water pricing has not been implemented for political reasons (Rong, 2011), the water price we present in this model is then set by the market at the level that makes water demand compatible with supply. In this setting, water supply is assumed to be completely inelastic (vertical). The valuable 'water gap' is going to measure the difference between water demand and supply.

We impose the small-country assumption for China, which implies that the world prices (in dollars) of imports and exports are exogenously determined. The elasticity of substitution used in the constant elasticity of substitution function (Armington assumption) and the constant elasticity of transformation (CET) function are taken from previous studies by Zhai and Hertel (2005) and Willenbockel (2006). The import tariff of each sector is taken from estimates by Li and Lejour (2000) (see Appendix 1).

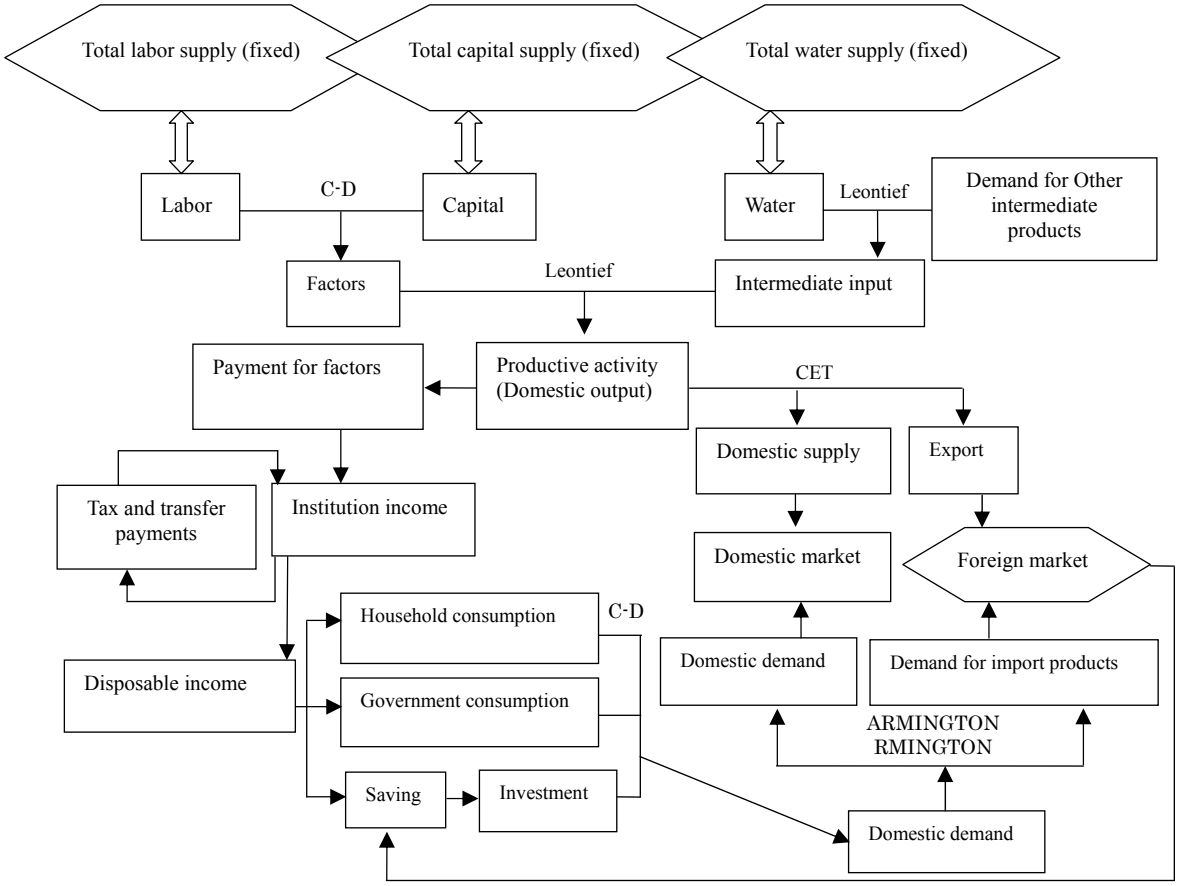

Figure 1 Model Structure for Each Agricultural and Food Product

Note: C-D, Cobb-Douglas function; Leontief, Leontief function;
ARMINGTON: the constant elasticity of substitution function
CET, the constant elasticity of transformation (CET) function;
Exogenous variables are circled by: ⬡ Endogenous variables are circled by ▭

The domestic prices of imports and exports are in Chinese Yuan. For simplicity, in the base year, all of the prices are assumed to equal one. The wage of labor is exogenously fixed as the numeraire price index. The total amount of savings is exogenous, as is investment; Hicksian equivalent variations (EV) measure household welfare changes: if EV is positive, the simulation increased welfare, and if it is negative, the simulation decreased welfare. On the consumption side, the consumption behaviors of rural and urban households are defined by Cobb-Douglas utility function. And Government consumption expenditure and investment are also assumed to be Cobb-Douglas with respect to all commodities.

4. Empirical Application and Simulation Results

(1) Simulation Design

The consumption pattern changes used in our simulations are estimated based on the results of a national survey provided by official database. From 2007 to 2010 for urban and rural household, the total consumption of gain had decreased by 5.08% and meat had increased by 8.66% (see Table 1). Simulation S1 assumes that only urban households' change their consumption patterns, S2 assumes that only rural households do so and S3

assumes that both household types do so simultaneously. We set the consumptions of grain and meat in 2010 as the target and assume that the productive conditions of agriculture and food are stable from 2007 to 2010.

Table 1 Per Capita Annual Purchases of Gain and Meat of Urban and Rural Households

Consumption Item (kg)	Urban household					Rural household					Total change (from 2007)
	2000	2005	2007	2010	Change (from 2007)	2000	2005	2007	2010	Change (from 2007)	
Grain	82.31	76.98	77.6	81.53	5.06%	247.7	206.94	197.74	179.83	-9.06%	-5.08%
Meat	25.5	32.83	31.80	34.72	9.18%	18.3	22.42	20.54	22.15	7.86%	8.66%
Pork	16.73	20.15	18.21	20.73	13.84%	13.28	15.62	13.37	14.40	7.73%	11.25%
Beef and Mutton (kg)	3.33	3.71	3.93	3.78	-3.82%	1.13	1.47	1.51	1.43	-5.17%	-4.19%
Poultry	5.44	8.97	9.66	10.21	5.67%	2.81	3.67	3.86	4.17	8.13%	6.38%

Source: China Statistical Yearbook 2008 and 2011 (NBS, 2013).

Precisely in model, the change in food consumption pattern is achieved through changing the value of parameter $\alpha_{i,l}$ (see appendix 2, "Household block") to represent the change in the consumption preference of household (see Table 2).

Table 2 Simulation Design

Simulations	Explanations	Changes in the parameters of model
S1: Urban change only	Grain increase by 5.06%; Meat increase by 9.18%	$\alpha_{grain,\ urban\ household} \times 1.0506$; $\alpha_{meat,\ urban\ household} \times 1.0918$
S2: Rural change only	Grain decrease by 9.06%; Meat increase by 7.86%	$\alpha_{grain,\ rural\ household} \times (1 - 0.0906)$; $\alpha_{meat,\ rural\ household} \times 1.0786$
S3: S1 and S2 combined	The above two cases occur simultaneously	$\alpha_{grain,\ urban\ household} \times 1.0506$; $\alpha_{meat,\ urban\ household} \times 1.0918$ $\alpha_{grain,\ rural\ household} \times (1 - 0.0906)$; $\alpha_{meat,\ rural\ household} \times 1.0786$

Note: "Grain" means grain products from grinding of grains industry; "Meat" means meat products from meat industry.

(2) The results of the simulation analysis

(a) Macroeconomic effects in each case

None of the simulations predicted a significant effect on national gross domestic product (GDP) (see Table 3); the worst effect occurred when both rural and urban households changed their consumption patterns (S3), and the decrease was only -0.031%. Furthermore, the change in rural household consumption improves welfare in both rural and urban households.

We observed that the water gap narrowed whether the change in consumption patterns occurred in urban households (S1), rural households (S2), or both (S3). This result was surprising and conflicted with many previous studies that reported that consumption of more meat and less grain would exacerbate water scarcity. A few previous studies in China supported our result; for example, Rozelle and Rosegrant (1997) reported that pork, which does not take as much land or water as beef to raise, accounts for approximately 75% of China's meat consumption. Table 3 shows that pork still occupies the most import position in total meat consumption to both rural and urban household in 2007 and 2010.

Table 3 Macroeconomic Effects in Each Case

Change in values	S1	S2	S3
GDP (%)	-0.028	-0.003	-0.031
Total consumption by household (%)	0.197	0.014	0.211
Total consumption by government (%)	-0.017	-0.001	-0.018
Total investment change (%)	-0.010	-0.001	-0.011
Total import (%)	-0.023	-0.002	-0.025
Total export (%)	-0.016	-0.002	-0.018
Exchange rate (%)	-0.024	-0.003	-0.027
CPI (consumer price index, %)	-0.023	-0.003	-0.026
Capital return (%)	-0.047	-0.006	-0.053
Welfare of rural household (10 million yuan)	-19.487	165.718	146.080
Welfare of urban household (10 million yuan)	2062.948	13.117	2076.532
Price of water (%)	-0.026	-0.003	-0.029
Water gap (%)	-1.130	-0.116	-1.246

(b) The change in Agriculture and food productions, export and import

For households, a change in rural consumption patterns (S2) almost does not impact all of agricultural and food prices compared to the obvious change of prices in urban consumption patterns (S1) and a change in both (S3) (see Figure 2).

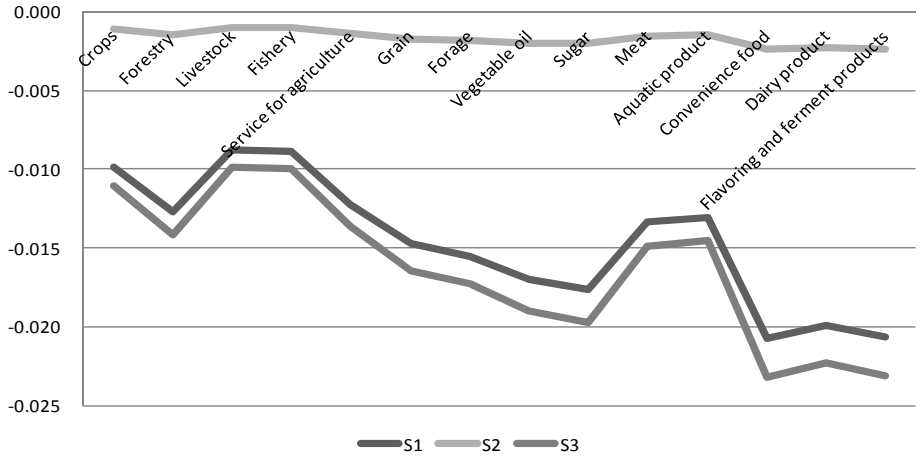

Figure 2 Change in the Prices of Agricultural and Food Products

Note: prices in this figure include the prices of composite, domestic, import and exports products, because their changes are almost the same

The another main difference between S1 and S2 is: in S1, crop and grain increase in the domestic output, import and export along with livestock, meat and processing of forage; in S2, fishery and refining of vegetable oil do so. S1 also shows that for the urban household's demand of food, when the increase in meat is higher than in grain, nearly all food production is stressed due to the decrease in their prices (see Figure 3).

For production in S3, the negative effect of the decrease in wheat demand is much higher than the positive effect of the increase in meat demand. Therefore, nearly all agricultural and food production sectors suffer losses, with the exceptions of livestock, meat and processing of forage. Thus, grain plays a more crucial role in food and agricultural production then meat does. Additionally, imports and exports of agricultural goods and food products only increase for livestock, meat and processing of forage (see Figure 3).

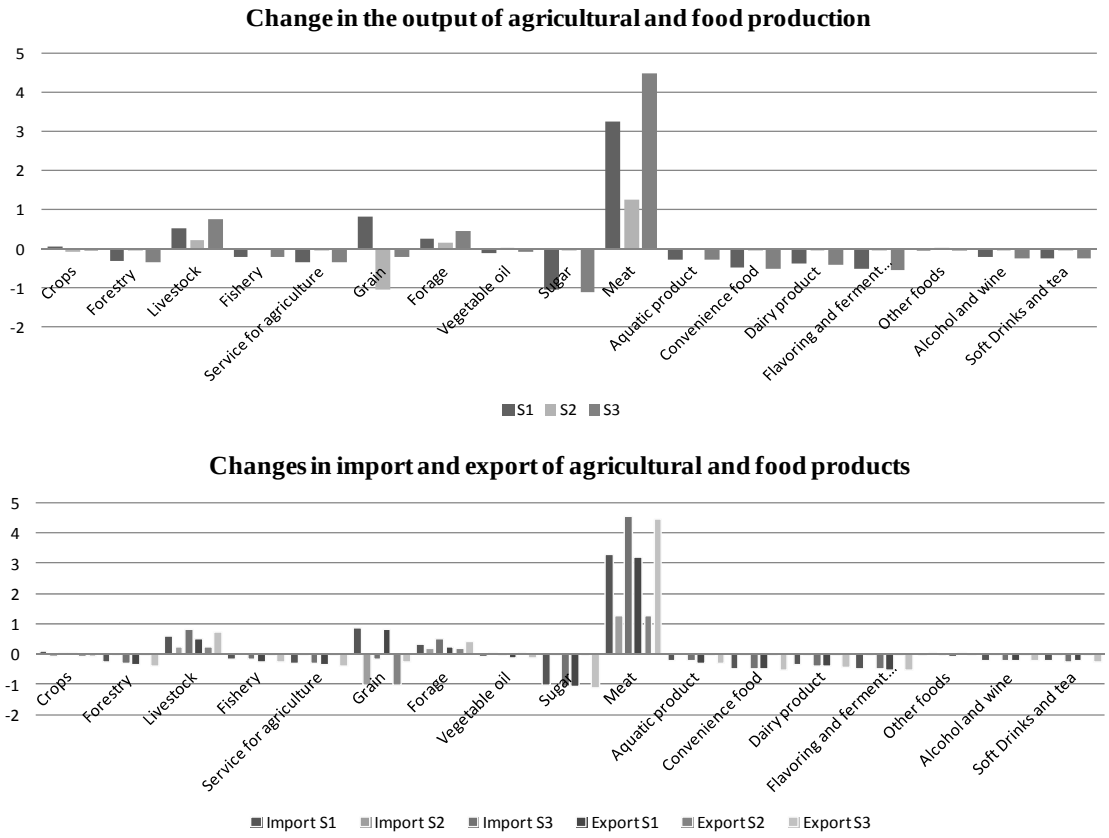

Figure 3 Changes in Output, Import and Export of Agricultural and Food Products in Each Case

5. Conclusion

Change in consumption pattern is a series of events to both of urban and rural household, but in this study we only focused on the various preferences of grain and meat and assumed that others stabilized. The results show that this change contributes to water savings. In the case that the consumption pattern change to more meat and less grain occurs in rural households (S2), both rural and urban households are better off and also the prices of agricultural and food products will not be impacted obviously. However, the positive effect of the increase in meat demand does not sufficiently offset the negative effect of the decrease in grain demand; thus domestic agricultural and food production and imports and exports decrease, with the exceptions of the sectors of livestock, meat and processing of forage (S3). Therefore, grain production is more important to the agricultural and food production sectors than is meat production.

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Appendix 1 Sector Abbreviations and Parameters for Import and Output Functions

	Sectors	Abbreviation Used in paper	Tariff rate (%)*	*Armington Elasticity, σ_i***	*CET Elasticity, Φ_i****
Agricultural goods	Crops	CRO	7	2.2	3.6
	Forestry	FOS	0	2.5	3.6
	Livestock	LIS	0	2.2	3.6
	Fishery	FIS	0	1.3	3.6
	Services in Support of Agriculture	SSA	0	2.2	3.6
Food and tobacco products	Grinding of Grains	GOG	11.3	2.6	4.5
	Processing of Forage	POF	11.3	2.6	4.5
	Refining of Vegetable Oil	RVO	11.3	3.3	4.5
	Sugar	SUG	11.3	2.7	4.7
	Meat product	MEP	11.3	2.2	4.5
	Processing of Aquatic Product	PAP	11.3	2.8	4.5
	Convenience Food	COF	11.3	2.8	4.5
	Dairy Products	DAP	11.3	2.8	4.5
	Flavoring and Ferment Products	FFP	11.3	2.8	4.5
	Other Food Products	OTF	11.3	2.2	4.5
	Alcohol and Wine	ALW	11.3	1.2	4.7
	Soft Drinks and Purified Tea	SDT	11.3	1.2	4.7
	Tobacco	TOB	11.3	1.2	4.7
Water and other sectors	Mining	MIN	2.5	2.8	4.6
	Textiles	TET	11.5	4	5.4
	Wood products	WOP	9	3.4	4.6
	Other Manufacture	OTM	9.4	2.8	4.6
	Electricity	ELE	2	2.8	3.8
	Gas manufacture, distribution	GAS	0	1.9	3.8
	Production and Distribution of Water	WAT	0	2.8	3.8
	Construction	CON	0	1.9	3.8
	Traffic, Transport and Storage	TTS	0	1.9	2.8
	Wholesale and Retail Trades	WRT	0	1.9	2.8
	Hotels and Catering Services	HCS	0	1.9	2.8
	Research and Comprehensive Technical Services	RCT	0	1.9	2.8
	Management of Water Conservancy	MWC	0	1.9	2.8
	Environment Management	ENM	0	1.9	2.8
	Other Services	OTS	0	1.9	2.8

Source: (Willenbockel, 2006**; Li and Lejour, 2000*; Zhai and Hertel, 2005***).

Appendix 2 Equations in Model

1. Domestic production

1.1 1st stage

$$Y_j = b_j \cdot \sum_h^n F_{h,j}^{\beta_{h,j}}$$
$$F_{h,j} = \beta_{h,j} \cdot py_j \cdot Y_j / pf_h$$

1.2 2nd stage

$$X_{i,j} = \alpha x_{i,j} \cdot Z_j$$
$$Y_j = \alpha y_j \cdot Z_j$$

$$pz_j = \alpha y_j \cdot py_j + \sum_i \alpha x_{i,j} \cdot pq_i$$

2. Enterprise

$$RN = \sum_h pf_h \cdot RFN_h$$

3. Government

$$TdH_l = taudH_l \cdot (\sum_h pf_h \cdot FF_{l,h} + PCINDEX \cdot (TEGH_l + TENH_l) + epsilon \cdot FRH_l)$$

$$TdN = taudN \cdot (RN + PCINDEX \cdot TEGN + epsilon \cdot FRN)$$

$$Tz_j = tauz_j \cdot pz_j \cdot Z_j$$

$$RG = \sum_h pf_h \cdot FG_h$$

$$Tm_i = taum_i \cdot pm_i \cdot M_i$$

$$pq_i \cdot Xg_i = \mu_i \cdot \left(\begin{array}{c} \sum_l TdH_l + TdN + \sum_j Tz_j + RG + epsilon \cdot FRG + \sum_j Tm_j - Sg \\ -PCINDEX \cdot (\sum_l TEGH_l + TEGN) \end{array} \right)$$

4. Saving

$$Sp_l = ssp_l \cdot (\sum_h pf_h \cdot FF_{l,h} + PCINDEX \cdot (TEGH_l + TENH_l) + epsilon \cdot FRH_l)$$

$$Sg = ssg \cdot (\sum_l TdH_l + TdN + \sum_j Tz_j + RG + epsilon \cdot FRG + \sum_j Tm_j)$$

$$Sn = ssn \cdot (RN + PCINDEX \cdot TEGN + epsilon \cdot FRN)$$

5. Household block

5.1 Consumption

$$pq_i \cdot Xp_{i,l} = \alpha_{i,l} \cdot (\sum_h pf_h \cdot FF_{l,h} + PCINDEX \cdot (TEGH_l + TENH_l) + epsilon \cdot FRH_l - Sp_l - TdH_l)$$

5.2 Utility values and Hicksian equivalent variations

$$U^0 = \prod_i {Xp_{i,l}}^{0^{\alpha_{il}}}$$

$$U^1 = \prod_i {Xp_{i,l}}^{1^{\alpha_{il}}}$$

$$EV = \frac{U^1}{\prod_i {\alpha_{i,l}}^{\alpha_{i,l}}} - \frac{U^0}{\prod_i {\alpha_{i,l}}^{\alpha_{i,l}}}$$

6. Price Index

$$PCINDEX = \sum_{i,l} {pq_i}^1 \cdot {XP_{i,l}}^0 / \sum_{i,l} {pq_i}^0 \cdot {XP_{i,l}}^0$$

7. Investment

$$pq_i \cdot Xv_i = \Lambda_i \cdot (\sum_l Sp_l + Sn + Sg + epsilon \cdot Sf - (\sum_{nwas} pq_{nwas} \cdot Xst_{nwas} + pq_{was} \cdot REWAS)$$

8. International trade

$$pe_i = epsilon \cdot pWe_i$$

$$pm_i = epsilon \cdot (1 + taum_i) \cdot pWm_i$$

$$\sum_i pWe_i \cdot E_i + Sf + \sum_h NFD_h + \sum_l FRH_l + FRG + FRN = \sum_i pWm_i \cdot M_i$$

9. Import and export

9.1 Armington function for the distribution of demand for import and domestic products

$$\eta_i = (\sigma_i - 1)/\sigma_i$$

$$Q_i = \gamma_i \cdot (\delta m_i \cdot {M_i}^{\eta_i} + \delta d_i \cdot {D_i}^{\eta_i})^{1/\eta_i}$$

$$M_i = \left(\frac{\gamma_i^{\eta_i} \cdot \delta m_i \cdot pq_i}{pm_i}\right)^{\frac{1}{1-\eta_i}} \cdot Q_i$$

$$D_i = \left(\frac{\gamma_i^{\eta_i} \cdot \delta d_i \cdot pq_i}{pd_i}\right)^{\frac{1}{1-\eta_i}} \cdot Q_i$$

9.2 Transformation (CET) function for the distribution of export and domestic sale

$$\varphi_i = (1 + \Phi_i)/\Phi_i$$

$$Z_i = \theta_i(\xi e_i \cdot E_i^{\varphi_i} + \xi d_i \cdot D_i^{\varphi_i})^{\frac{1}{\varphi_i}}$$

$$E_i = \left(\frac{\theta_i^{\varphi_i} \cdot \xi e_i \cdot (1 + tauz_i) \cdot pz_i}{pe_i}\right)^{\frac{1}{1-\varphi_i}} \cdot Z_i$$

$$D_i = \left(\frac{\theta_i^{\varphi_i} \cdot \xi d_i \cdot (1 + tauz_i) \cdot pz_i}{pd_i}\right)^{\frac{1}{1-\varphi_i}} \cdot Z_i$$

10. Marketing clear conditions

$$Q_{nwas} = \sum_l Xp_{nwas,l} + Xg_{nwas} + Xv_{nwas} + \sum_j X_{nwas,j} + Xst_{nwas}$$

$$\sum_j F_{h,j} + NFD_h = \sum_l FF_{l,h} + FG_h + RFN_h$$

11. Water block

Total water supply would be fixed, in case the gap presenting the difference between water demand and supply, "WATGAP", was introduced

$$\sum_i X_{was,i} + \sum_l Xp_{was,l} + WATGAP = \overline{WATT}$$

12. GDP

$$GDP = \sum_{h,j} pf_h \cdot F_{h,j} + \sum_j Tz_j + Tm_j$$

Notation for sectors and time

i, j	Goods
h, k	Factors
l, w	Households
0, 1	Periods in benchmark and propose change
nwas	Non-water sectors
was	Water sector

Endogenous Variables

(1) Price variables

pf_h	Price of the h-th factor
py_j	Price of the composite factor in the j-th firm
pq_j	Price of the i-th composite good (Armington good)
pd_j	Price of i-th domestic good
epsilon	exchange rate
pe_j	Price of the i-th export good in terms of domestic currency
pm_j	Price of the i-th import good
pz_j	Unit cost for the j-th firm's output at 2nd stage

(2) Quantity Variables

Y_j	Composite factor of the j-th firm
$F_{h,j}$	The h-th factor used by the j-th firm at 1st stage
$X_{i,j}$	The i-th intermediates of the j-th firm at 2nd stage
Xv_i	Demand for the i-th investment good
$Xp_{i,l}$	The l-th household consumption of the i-th good
Xg_i	Government consumption of the i-th good
Sp_l	The l-th household savings
Sg	Government savings
Sn	Enterprise savings

Q_i	The i-th Armington composite good
M_i	The i-th import good
D_i	The i-th domestic output
Z_i	Gross domestic output of the j-th firm
E_i	Exports on the i-th good
WATGAP	Gap between water demand and supply

(3) Value variables

TdH_l	Direct tax revenue of the l-th household
TdN	Direct tax revenue of enterprise
Tz_j	The j-th production tax balance (production tax - subsidies)
Tm_i	Import tariff of the i-th good
RN	Revenue from enterprise's endowment
RG	Revenue from government's endowment
PCINDEX	Price index
GDP	Gross domestic product

Exogenous Variables

Xst_i	Stock change
NFD_h	Net revenue of factor from foreign demand
$FF_{l,h}$	The h-th factor endowment of the l-th household
FG_h	The h-th factor endowment of government
RFN_h	The h-th factor endowment of enterprise
Sf	Foreign saving in US dollars
FRH_l	Foreign revenue of household
FRG	Foreign revenue of government
FRN	Foreign revenue of enterprise
pWe_i	Export price in US dollars
pWm_i	Import price in US dollars
WATT	Total water supply
$TEGH_l$	Transfer receipts from government to l-th household
$TENH_l$	Transfer receipts from enterprise to l-th household
TEGN	Transfer receipts from government to enterprise

Parameters

σ_i	Elasticity of substitution (domestic good or import)
Φ_i	Elasticity of transformation (domestic good or export)
η_i	Transformation substitution elasticity parameter
φ_i	Transformation elasticity parameter
$\alpha_{i,l}$	The i-th share parameter in the l-th household's utility function
$\beta_{h,j}$	The h-th input share parameter in production function at the 2nd stage
b_j	Scale parameter in production function at the 2nd stage
$\alpha x_{i,j}$	The i-th input intermediate requirement coeff. by j-th firm
αy_j	Composite factor input requirement coeff. by the j-th firm
μ_i	Government consumption share
Λ_i	Investment demand share
δm_i	Share parameter of the i-th import goods in Armington function
δd_i	Share parameter of the i-th domestic goods in Armington function
γ_i	Scale parameter in Armington function
ξe_i	Share parameter of the i-th domestic goods in transformation function
ξd_i	Share parameter of the i-th export goods in transformation function
θ_i	Scale parameter in transformation function
ssp_l	Average propensity for private saving of the l-th household
ssg	Average propensity for gov. saving
ssn	Average propensity for enterprise saving
$taudH_l$	Direct tax rate for the l-th household
taudN	Direct tax rate for the enterprise
$tauz_j$	Production tax rate for j-th firm
$taum_i$	Import tariff rate for i-th good

Appendix 3 Social Accounting Matrix of China Marco Economy

	CRO	FOS	LIS	FIS	SSA	MIN	GOG	POF	RVO	SUG	MEP	PAP	COF	DAP	FFP	OTF	ALW
CRO	21086505	245502.12	19772186	1375381	1415443.1	7709.4646	25657773	15055462	19888436	2953843.3	285946.95	150693.94	1157423.8	289316.44	2595093.3	21313269	5360247.4
FOS	75607.476	1208970.4	43451.748	69757.512	66142.466	771879.48	172602.76	44.507793	3346.586	15519.913	429.08129	384.1641	18477.38	72326.974	130301.56	601615.68	17538.764
LIS	399618.94	19754.626	13231699	44152.406	539959.9	1414.3379	324.34296	947135.89	799086.79	39271.637	27450488	0	163050.32	5315323.2	194389.46	5063993.7	152514.2
FIS	243.7502	99.367872	9003.7874	1597427.2	59696.081	268.8303	0	1642051	132974.6	4486.9272	122971.86	13334471	24356.78	21956.98	36609.472	931032.36	23936.462
SSA	4135684.1	571858.51	1128987.1	937362.41	737071.23	0	0	0	0	0	0	0	0	0	0	0	0
MIN	160169	16953.741	110755.75	29503.944	13471.126	21882623	30100.655	62615.107	277669.33	26891.592	16546.284	10219.263	97138.705	128004.14	97912.096	355219.81	187220.11
GOG	1311841.7	700.18074	7260392.1	492829.67	154215.94	0	1329037.8	2691016.7	290637.44	34125.529	24982.824	126516.02	2583687	5428.9414	428719.5	3858747.7	2327811.2
POF	1011122.1	2968.5038	30170236	4905616.9	426220.83	0	0	1586006.4	0	0	417329.34	248474.04	0	0	0	2408.2778	0
RVO	109191.11	8217.4808	784499.37	92815.118	119414.29	2904.712	277272.03	2220249.9	8829539.7	19266.094	539140.7	477328.56	756321.61	140276.42	295169.17	3602897.3	103328.19
SUG	216.05017	9.3006238	184.51695	2.3123986	0	0	0	0	0	598782.19	31836.279	63582.81	60043.06	265566.11	156658.46	1581592.5	136341.61
MEP	0	0	0	0	0	0	0	298554.06	0	0	4452349.8	207173.04	390937.61	30701.32	67196.931	962135	0
PAP	0	0	5192.9644	16106.163	0	0	0	2225497.1	0	0	0	2415279.8	48707.645	32647.499	83575.872	628363.94	22682.92
COF	0	0	0	0	0	0	0	0	0	0	0	0	326623.5	0	0	0	0
DAP	0	0	0	0	0	0	0	0	109120.87	0	0	0	30878.564	1896811.9	22261.505	981384.24	21397.247
FFP	0	0	0	0	0	0	0	94582.056	46264.144	1778.6853	210692.76	112065.54	533289.88	44957.218	946073.32	601495.46	132223.84
OTF	0	0	0	0	39298.456	0	192841.7	2649066.2	366787.47	46323.414	977494.73	675476.49	827576.99	562040.51	958314.67	5449312.1	394801.46
ALW	25676.36	1774.8788	15942.094	3394.0186	27013.69	2249.3475	0	39859.165	0	0	5277.5893	9442.9776	10644.703	14693.172	32101.441	110940.78	2205107.1
SDT	1596.2894	2421.5954	1007.3444	309.2199	7340.0699	136893.1	35230.257	33397.561	35844.992	6995.1337	40226.953	793.94151	2336.8773	29557.51	3336.0811	96499.097	6553.5503
TOB	0	0	0	0	25098.113	503499.46	51552.852	61874.34	74350.056	13171.17	82851.133	37474.369	23901.749	31570.651	17273.604	125924.53	45677.543
TET	14623.261	25596.614	31413.783	5747.1375	194218.16	1365185.8	68872.221	44550.791	46762.778	12722.309	26888.757	16479.73	20686.383	23380.716	38963.077	146962.85	99582.54
WOP	202740.38	33605.444	84076.84	120367.06	51530.658	1485265	22345.287	18160.081	10777.499	1729.637	26547.134	14449.01	11086.772	32701.867	11056.859	149863.4	74096.26
OTM	39363487	2105420.3	2029685.3	4022856.3	2151903	70945599	1032072.2	1645373.5	1271545.5	320124.3	1307623.4	1106051.6	1162028	2125778.3	1248401.7	6701153.9	3605343.4
ELE	3553636	52758.751	420560.81	335170.58	220757.66	23497962	716525.14	362491.93	370910.11	125600.98	183715.76	154928.36	151216.47	184532.66	193888.21	1223596.3	360762.64
GAS	10222.499	594.71315	2576.5717	3517.6639	1552.4117	682847.65	13980.408	3331.1433	5615.0013	6933.7175	6057.3437	5799.126	15925.956	13186.593	10926.295	72893.424	43119.668
WAT	22931.283	7357.6481	10919.864	9203.0087	40478.401	401326.43	27615.54	28613.939	27932.705	3223.3422	21878.665	25508.055	1901.9372	13126.477	1157.7896	13904.208	41821.198
CON	93195.298	4378.8068	5921.231	4165.9842	5610.1289	270149.34	7646.9816	7539.5203	5741.2134	2333.1682	9696.5211	4036.8548	2708.9516	3407.2129	2789.013	23861.744	15169.027
TTS	4165568.9	414671.83	1370491.8	848631.79	853120.88	12113766	948443.54	754350.95	823542.59	250210.98	694367.18	586079.61	364280.75	542183.9	390174.59	2788833.8	1252157
WRT	2506388.1	214801.4	3672097.9	578937.1	252368.77	3271456.2	765532	944250.04	757229.62	133841.51	1357440.1	580263.3	293958.2	447014.57	362390.36	1868851.9	753663.28
HCS	456630.84	138275.2	164808.44	113048.22	419651.9	3249000.7	156289.66	173535.41	103624.99	26039.136	143913.92	114845.34	73820.199	129042.23	74149.07	492315.38	309603.6
RCT	2313969.1	249718.87	810273.64	178985.26	255330.36	2236670.4	60724.619	129789.47	37299.902	12376.67	104521.09	51130.489	24467.226	50338.93	24599.489	284112.56	180485.4
MWC	565715.6	14021.133	45629.798	91710.024	115502.41	31472.858	0	0	0	3054.5181	357.65865	136.90993	0	134.74234	283.72366	1345.9229	3221.8798
ENM	126081.7	1647.9458	17250.659	1638.4551	9065.2258	323797	3076.4684	2242.0909	1268.9076	5091.2244	4925.4967	5664.2516	1637.9098	2307.535	5649.0031	16896.09	20099.642
OTS	4869570.9	526404.11	2031321.9	1393885.5	1182982.1	10627133	601248.54	624375.54	650883.19	280473.84	906938.37	631702.43	371297.64	769059.24	615210.52	3218674.8	1440652.2
LAB	151544213	12115730	74125305	25947006	8084016.1	48631487	2888913.5	3306109.2	3104129.6	427300.11	3489224.7	2695611.6	655922.37	773645.93	608651.06	4383735.3	2638099.3
CAP	7985534.3	635786.18	3894127.9	1360472.5	421526.73	64203005	3277407.2	2801707.8	3774395.5	569186.78	2485553.8	1833334.8	1319926	1582492.9	1123789.6	7826970.6	4292371.7
DIT																	
NTP	478020	0	0	0	0	25163431	1471828.9	783246.96	1281171.7	382005.56	1726666.8	1126458.9	516089.45	679522.18	483953.97	3390404.6	3170804.9
TRF	974865.53	0	0	0	0	2521677	42411.476	11625.679	584464.95	44899.269	215939.32	300464.08	1623.1308	72407.269	9277.0691	184450.32	100801.19
RUH																	
URH																	
GOV																	
ENT																	
INV																	
STC																	
ROW	13926650	6565406.1	1625679.6	150754.82	36252.663	100867081	375322.79	102882.11	5172256.2	397338.66	1910967.5	2658974.1	14363.989	640772.29	82097.957	1632303.7	892045.92
TOT	261491516	25185406	162875680	44730755	17926253	395197753	40226992	41351588	48883610	6764941.3	49281788	29781294	12058337	16966214	11352396	80687962	30431282

(**Appendix 3 continued)**

	SDT	TOB	TET	WOP	OTM	ELE	GAS	WAT	CON	TTS	WRT	HCS	RCT	MWC	ENM	OTS	LAB
CRO	3031672.6	3811673.7	24127109	812001.85	10574151	3754.903	917.67699	0	1374483.4	3787943.8	53769.314	2495672.4	248155.59	4925.4246	61079.876	2594389.5	
FOS	92146.79	9.8599833	30576.242	12324748	7841731.9	633.09819	131.05106	0	1218517.8	7831.0193	0	201008.77	61614.029	0	0	117769.14	
LIS	360546.22	0	13488026	0	10419550	0	236.21126	0	0	544.57578	16498.296	7231511.2	147594.16	0	14807.679	355703.87	
FIS	24617.716	0	193413.58	35778.821	166888.1	0	39.96175	0	0	1087.2235	6175.9032	7842055.4	97752.865	0	0	152558.41	
SSA	0	0	6253083.9	30949.8	28486.392	0	0	0	0	0	0	0	0	0	0	0	
MIN	149920.27	59671.938	1863066.8	593152.43	305373886	36697115	6241526.4	35911.73	8916077.5	1506235.6	84025.229	468497.82	164767.44	25927.711	51872.153	1997300.2	
GOG	139862.09	0	14482.307	36614.792	148745.81	0	0	0	0	17769.586	72076.012	2371777.9	15983.002	0	0	240470.57	
POF	0	0	0	0	62575.126	0	0	0	0	0	30872.931	0	0	0	0	0	
RVO	139172.74	0	833778.39	156893.14	4511158.8	3932.8734	172.18204	104.85683	27108.193	20793.75	248239.99	4968749.2	14480.742	98.517968	9797.6788	636978.76	
SUG	1636214.8	0	0	0	283423.36	0	27.485312	46.901338	0	749.56273	0	153312.98	0	0	0	30634.82	
MEP	0	0	7920095.2	0	516276.7	0	0	0	0	10221.657	26921.846	7372684.2	1685.7138	0	23069.685	52714.218	
PAP	24377.869	0	0	0	412108.16	0	0	0	0	4881.5451	8264.7144	8168997.1	28342.427	0	1179.0525	187893.82	
COF	0	0	0	0	0	0	0	0	0	296723.58	0	549489.63	0	0	0	23325.247	
DAP	1004950.3	2.5847464	0	0	1310.9544	0	0	0	0	254.90355	0	655918.3	0	0	0	75837.401	
FFP	39439.455	398.81765	0	0	75305.433	0	0	0	0	638.10807	0	1775030.6	0	0	0	0	
OTF	1498423.5	8703.8486	156502.65	1793.0407	1031491	0	0	0	0	706101.07	151376.96	4982162	83807.299	777.53973	7522.1116	1943623.9	
ALW	617056.17	4940.3799	610849.9	2997.6761	1702412.1	578.65303	50.103158	0	954168.43	63433.383	36604.999	7791245.2	30847.384	6650.289	7168.3437	2788307.3	
SDT	1393861.5	79170.916	603379.61	146654.57	5273823.6	302443.22	14399.667	16616.191	394499.75	754926.87	342428.59	3538230.3	14888.699	643.4704	13943.805	1922632.9	
TOB	39509.538	2468090	664490.77	184514.99	5593028.1	633511.4	21533.622	16218.396	1073036.2	549892.5	1023537.8	1678699.2	94014.313	7623.221	7625.5835	2348743.9	
TET	61395.594	142104.74	18811775	3281966	26576386	1036145.5	110113.96	66277.306	2681494.9	2392438.5	3520930.1	1320880	408344.92	14313.773	105971.33	12928343	
WOP	40149.967	30705.174	518803.73	31860103	16045559	188270.25	11269.348	18521.525	10961007	337370.83	1186089	277313.48	80062.194	41358.068	49189.177	9832972.4	
OTM	5173811.9	5063446.7	58642131	21780305	1.997E+09	46112817	857888.39	1584758.6	345675189	96914898	20573918	5741369.7	12886609	492485.88	1686738.1	204119584	
ELE	396148.77	105781.2	6748770.2	2463790.7	110030640	112937137	184713	2311912.3	8271960.9	3506077.6	4382615.2	3769724.1	447993.16	84893.886	105184.68	15313735	
GAS	16067.948	12796.996	184822.33	47647.887	3862755	330935.92	491212.48	38280.753	67811.385	318729.94	72750.963	417108.45	13175.866	129.88691	6712.8611	507804.46	
WAT	41366.401	21911.024	404365.46	110055.14	3667159.1	599255.79	8121.4335	408817.28	232625.1	247509.38	230025.52	503668.92	89736.662	14127.014	11203.786	1579661.7	
CON	8795.8955	13837.754	98445.881	25351.807	979746.59	96013.493	6554.8329	14052.156	5980359.8	998403.98	902395.63	373619.61	139464.18	28541.472	100277.53	9765349.9	
TTS	1002849.9	650901.05	7783258.5	3348097.7	76643043	3594803.3	263864.82	102923.32	47242283	21623598	25745293	1949336.2	1694193.2	67828.407	101947.26	23775520	
WRT	849510.4	890989.14	6410770.3	2205490.7	73207573	2345982.1	156906.69	74149.415	14665872	3573987.6	1876772.7	4133123.8	654343.94	23803.95	78110.086	17228686	
HCS	228360.73	222624.62	1827362.5	555669.16	16878926	796284.98	39980.894	90133.751	5561411.4	3842666.5	6848143.5	1216257.6	1836540.7	96938.888	97906.831	38574647	
RCT	216389.01	178726.5	1012483.8	203970.71	20265796	2057170.1	19284.644	16773.29	5695229.2	398794.03	1783279.2	27275.847	2507496.7	30443.811	22299.283	2413442.9	
MWC	24177.605	0	2905.4324	707.00056	456481.04	346311.85	3184.1567	583586.24	0	0	0	0	0	208740.19	0	0	
ENM	5526.5525	20990.375	334577.03	14128.695	723930.53	153003.41	1118.4857	6651.9138	30919.372	95398.039	90241.152	60878.476	11799.446	5831.0553	66698.973	1632588.6	
OTS	1771028.1	836499.83	14391515	3586421.4	109863733	18525264	429208	921901.62	21058785	28777011	45687796	10451549	3062922	338742.6	678297.18	133931204	
LAB	1759117.9	4177017	37411997	10377523	234205869	20980548	930961.08	2442855	74053207	37837386	41886090	15378831	14856995	1460009.2	1711396.6	255584097	
CAP	3292416.4	4278124.6	32990403	10350072	356722146	55684336	1132746	2289958.1	53077633	94544054	89392906	34130727	10776822	1617122.8	1097351	314013473	
DIT																	
NTP	1589867	15817359	19060066	5401906.4	157716265	11433636	156732.67	747811.9	18003673	13862761	42045373	6157651.4	2180256	66375.675	71479.881	50222413	
TRF	23887.584	13430.397	1471857.2	223334.79	44512386	3526.6053	0	0	0	0	0	0	0	0	0	0	
RUH																	177073722
URH																	926699469
GOV																	
ENT																	
INV																	
STC																	
ROW	211394.55	118853.07	12798759	2481497.7	475559675	176330.26	0	0	2212627.1	10631808	0	5233456	6229250	0	0	36187417	
TOT	26904034	39028762	446969899	1126441138	4.079E+09	315039741	11082895	11788262	629429979	327632921	288325411	153387813	58879940	4638332.8	6188830.5	1.143E+09	1.104E+09

	CAP	DIT	NTP	TRF	RUH	URH	GOV	ENT	INV	STC	ROW	TOT
CRO					29090841	24948489	0		0	10444576	5415678	261491516
FOS					226823.82	189595.63	0		0	-430386.46	34258.688	25185406
LIS					16964396	25375559	0		10671736	22929950	536842.18	162875680
FIS					5311403.8	9453391.2	0		0	2831622.3	672383.73	44730755
SSA					0	0	3416229.6		0	685917.44	622.50982	17926253
MIN					873463.11	604441.55	0		0	-412624.78	6400504.6	395197753
GOG					4573232.8	6933327.5	0		0	1988472.6	753486.33	40226992
POF					0	84457.522	0		0	2013735.8	389563.82	41351588
RVO					4688659	8305354.1	0		0	5484366.5	455939.15	48883610
SUG					467394.19	565909.26	0		0	517097.07	215315.68	6764941.3
MEP					6886002.3	15895958	0		0	2365040.7	1802069.8	49281788
PAP					1019146.4	7283511.1	0		0	1505269.7	5659268.2	29781294
COF					3590652.7	5930362.2	0		0	970355.62	370805.03	12058337
DAP					1407036.4	9555520.4	0		0	947246.2	256282.72	16966214
FFP					1381262.5	4472350.2	0		0	623819.75	260728.11	11352396
OTF					8574704.6	38395303	0		0	3509437.4	6496898.3	80687962
ALW					3870935.9	7167665	0		0	1916542	354712	30431282
SDT					2131610.6	5798749.6	0		0	1802178.4	1918611.7	26904034
TOB					5426024.8	12473933	0		0	3443059.9	187454.5	39028762
TET					12015254	49122300	0		0	1999530.9	138885320	446969899
WOP					1027016.9	4145089.5	0		11827624	-2429393.3	24244658	112644138

(**Appendix 3 continued)**

OTM					25158781	96377100	0		372350398	-4091233.5	622688980	4.079E+09
ELE					5074715.2	18454891	0		0	-12311087	651130.47	315039741
GAS					467087.71	2752837.4	0		0	575146.86	0	11082895
WAT					516099.44	2704988.6	0		0	-301335.71	0	11788262
CON					0	9318748.3	0		588465912	7557010.9	4088746.8	629429979
TTS					5593112.3	17915135	16214816		2632806.2	696676.29	39829759	327632921
WRT					20602804	56874280	0		18821092	4815034	40075644	288325411
HCS					12972839	44507053	0		0	3490237.5	7365234.4	153387813
RCT					0	0	14508702		0	257053.23	260535.85	58879940
MWC					0	0	2021972.2		0	117679.93	0	4638332.8
ENM					62407.078	564611.04	1744996.3		0	14194.33	0	6188830.5
OTS					63198734	236182832	314002470		49589132	9914486.9	45138477	1.143E+09
LAB											3300190.7	1.104E+09
CAP												1.175E+09
DIT					26813448	113162352		77237366				217213166
NTP												385187233
TRF												51313329
RUH	304497279						6781657	18056596				506409254
URH	128170543						84294899	40060849			29528978	1.209E+09
GOV	44920324	217213166	385187233	51313329							-126195.98	698507856
ENT	697189731						20605400				16233339	734028470
INV					236423365	373238642	234916714	598673660			-3.15E+08	1.128E+09
STC									73439677			73439677
ROW												688892218
TOT	1.175E+09	217213166	385187233	51313329	506409254	1.209E+09	698507856	734028470	1.128E+09	73439677	688892218	