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The Chinese Economy From 1997-2015: Developing a Baseline for the MC-HUGE Model

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The Centre of Policy Studies (COPS) is a research centre at Monash University devoted to quantitative analysis of issues relevant to Australian economic policy.

Abstract

MC-HUGE is a dynamic Computable General Equilibrium model of the Chinese economy. The core CGE part of the MC-HUGE model is based on that of the ORANI model. The dynamic mechanism of MC-HUGE is based on that of the MONASH model. This paper documents how the MC-HUGE model is calibrated to China's economic growth data from 1997 to 2005. It also reports how the model is used to forecast a growth path for the Chinese economy from 2005 to 2015. The historical and the forecast simulation produce a baseline or a business-as-usual scenario with which to compare the effects of any changes in economic policies or environment.

Key Words: China, CGE modelling, economic growth, oil
JEL classifications: C68, F14, O10

Acronyms and Initials

CGE	Computable General Equilibrium
CoPS	Centre of Policy Studies
GDP	Gross Domestic Product
GNE	Gross National Expenditure
GNP	Gross National Product
GTAP	Global Trade Analysis Project
IEA	International Energy Agency
MC-HUGE	Monash-China Hunan-University General Equilibrium
SIC	State Information Centre
UNPD	United Nation Population Division
WDI	World Development Indicators
WTO	World Trade Organisation

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Tables and Figures

1. Introduction

The MC-HUGE (**M**onash-**C**hina **H**unan-**U**niversity **G**eneral **E**quilibrium) Model is a dynamic Computable General Equilibrium (CGE) model of the Chinese economy. It was developed through a joint research project between the Centre of Policy Studies (CoPS) and the Hunan University.

The core CGE part of the MC-HUGE model is based on that of ORANI, a static CGE model of the Australian economy (see Dixon, Parmenter, Sutton, and Vincent 1982). The dynamic mechanism of MC-HUGE is based on that of the MONASH model of the Australian economy developed at CoPS (see Dixon and Rimmer 2002). Version 1 MC-HUGE has 57 commodities and industries of the Global Trade Analysis Project (GTAP)[1] database (Table 1).

This paper reports how the MC-HUGE model is calibrated to China's economic growth data from 1997 to 2005. It also reports how the model is used to forecast a growth path for the Chinese economy from 2005 to 2015. The calibration of the model to historical data is called a historical simulation. The historical simulation from 1997 to 2005 and the forecast simulation from 2005 to 2015 produce a business-as-usual scenario or a baseline for the model. Under a dynamic CGE framework, the effects of any policy changes are measured as deviations of economic variables from their baseline levels (Figure 1).

Section 1 of this paper contains this introduction. In section 2 I discuss the methodology of the historical simulation. In sections 3 to 5 I discuss macroeconomic data. In sections 6 to 13 I discuss industry data. For each of the topics in sections 3 to 13, I report sources of data for the historical period 1997-2005 and assumptions used to develop the forecast simulation. Section 14 contains a summary of the key results of the historical and forecast simulations. Section 15 concludes this paper.

[1] The GTAP version 5 database contains 1997 input output data for China (for details about GTAP 5 database see Dimaranan and McDougall 2002). The 2002 China input-output table was released after the modelling work for Version 1 MC-HUGE was well underway, we were therefore unable to incorporate it into the Version 1 MC-HUGE model. We expect to use the 2002 China input-output table for the Version 2 MC-HUGE database.

2. How does a historical simulation work?

In a standard policy simulation using a CGE model, quantities and prices of production outputs and inputs, consumption, and international trade are typical endogenous variables; while production technology and consumer preferences are typical exogenous variables. In these simulations, the model is informed of a change in a technology or policy variable (such as a deterioration in agricultural productivity or a tariff cut), and the model calculates the resulting changes to GDP, consumption, output, employment and other endogenous variables.

In a historical simulation, the model operates in a reverse fashion with GDP, production, consumption and international trade exogenous, and the corresponding technical and preference change variables (such as multi-factor productivity) endogenous. In a historical simulation, the model is informed of changes in GDP, consumption, investment, and other observed variables during a historical period. It then calculates the necessary changes in technology and preferences.

The historical-simulation technique using a CGE model was first applied in a systematic manner by Dixon and Rimmer (2002) when they developed the MONASH model of the Australian economy. Since then, many others have used the approach to calibrate other dynamic models and to estimate technology and preference changes (Mai, Perkins and Horridge 2003).

The MC-HUGE model is a very large model with hundreds of thousands of equations and variables. The detail is necessary for answering practical policy questions. However, the few equations listed in Box 2.1 can provide a good understanding of the fundamentals of the model. Together they form the Back-Of-The-Envelope (BOTE) model (Dixon et al 1982 and Dixon and Rimmer 2002) that is very useful in explaining simulation results. In the following paragraphs, we use the BOTE model presented in Box 1 to explain the methodology of the historical simulation conducted for this study.

The modelling starts with a database that describes the structure of the Chinese economy in 1997. The GTAP version 5 database (Dimaranan and McDougall 2002) is the main source of input-output data for the Version 1 MC-HUGE model.

The historical simulation is an effort to understand how the Chinese economy evolved from 1997 to 2005. In the context of the BOTE model, we force the model to replicate observed growth in the following macroeconomic variables for the period 1997-2005:

- real GDP (Y), GDP price index (P_g), consumption (C), investment (I), government expenditure (G), exports (X) and imports (M); and
- population and employment (L) for each country in the model.

The model has dynamic equations that link the economy from one year to the next. One such equation block models the accumulation of physical capital where the capital stock in the following year equals the capital stock in the current year plus investment in the current year minus depreciation (Equation (5) in Box 2.1). Once we inform the model the growth in investment (I), the growth in aggregate capital stock (K) is determined by the equation block modelling the accumulation of capital stock through investment in the model.

After we have informed the model of Y, L and I (and thus K), changes in technology (A) will be solved for by the aggregate production function (Equation (2) in Box 2.1). Since growth in the GDP price index (P_g) is also tied down, Equation (3) in Box 1 will solve for the capital rental (Q) and Equation (4) will solve for the wage level (W).

Box 1 The BOTE Model

The two most important relationships in the MMC model are the GDP identity and the aggregate production function:

$$Y = C + I + G + X - M, \quad \text{and} \tag{1}$$

$$Y = \frac{1}{A} * F(K, L) \quad , \tag{2}$$

where Y is GDP;
C is consumption;
I is investment;
G is government expenditure;
X is exports;
M is imports;
K is aggregate capital stock;
L is aggregate employment; and decreases in A allow for technological progress.

Equilibrium in the capital market requires the real cost of capital to be equal to the marginal physical product of capital. Hence:

$$\frac{Q}{P_g} = \frac{1}{A} * F_k(K/L) \quad . \tag{3}$$

where
Q is the rental per unit of capital;
P_g is the price of a unit of GDP; and
F_k is the partial derivative of F with respect to K. We write F_k as a function of K/L under the assumption that F is homogenous of degree one.

Labour-market equilibrium requires:

$$\frac{W}{P_g} = \frac{1}{A} * F_\ell(K/L) \quad , \tag{4}$$

where
W is the wage rate; and
F_ℓ is the partial derivative of F with respect to L.

The final equation in our BOTE model explains capital in the current plus one year as the sum of net capital in the current year plus investment. Hence:

$$K_1 = K + I - D. \tag{5}$$

where
K and K_1 are the capital stock in the current and following year respectively; and
I and D are investment and depreciation in the current year.

At the industry level, we force the model to replicate historical growth for output (Y_i), employment (L_i), wages (W_i) and the price of output (P_i)[2]. Consequently, the industry versions of the aggregate production function (2) and factor market equilibrium conditions (2) and (3) can jointly solve for industry specific capital stock (K_i), rental (Q_i) and technology (A_i).

The main data sources used in this study to conduct the historical simulation are:

- China National Bureau of Statistics;
- State Information Centre;
- Chinese Ministry of Agriculture;
- Chinese Ministry of Commerce;
- World Bank, World Development Indicators;
- United Nation, United Nations Commodity Trade Statistics Database;
- International Labour Organisation;
- Food and Agriculture Organisation, FAOSTATS;
- International Energy Agency;
- International Monetary Fund, International Financial Statistics;
- BP;
- United Nations Conference on Trade and Development (UNCTAD), World Investment Report;
- United Nation Industrial Development Organisation, International Yearbook of Industrial Statistics; and
- United National Population Division.

In the next ten sections, I'll discuss how these data are incorporated into the historical simulation. For changes made to model closure in order to incorporate observed statistics into the historical simulation, see Box 2.

[2] i denotes industry i. In the full model there are 57 industries.

Box 2. Closure changes for the historical simulation

As in other CGE models, the number of equations in the MC-HUGE model is smaller than the number of variables. A model closure specified by a user informs MC-HUGE which variables are to be determined exogenously and which variables are to be determined by the model's equation system. The number of variables that the model can solve for equals to the number of equations in the model.

Structurally, output, consumption, investment, imports and exports are endogenously determined by the model, because MC-HUGE has equations that explain the movements of these variables. However, in a historical or a baseline forecast simulation, we force the MC-HUGE model to replicate observed changes in these variables and allow MC-HUGE to endogenously solve for relevant behaviour variables. The changes to a structural closure to conduct the historical simulation are listed below:

- exogenise consumption by commodities and endogenise corresponding consumer preference variables;
- exogenise investment by industries and endogenise variables that allow the corresponding capital supply curves to shift;
- exogenise imports by commodities and endogenise corresponding variables describing user preference in favour of (or against) imports;
- exogenise exports by commodities and endogenise variables that allow the corresponding export demand curves to shift;
- exogenise employment and endogenise corresponding labour productivity variables;
- exogenise output by industries and endogenise corresponding efficiency variables in the usage of intermediate goods in current production;
- exogenise wage rates by industry and endogenise the corresponding variables that affects the difference in wage levels by industry;
- exogenise price of value added by industry and endogenise the corresponding technology variables that affects capital/labour ratio by industry.

3. Real GDP from Expenditure Side

3.1 Data for historical simulation

In this study, the main data source used for the growth rates of real GDP and its expenditure-side components is the World Bank World Development Indicators (WDI). Table 2 shows the annual growth rates of real GDP, consumption, investment, government expenditure, exports and imports from 1998 to 2005.

Before I incorporate the model the WDI growth rates for GDP components, I check whether the real GDP growth and the growth rates of its components satisfy the GDP identity (Equation (1) in Box 1):

$$Y = C + I + G + X - M \qquad (1)$$

Where Y, C, I, G, X, and M are levels of GDP, consumption, investment, government expenditure, exports and imports respectively.

To do this, I multiply the levels of C, I, G, X and M in the MC-HUGE database with the respective WDI growth rates to see if the implied changes in GDP components sum to the level of GDP in the MC-HUGE database multiplied by the WDI growth rate for real GDP. I illustrate this here for the first simulation year, 1998.

	1997 levels in MC-HUGE database	WDI rates of growth in 1998	Resulting changes in 1998	Scaled rates of growth
	(a)	(b)	(a)*(b)/100	
Consumption	414093	6.8	27993	5.6
Investment	309995	12.6	38904	10.4
Government	104350	9.6	9976	8.0
Exports	241436	7.2	17287	6.0
Imports	-215161	3.1	-6692	2.6
Sum of GDP components	854713		**87468**	
Real GDP	854713	7.8	**66668**	

We can see from the above calculation that the growth rates of GDP components imply a larger change in real GDP (87468) than that suggested by the real GDP growth rate of 7.8 per cent (66668).

To deal with this data inconsistency, I scale the growth rates of GDP components proportionally so that they are consistent with the real GDP growth rate of 7.8 per cent for the year 1998 (in terms of GDP identity). In this case, I choose to consider real GDP growth as being more reliable than the growth rates of its components.

While the growth rates of GDP components are adjusted, the pattern presented by the WDI data is preserved. That is, consumption grew slower and investment grew faster than real GDP. While in most of the years, trade grew much faster than real GDP, in this particular year, trade grew slower than real GDP. Exports grew faster than imports (see the above calculation).

I apply this calculation to all the years during the historical period (1997-2005). The resulting growth rates of GDP components are presented in Table 3. These numbers are used as input into MC-HUGE for the historical simulation from 1997 to 2005[3].

Tables 2 and 3 show that China enjoyed a high GDP growth of around 9 per cent from 1997 to 2005. Within Gross National Expenditure (GNE), real investment (or gross fixed capital formation) grew much faster then real private and government consumption indicating a high saving rate in China. Both export and import volumes grew at double digits, much faster than real GDP and GNE. The volume of export grew faster then the volume of import contributing to China's current account surplus during the period.

3.2 Data for forecast simulation

For the forecast period from 2005 to 2015, I assumed that real GDP will settle down to a slower longer-term trend of around 7.9 per cent (Table 4). The growth of GDP components shows similar characteristics as in history, that is, higher growth in investment than in consumption and high growth in trade volumes. The relative rates

[3] For the year 2005, I assumed that the growth rates of GDP components are the same as their average annual rates from 1997 to 2004.

of growth for the GDP components presented in Table 4 are derived from WDI data for a longer historical period from 1980-2005.

4. Production factors

4.1 Population and Employment Growth

The sources for population- and employment-growth data are China Statistical Yearbooks, WDI and United Nation Population Division Population Projections. According to United Nation Population Division (UNPD), China's population grew at an average annual growth rate of 0.7 per cent during 1997-2005. Assuming a constant fertility rate during the forecast period, the growth will slow down to around 0.5 per cent during 2005-2015. These numbers are incorporated into the baseline simulation for MC-HUGE.

Table 5 listed grow rates of employment and labour force in China from various data sources. According to China Statistical Yearbooks, the total number of persons employed grew at around 1 per cent during 1997-2002. According to WDI, the average annual growth of China's labour force was around 1 per cent during 1997-2004. According to UNPD, China's labour force grew at 1.3 per cent during 1997-2005, and the growth will slow down to 0.9 per cent during 2005-2010 and 0.5 per cent during 2010-2015. For the historical simulation of the MC-HUGE baseline, I used data from China Statistical Yearbook where possible, supplemented by WDI data. For the forecast simulation of the MC-HUGE baseline, I used UNPD growth data for labour force as the growth rate of the total number of persons employed, assuming a constant rate of unemployment (Table 5).

4.2 Agricultural Land

In the MC-HUGE model, the agricultural sector uses land as a primary factor input. WDI data shows that agricultural land in China grew on average by about 0.6 per cent per annum from 1997 to 2003. This information is incorporated into the historical simulation in the MC-HUGE baseline.

For the forecast period (2005-2015), however, I reverted to a more common assumption used in CGE modelling where agricultural land is a fixed factor of production.

4.3 Capital Stock

Reliable data for capital stock in China is almost impossible to find. A close approximation is the accumulation of yearly gross fixed capital formation allowing for depreciation over a long period of time. For the MC-HUGE baseline simulation, I therefore switched on capital accumulation equations of the MC-HUGE model and allow capital stock to be determined by the stock at the beginning of the year plus investment during the year minus depreciation.

5. Price indices

The key indicator for inflation is the GDP price index. According to WDI data, the GDP price index for China grew at 1.7 per cent per year during 1997-2004. This number is incorporated into the historical simulation of MC-HUGE baseline. During the forecast period, I assumed that the GDP price index will grew at a slightly slower rate of 1.4 per cent per year given a slower trend of GDP growth in forecast than in history.

For the growth rates of import prices, I used that of WDI import-price index of 1.8 per cent per year for most of the imported commodities during 1997-2005. Oil, however, is an exception. According to International Energy Agency (IEA), the import price for oil grew fast at over 10 per cent per year during 1997-2005.

For the forecast period, I assumed that import prices will grew slightly slower than in history given a slower rate of growth for imports. Following the trend in history, I assumed import prices during the forecast period grow at 1.5 per cent, slightly faster than the GDP price index.

The higher growth in the import price index than the GDP price index implies a real devaluation for China in both history and forecast periods[4]. The nominal exchange rate, on the other hand, remains rather fixed in China with a narrow band for variation. The GTAP database is in US dollars. The nominal exchange rate therefore started with a value of 1. For the historical simulation, I assumed that nominal exchange rate remains constant, and this trend is carried through to the forecast period.

The baseline simulation suggests that, during the historical period, China's terms of trade worsens. This is consistent with WDI data. Because the forecast is developed in a manner that China continues to drift along its historical path, the trend of worsening terms of trade is therefore carried through to the forecast period.

6. Value added by Aggregate Sector and industry

In the above three sections, I discussed macroeconomic indicators that I incorporated into MC-HUGE baseline in order to calibrate the model. In the following eight sections, I discuss commodity and industry details that I incorporated into the MC-HUGE model.

When the model is informed only of the real GDP growth in the historical simulation, it typically maintains the industry structure by giving a similar growth rates for all industries. In reality, however, agricultural and mining sectors grew much slower than manufacturing and services during the historical period as is indicated by the WDI data presented in Table 6.

Table 7 shows the sectoral growth incorporated into the MC-HUGE simulation after adjustment were made to the WTO data to ensure data consistency, that is, the weighted sum of the sectoral growth rates is consistent with the GDP growth rates. The sectoral growth rates were incorporated into the historical simulation in a way that individual industries within each sector is determined by demand and supply conditions for each industry while the weighted sum of the sub-industries equals to

[4] There is a good possibility that in the forecast period, China's real exchange rate will tend to appreciate due to a large current account surplus. However, I choose to assume that, for a business-as-usual scenario, Chinese economy continues to drift along its historical path where it had a current account surplus and a real depreciation. This leaves room for the appreciation of Yuan to be analysed as a policy deviation, or an alternative scenario.

the sectoral growth rates. There is therefore scope to inform the model growth rates of individual industries within each aggregate sector.

After incorporating into the model the growth rates of aggregate sectors, I compare the growth rate of each industry calculated by the model with published statistics. More specifically, I compare

- the growth rates of mining industries with data published by BP and China Statistical Yearbook;

- the growth rates of agricultural industries with data published by Food and Agriculture Organisation and Chinese Ministry of Agriculture; and

- the growth rates of manufacturing and services industries with China Statistical Yearbook and International Yearbook of Industrial Statistics published by United Nation Industrial Development Organisation.

Further information was then incorporated into the model where the model results deviate from published statistics. For example, the model typically gives a higher than observed growth in the output of the oil industry for China. In this study, an output growth of 2 percentage points according to China Statistical Yearbook was incorporated into the historical simulation.

7. Consumption by sector

Tables 8 to 14 show changes in consumption patterns of both urban and rural households. Tables 8 and 9 show that, during 1997-2005, both urban and rural households consumed less grain and more high protein food, especially meat and seafood. While the consumption of grain fell, that of high protein food grew rather strongly.

During the historical period, computer, mobile phone and automobile were among the fastest growing consumer durables owned by urban households (Table 10); while motorcycle and colour TV were favourite purchasing items of the rural households (Table 11).

Table 12 and 13 show that consumption of services grew faster than that of food and durables for both urban and rural households. While household-utility bill grew rather strongly for urban households, residential floor space grew only moderately (Table 12 and 14).

The above observed patterns of change in consumption are reflected in MC-HUGE baseline as a trend in the relative growth of various consumption-good categories (Table15). The 12 categories of consumption goods cover all the major consumption items in the MC-HUGE model with commodities used as intermediate inputs grouped into the “other” category.

For each year during the historical period, the trend of relative growth of various consumption categories is scaled to the growth of aggregate consumption presented in Table 3. For the forecast simulation, the trend of relative growth of various consumption categories is scaled to the growth of aggregate consumption presented in Table 4.

8. Investment by sector

The historical trend of relative growth in investment by various sectors is calculated from data provided by SIC (Table 16). Table 16 shows that investment in agriculture and mining sectors grew slower than that in manufacturing and services.

To ensure data consistency, the pattern of relative growth of investment by sector calculated from the SIC data were adjusted so that the weighted sum of sectoral investment growth equals the growth rate of aggregate investment presented in Table 3. For the forecast simulation, the trend of relative sectoral investment growth is scaled to the growth of aggregate investment presented in Table 4.

9. Exports and Imports by categories of commodities

The main source for the growth rates of exports and imports by categories of commodities is UNCOMTRAD. For the agricultural commodities, the main source is supplemented by data from Food and Agriculture Organisation. For the mining

commodities, the main source is supplemented by data from China Statistical Yearbooks and BP.

The above data sources show that, for total agriculture products (FAOSTAT item code 1882), imports grew faster than exports, especially since the year 2000 (Figure 2). For the mining products listed in Table 1, exports registered small or negative growth except for coal. Imports of mining products, on the other hand, grew very fast during 1997-2005. For the manufacturing and services products, the period 1997-2005 saw high growth in both imports and exports.

The above pattern of import and export growth by commodities is incorporated into the MC-HUGE historical simulation. Tables 17 and 18 show the growth rates for key import and export categories. Again, the growth rates from above sources were adjusted so that they are consistent with trade values in the MC-HUGE database and the aggregate growth rates of import and export volumes presented in Table 3.

For the forecast period 2005-2015, the import and export growth rates by commodity are adjusted so that they are consistent with the growth rates of total import and export volumes in the forecast period presented in Table 4.

10. Employment and wage rates by Sector

The main source of data for the growth rates of employment and wage rates by industry/sector are SIC supplemented by China Statistical Yearbooks and International Labour Organisation. These data source show that employment in the agriculture and mining sectors in China declined during 1997-2005. The manufacturing sector saw moderate growth in employment. The services sector, however, registered the highest growth in employment during 1997-2005.

Real wage saw a high rate of growth at the national level – about 10 per cent per year during 1997-2005. At sectoral level, real wage in agriculture and mining grew slower than in manufacturing and services.

The patterns of sectoral employment and wage-rate growth are incorporated into the historical simulation (Tables 19 and 20). Again, to ensure data consistency, these sectoral growth rates are adjusted in a manner discussed in Section 3.1 of this paper.

For the forecast simulation, I assume that the historical trend prevails except for the employment in the mining sector. I assume that employment in the mining sector during 2005-2015 grow slightly, reversing the trend in the historical simulation (Table 19).

During the historical period 1997-2005, the decline in employment in the mining sector was due to an overhaul of the mining sector, especially of the oil and gas industries. To embrace the forthcoming competition of the WTO entry, the government restructured the state-owned enterprises in the oil and gas industry to form three vertically integrated oil companies (PetroChina, SINOPEC and CNOOC) and to list them in overseas stock markets (for more details, see Mai 2002). Since the restructuring has been completed during the historical period of 1997-2005, I assume a positive employment growth for the mining sector in the forecast simulation.

11. Relative Price of Value Added by Sector

The sources for the price of value added by sector/industry are WDI and China Statistical Yearbooks. These data show that the price of value added for the agricultural sector grew faster than that for manufacturing; and the price of value added for the services sector grew faster than that for the agricultural sector. This pattern of change is incorporated into the historical and forecast simulations (Table 21).

12. Highlights of the Baseline Simulation Results

In the sections 3 to 11, I discussed in detail the historical statistics incorporated into the MC-HUGE historical simulation and assumptions made in the forecast simulation. The historical and the forecast simulation form a baseline for the MC-HUGE model. It shows how the Chinese economy evolved from 1997 to 2015. In this section, I highlight some of the key results from the MC-HUGE baseline simulation.

12.1 Current price GDP

Table 22 shows the current price GDP from MC-HUGE baseline simulation. It also presents WDI and China Statistical Yearbook data for comparison. The 1997 value of the MC-HUGE baseline is from the Version 5 GTAP database that is the main source of input-output and trade data for the Version 1 MC-HUGE model. We can see from the first column of Table 22 that the GDP value of the GTAP and thus MC-HUGE database is slightly lower than the WDI and China Statistical Yearbook.

The second column of Table 22 shows the current price GDP in 2004 from MC-HUGE baseline, WDI and China Statistical Yearbook. As discussed in Section 3.1, I used WDI data for the growth rates of real GDP and GDP price index. As a result, I have brought the current price GDP value produced by MC-HUGE to a level resemble that of the WDI data, which is slightly higher than the value suggested by China Statistical Yearbook.

In the forecast simulation, I assumed that the historical trend prevails but at a slightly slower pace. Under this assumption, MC-HUGE baseline simulation projects that the value of China's GDP will be about 4.3 trillion by 2014, more than double of its value in 2004.

12.2 Shares of value added by sector

Table 23 shows the shares of value added by sector from MC-HUGE baseline and WDI. The MC-HUGE baseline shows a decline in the share of agriculture and industry and rising share of services in GDP – a trend indicated by the WDI data. The MC-HUGE baseline projects that, by 2014, the share of Agricultural sector will be about 12 per cent, industry 47 per cent and services 42 per cent of GDP.

12.3 Share of oil imports

Table 24 shows the share of imports in total oil consumption in China. From 1997 to 2004, MC-HUGE baseline resembles data from China Statistical Yearbooks. If the Chinese economy continues to drift along a path of its recent history, the share of imports in total oil consumption is likely to reach 71 per cent by the year 2014. Please

note that I did not assume any additional policy measured adopted to curb oil consumption or reduce oil share in energy mix. Such policy measures can be simulated as a policy scenario.

13. Concluding comments

Baseline serves as a bench-mark against which effects of any changes in economic policies or environment are measured. It is thus a very important part of the economic analysis using a dynamic CGE model. A realistic baseline is the first step towards practical policy modelling.

In this paper, I discussed the methodology and data used to formulate a baseline for the MC-HUGE model. Users of the model can either formulate their own baseline or change certain assumptions of the baseline presented in this paper.

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Table 1. List of MC-HUGE industries

1	paddy rice	30	wood products
2	wheat	31	paper products, publishing
3	cereal grains nec	32	petroleum, coal products
4	vegetables,fruit,nuts	33	chemical, rubber, plastic prods
5	oil seeds	34	mineral products nec
6	sugar cane, sugar beet	35	ferrous metals
7	plant-based fibers	36	metal nec
8	crops nec	37	metal products
9	cattle,sheep,goats,horses	38	motor vehicles and parts
10	animal products nec	39	transport equiqment nec
11	raw milk	40	electronic equipment
12	wool,silk-worm cocoons	41	machinery and equipment nec
13	forestry	42	miscellaneous manufactures
14	fishing	43	electricity
15	coal	44	gas manufacture, distribution
16	oil	45	water
17	gas	46	construction
18	minerals nec	47	trade
19	meat:cattle,sheep,goats,horse	48	transport nec
20	meat products nec	49	sea transport
21	vegetable oils and fats	50	air transport
22	dairy products	51	communication
23	processed rice	52	financial services nec
24	sugar	53	insurance
25	food products nec	54	business services nec
26	beverages and tobacco products	55	recreation and other services
27	Textiles	56	pubadmin/defence/health/educat
28	wearing apparel	57	dwellings
29	leather products		

Note: The industry classification reported here is identical to the classification used for version 5 of the GTAP database (see Dimaranan and McDougall, 2002). The term “nec” means not elsewhere classified.

Figure 1. Baseline history, forecasts and policy simulations

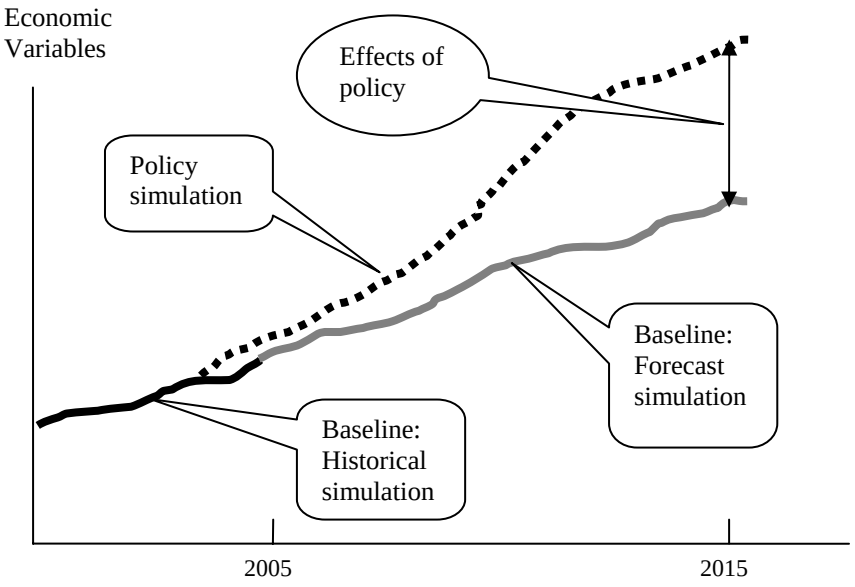


Table 2. WDI growth rates of real GDP and components

1997-2005, per cent

	Real GDP	Real Consumption	Real Investment	Government Expenditure	Export Volumes	Import Volumes
1998	7.8	6.8	12.5	9.6	7.2	3.1
1999	7.6	8.0	9.1	11.0	15.2	22.6
2000	8.4	8.6	9.6	12.2	30.6	24.5
2001	8.3	6.3	11.5	10.5	9.6	10.8
2002	9.1	7.4	14.1	7.7	29.4	27.5
2003	10.0	6.5	19.7	4.8	26.8	24.8
2004	10.1	7.9	12.4	6.8	28.4	22.5
2005	10.0	n.a.	n.a.	n.a.	n.a.	n.a.
1997-2004	8.9	7.3	12.7	8.9	20.7	19.4

n.a. not available.

Source: World Bank, *World Development Indicators*, accessed on-line through the Monash University Library.

Table 3. Historical simulation: growth rates of real GDP and components

1997-2004, per cent

	Real GDP	Real Consumption	Real Investment	Government Expenditure	Export Volumes	Import Volumes
1998	7.8	5.2	9.6	7.3	5.5	2.4
1999	7.7	8.4	9.5	12.1	15.9	23.7
2000	8.5	6.7	7.5	10.2	21.8	19.0
2001	8.3	6.1	11.3	10.3	9.4	10.5
2002	9.2	6.6	12.6	7.9	24.0	24.5
2003	10.2	5.5	16.5	5.5	20.9	20.7
2004	10.3	7.0	11.0	7.5	23.0	19.9
2005	10.0	6.7	11.4	9.5	18.9	17.4
1997-2004	9.0	6.5	11.2	8.8	17.4	17.3

Source: WDI and author calculation.

Table 4. Forecast simulation: growth rates of real GDP and components

	Average annual growth 2005-2015, per cent
Real GDP	7.9
Real Consumption	6.0
Real Investment	9.9
Government Expenditure	6.9
Export Volumes	11.1
Import Volumes	11.3

Source: Author calculation.

Table 5. Labour force and employment growth

Annual and average annual growth rates, per cent

	China Statistical Yearbook (number of persons employed)	UNPD (labour force)	WDI (labour force)	MC-HUGE baseline (number of persons employed)
1998	1.2	n.a.	1.0	1.2
1999	1.1	n.a.	1.1	1.1
2000	1.0	n.a.	1.0	1.0
2001	1.3	n.a.	1.0	1.3
2002	1.0	n.a.	0.8	1.0
2003	n.a.	n.a.	0.9	0.9
2004	n.a.	n.a.	1.1	0.9
2005	n.a.	n.a.	n.a.	0.9
1997-2005	1.1[a]	1.3	1.0[b]	1.0
2005-2010	n.a.	0.9	n.a.	0.9
2010-2015	n.a.	0.5	n.a.	0.5

[a] 1997-2002. [b] 1997-2004. n.a. not available.

Source: China Statistical Yearbooks, WDI and UNPD.

Table 6. WDI growth of value added by industry groups

	Agriculture	Industry	Services
1998	3.5	8.9	8.3
1999	2.8	8.1	9.3
2000	2.4	9.4	9.7
2001	2.8	8.4	10.8
2002	2.9	9.8	10.6
2003	2.5	12.7	8.4
2004	6.3	11.1	9.8
2005	n.a.	n.a.	n.a.
1997-2004	3.3	9.8	9.5

n.a. not available.

Source: MC-HUGE baseline simulation.

Table 7. MC-HUGE baseline simulation: value added by industry groups

	History	Forecast
	1997-2005	2005-2015
Agriculture Forestry Fishing	3.5	3.0
Industry	10.2	8.8
Services	10.0	8.6

Source: MC-HUGE baseline simulation.

Table 8. Per Capita Annual Purchases of Major Commodities of Urban Households

Average annual growth rates, per cent

	Average annual growth (%)		Level (kg)
	1995-2004	1997-2004	2004
Grain (kg)	-2.4	-1.8	78
Fresh Vegetables (kg)	0.5	1.1	122
Fresh Melons and Fruits (kg)	2.6	n.a.	56
Edible Vegetable Oil (kg)	3.0	3.7	9
Pork (kg)	1.2	3.3	19
Beef and Mutton (kg)	4.6	-0.2	4
Poultry (kg)	5.4	3.7	6
Fresh Eggs (kg)	0.7	-1.0	10
Aquatic Products (kg)	3.4	4.3	12
Milk (kg)	16.9	n.a.	19
Liquor (kg)	-1.2	-0.9	9

n.a. not available.

Source: China Statistical Yearbooks.

Table 9. Per Capita Consumption of Major Consumer Goods in Rural Households

	Average annual growth (%)	Level (kg)
	1997-2004	2004
Grain (Unprocessed) (kg)	-2.0	218
Fresh Vegetables (kg)	-0.1	107
Edible Oil (kg)	-2.1	5
Pork, Beef and Mutton (kg)	2.1	15
Poultry (kg)	4.1	3
Eggs and Related Products (kg)	1.7	5
Fish and Shrimp (kg)	4.1	5
Liquor (kg)	1.4	8

Source: China Statistical Yearbooks.

Table 10. Number of Major Durable Consumer Goods Owned per 100 Urban Households at the Year-end

	Average annual growth (%)		Level (units or sets)
	1995-04	1999-04	2004
Motorcycle	16.5	5.7	25
Washing Machine	0.8	0.5	96
Refrigerator	3.5	1.7	90
Color Television Set	4.5	2.0	133
Video-recorder	-0.4	-2.4	18
Hi-Fi Stereo Component System	11.6	4.1	28
Camera	4.9	2.4	47
Air Conditioner	27.1	12.4	70
Shower	9.8	4.8	69
Smoke Absorber	7.4	3.4	66
Video Disc Player	n.a.	11.0	63
Computer	n.a.	21.1	33
Pickup Camera	n.a.	12.9	3
Oven	n.a.	14.7	42
Healthy Equipment	n.a.	1.1	4
Mobile Telephone	n.a.	35.7	111
Automobile	n.a.	22.9	2

n.a. not available.

Source: China Statistical Yearbooks.

Table 11. Number of Durable Consumer Goods Owned per 100 Rural Households at the Year-end

	Average annual growth (%)	Level (units or sets)
	1997-2004	2004
Sofa Desk Wardrobe	2.7	294
Washing Machine	8.6	37
Electric Fan	4.1	142
Refrigerator	11.5	18
Bicycle	-2.5	118
Motorcycle	17.8	36
Black and White TV	-8.2	38
Colour TV	14.9	75
Radio Cassette Player	-9.3	18
Camera	8.8	4

Source: China Statistical Yearbooks.

Table 12. Per Capita Annual Consumption Expenditure of Urban Households

	Average annual growth (%)	Level (Yuan)
	1998-2004	2004
CONSUMPTION EXPENDITURE	**8.8**	**7182.1**
Food	**5.8**	**2709.6**
grain	0.9	238.8
starches and tubers	-1.6	18.4
beans and products	0.9	35.9
oil and fats	2.9	89.2
meat, poultry and related products	3.4	526.8
eggs	0.3	68.2
aquatic products	3.8	178.1
vegetables	4.5	256.5
condiments	4.3	36.1
sugar	2.6	28.1
tobacco	6.1	133.7
liquor and beverages	5.1	123.7
dried and fresh melons and fruits	7.8	189.6
nuts and kernels	3.9	30.6
cake	6.1	57.5
milk and its products	18.4	132.4
other food	10.5	62.4
dining out	15.3	533.4
food processing service fees	4.1	0.9
Clothing	**6.1**	**686.8**
garments	8.0	493.8
clothing materials	-19.2	10.0
shoes	3.8	150.7
tailoring and laundering service fees	-11.3	6.5
Household appliances and services	**2.2**	**407.4**
durable consumer goods	-0.2	198.8
room decorations	3.1	16.0
bed articles	8.8	32.4
household articles for daily use	7.7	126.8
furniture materials	-12.5	2.8
household services	-2.3	30.4
Health care and medical services	**17.1**	**528.2**
Transport and communications	**21.9**	**843.6**
transport	22.6	389.1
communications	21.3	454.6
Education, culture and recreation services	**12.9**	**1032.8**
recreation articles	12.6	256.7
education	12.5	5589.0
recreation services	14.1	217.2
Housing	**10.3**	**733.5**
house	6.2	247.8
water, electricity, fuels and others	11.5	451.5
Miscellaneous goods and services	**3.4**	**240.2**

Source: China Statistical Yearbooks.

Table 13. Per Capita Annual Consumption Expenditure of Rural Households

	Average annual growth (%)	Level (Yuan)
	1998-2004	2004
Consumption Expenditure	**5.4**	**2184.7**
Food	3.3	1031.9
Clothing	3.4	120.2
Residence	5.2	324.3
Household facilities, articles and services	1.4	89.2
Medicines and medical services	11.4	130.6
Transportation and communications	21.2	192.6
Cultural, educational and recreational articles and services	7.6	247.6
Other commodities and services	6.6	48.3

Source: China Statistical Yearbooks.

Table 14. Per Capita Floor Space of Residential Building

	Average Annual Growth (%)	Level (sq.m)
	1997-2004	2004
Urban	5.0	25.0
Rural	3.1	27.9

Source: China Statistical Yearbooks.

Table 15. MC-HUGE baseline simulation: consumption by commodity groups

	History	Forecast
	1997-2005	2005-2015
grains	0.9	0.8
protein	6.0	5.0
Beverages and tobacco	5.1	4.2
other food	4.1	3.4
clothing	8.1	6.6
dwelling	5.1	4.2
motor vehicles and parts	16.4	13.4
consumer durables	7.2	5.9
transport and communication	13.4	11.0
other services	11.3	9.3
fuel	7.7	6.3
other	4.1	3.3

Source: MC-HUGE baseline simulation.

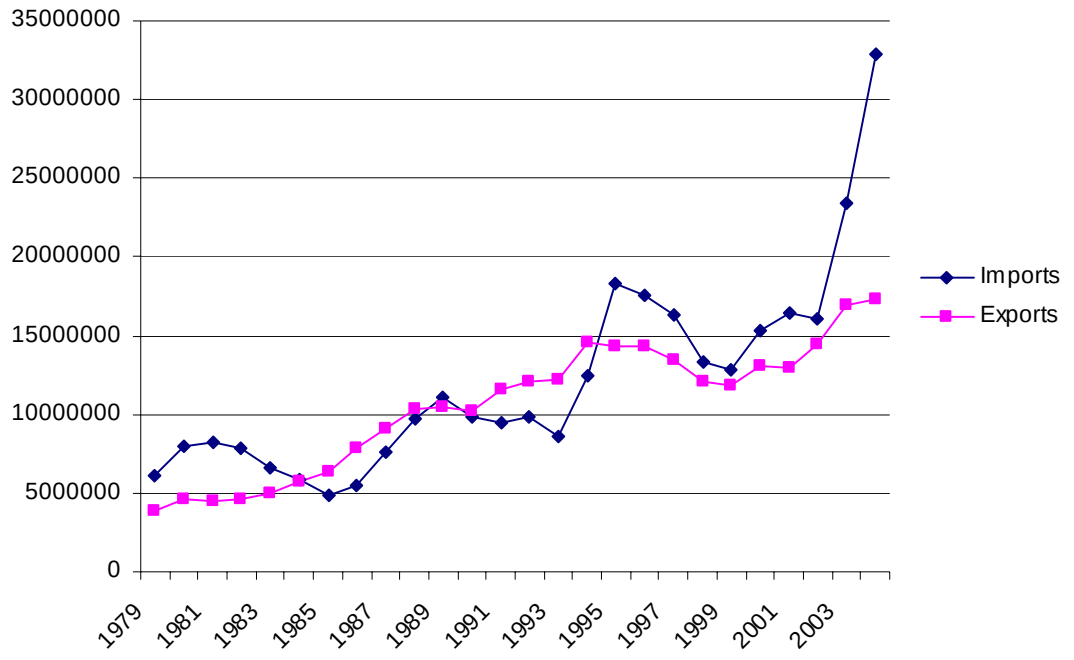
Table 16. MC-HUGE baseline simulation: investment by commodity groups

	History	Forecast
	1997-2005	2005-2015
Agriculture Forestry Fishing	6.4	5.4
Mining	5.7	4.8
Manufacturing	12.6	10.8
Electricity Gas Water	5.9	5.0
Construction	11.8	10.0
Transport Communication	7.6	6.5
Trade	12.6	10.8
Financial services	7.8	6.7
Other business and personal services	7.6	6.5
Public services	12.6	10.8
Dwelling	13.7	11.6

Source: MC-HUGE baseline simulation.

Figure 2. China: value of imports and exports of agricultural products

1979-2004, $US1,000



Source: FAO, FAOSTAT 2006.

Note: The agricultural products in this chart refer to "Agriculture products, Total" in FAOSTAT (item code 1882). It includes food and agriculture products, excluding fishery and forestry products. The data was accessed in April 2006.

Table 17. MC-HUGE baseline simulation: imports by commodity groups

	History	Forecast
	1997-2005	2005-2015
Oil	17.0	12.9
Other Minerals	10.0	8.0
Textiles	20.8	11.9
Paper Products Publishing	17.4	11.2
Chemical, Rubber, Plastic Products	16.6	11.2
Iron and Steel	18.3	12.2
Non-ferrous Metals	17.0	11.9
Motor Vehicle and Parts	21.6	10.8
Electronic Equipment	16.0	11.0
Machinery and Equipment nec	16.8	11.3
Agriculture Forestry Fishing	10.0	8.0
Other Merchandise imports	18.3	11.2
Services	17.2	11.5

Source: MC-HUGE baseline simulation.

Table 18. MC-HUGE baseline simulation: exports by commodity groups

	History	Forecast
	1997-2005	2005-2015
Textiles	21.3	13.5
Wearing Apparel	17.5	8.0
leather Products	12.9	6.3
Chemical Rubber Plastic Products	19.1	13.8
Iron and Steel	16.0	11.2
Metal Products	16.3	11.5
Motor Vehicle and Parts	12.6	5.8
Electronic Equipment	18.8	11.6
Machinery and Equipment nec	18.4	12.2
Other Manufacturing	22.3	13.2
Agriculture Forestry Fishing	6.3	3.2
Other Merchandise imports	10.7	5.5
Services	23.2	11.2

Source: MC-HUGE baseline simulation.

Table 19. MC-HUGE baseline simulation: employment by industry groups

	History	Forecast
	1997-2005	2005-2015
Agriculture Forestry Fishing	-0.3	-0.2
Mining	-4.1	0.1
Manufacturing	0.5	0.3
Electricity Gas Water	1.6	0.9
Construction	3.4	1.9
Services	3.6	2.0

Source: MC-HUGE baseline simulation.

Table 20. MC-HUGE baseline simulation: wages by industry groups

	History	Forecast
	1997-2005	2005-2015
National total	**9.8**	**8.6**
Agriculture Forestry Fishing	6.8	5.7
Mining	7.5	6.3
Manufacturing	10.9	9.2
Electricity Gas Water	9.1	7.7
Construction	8.1	6.9
Services	11.2	9.5

Source: MC-HUGE baseline simulation.

Table 21. WDI and MC-HUGE baseline simulation: price of value added by industry groups

	WDI	History	Forecast
	1997-2004	1997-2005	2005-2015
Agriculture Forestry Fishing	2.4	5.9	5.5
Industry	0.4	4.8	4.1
Services	3.8	8.1	5.8

Source: MC-HUGE baseline simulation.

Table 22. Current price GDP, Million USD

	1997	2004	2014
MC-HUGE baseline	854,694	1,940,932	4,339,885
WDI	952,653	1,931,710	n.a.
China Statistical Yearbook*	914,284	1,707,304	n.a.

n.a. not available * exchange rate = 8 yuan/USD

Table 23. Share of value added by sector

per cent

	MC-HUGE baseline			WDI	
	1997	2004	2014	1997	2004
Agriculture Forestry Fishing	0.20	0.15	0.12	0.18	0.13
Industry	0.52	0.48	0.47	0.48	0.46
Services	0.28	0.36	0.42	0.34	0.41

Table 24. China: import oil share, per cent

	1997	2004	2014
MC-HUGE baseline	0.22	0.56	0.71
China Statistical Yearbook	0.23	0.49*	n.a.

* 2003 n.a. not available.