A macroeconomic model of China economy

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Introduction

We are constructing a macroeconomic model of China economy. The objective of the model is to capture the trend of Chinese economy since 1992. Our economic system has transformed from planned economy to market economy during this period. At the same time, the national accounts system has been transformed from the material product system (MPS) to national accounts system (SNA).

In this paper, we will present the structure of the model and a preliminary specification of equations.
We call the model CUFEM, that means the model of Central University of Finance and Economics.

CUFEM is an annually model. The sample period is from 1992 to 2007. In this period, data used by our model can be obtained from the public resources, such as China statistical yearbook.

The model contains 105 equations, in which 47 are behavioral equations.

The model is demand oriented and follows Keynes’ framework. In this model, we begin the analysis with aggregate demand, which includes consumption, investment and net exports.
Consumption includes urban household consumption and rural household consumption, each of them is divided into five categories: food, medicine, durable consumer goods, education and others.

Investment includes investment in fixed assets and change in inventories. Investment in fixed assets is divided into state-owned investment, collective-owned investment, self-employed individual investment, direct foreign investment and other investment.

Exports and Imports are divided into imports of goods, exports of goods, imports of services, and exports of services.
Structure of the Model

The model includes following modules:

- consumption
- investment
- imports and exports
- income
- price
- employment
- value-added
- government finance
- and finance, as showed in figure 1.
Figure 1 the infrastructure of model
A convenient starting point for the specification of a macroeconomic model is the GDP identity:

$$gdpR = cR + invR + gR + exR - imR$$

Where all the variables are measured in real terms, and

$gdpR = \text{gross domestic product}$

$cR = \text{consumption expenditure}$

$invR = \text{investment}$

$exR = \text{exports}$

$imR = \text{imports}$
Consumption

In this module, we construct consumption equations for urban household and rural household respectively.

According to the data of consumption, we divide consumption into five categories: food, medicine, durable consumer goods, education and others. So we specify one equation for each category. For example, the estimated equation of urban households’ durable consumption goods is

\[ cu\hat{R}_{dura} = 72.891 + 0.074dyuR - 1.259Rpu_{dura} \]

\[ R^2 = 0.88 \]

\[ t : \quad (18.35) \quad (9.44) \quad (-3.49) \]

where, \( cu\hat{R}_{dura} \) is expenditure of durable goods per capita of urban households, \( yuR \) is disposable income per capita of urban households, \( dyuR \) is the difference of \( yuR \), \( Rpu_{dura} \) is consumer price index of durable goods. All variables are measured in real terms.
We then get urban household consumption, rural household consumption and total consumption by following identities:

\[
\text{cuR} = \text{cuR	extunderscore food} + \text{cuR	extunderscore dura} + \text{cuR	extunderscore edu} + \text{cuR	extunderscore medc} + \text{cuR	extunderscore other}
\]

\[
\text{TcuR} = \text{cuR} \times \text{upop}
\]

\[
\text{crR} = \text{crR	extunderscore food} + \text{crR	extunderscore dura} + \text{crR	extunderscore edu} + \text{crR	extunderscore medc} + \text{crR	extunderscore other}
\]

\[
\text{TcrR} = \text{crR} \times \text{rpop}
\]

\[
\text{cR} = \text{TcuR} + \text{TcrR}
\]

Where \(\text{cuR}\) and \(\text{crR}\) are urban household consumption per capita and rural household consumption per capita respectively. \(\text{TcuR}\) and \(\text{TcrR}\) is total urban household consumption and total rural household consumption respectively. \(\text{cR}\) is total household consumption.
Investment

In the specification of investment equations, we divided the total fixed assets investment into five parts by investor: state-owned investment, collective-owned investment, self-employed individual investment, direct foreign investment, other investment.

We construct one behavioral equation for each kind of investment. The main explanatory variables for investment equations include change in GDP, government expenditure in economic construction, bank loans, interest rate and price of fixed assets investment.
For example, the estimated equation of state-owned investment is as follows.

\[
\hat{fiR}_{\text{state}} = -6007.15 + 3.45\text{loanR} + 1.63\text{efecR} + 47.91\text{pfi}
\]

\[R^2 = 0.998\]

\(t:\) \quad (-4.35) \quad (16.08) \quad (3.76) \quad (4.15)

Where, \(fiR\_state\) is state-owned investment, \(\text{loanR}\) is balance of bank loans, \(\text{efecR}\) is government expenditure of economic construction, \(\text{pfi}\) is fixed assets investment deflator.
We get the investment in fixed assets and total investment by following identities:

\[ \text{fiR} = \text{fiR\_fore} + \text{fiR\_state} + \text{fiR\_coll} + \text{fiR\_indi} + \text{fiR\_other} \]

\[ \text{invR} = \text{viR} + \text{fiR} \]

Where

- \( \text{fiR} \) = investment in fixed assets.
- \( \text{fiR\_fore} \) = direct foreign investment
- \( \text{fiR\_state} \) = state-owned investment
- \( \text{fiR\_coll} \) = collective-owned investment
- \( \text{fiR\_indi} \) = individual investment
- \( \text{fiR\_other} \) = other investment
- \( \text{invR} \) = total investment
- \( \text{viR} \) = change in inventories
Imports and exports

The foreign trade equations explain exports and imports in terms of both activity variables and relative prices. The relevant activity variable for exports is world trade, which acts as a proxy for world income and that for imports is domestic GDP. In each case the relative prices variable is

\[ \frac{P}{(PW \times E)} \]

Where P is the domestic price level, PW is the world price level, and E is the exchange rate (RMB/US$).

We specify behavioral equations for imports of goods, exports of goods, imports of services, and exports of services. For example, the estimated equation of imports of goods is as follows.
\[ \hat{gimR} = 16242.96 + 34.99 \text{relprice} + 0.17 \text{dgdp} + 14.92 \text{time} \quad \bar{R}^2 = 0.99 \]

\[ t: \quad (3.98) \quad (9.29) \quad (17.73) \quad (3.01) \]

Where \( \hat{gimR} \) is import goods, \( \text{relprice} \) is the relative price. \( \text{dgdp} \) is the first difference of GDP, \( \text{time} \) is a time trend.

We then get total imports and exports by two identities:

\[ exR = gexR + sexR \]
\[ imR = gimR + simR \]
GDP

After getting consumption, investment and net exports, GDP based on expenditure approach (gdpR) can be calculate as:

\[ gdpR = cR + invR + gR + exR - imR \]

To estimate GDP based on production approach (gdp), we estimate value added of primary industry (agriculture), secondary industry (industry and construction), and thirdly industry (tertiary), all measured in current prices. The estimated equation of agriculture value added is as follows.
Where agradd is value-added of primary industry. dtyr is the first difference of total income of rural household. ccf is consumption of chemical fertilizer, dia is the first difference of irrigated areas, tpam is the total power of agriculture machinery.

After estimating value added for three industries, we can get nominal GDP and GDP deflator:

\[
gdp = \text{agradd} + \text{secadd} + \text{teradd}
\]

\[
gdpD = \frac{\text{gdp}}{\text{gdpR}}
\]

\[
\text{agradd} = -18081.63 + 0.58dtyr + 6.41ccf + 120.50dia + 0.11tpam \quad \bar{R}^2 = 0.99
\]

\[
t : \quad (-7.98) \quad (6.92) \quad (5.61) \quad (2.76) \quad (2.36)
\]

\[
LM(1) = 0.99(p = 0.32)
\]
Prices

In the price module, we use behavioral equations to decide the following price indexes:
(1) consumers’ prices index (cpi)
(2) producer price index for manufactured goods (ppi)
(3) commodity retail price index (rpi)
(4) fixed assets investment deflator
(5) consumption deflator
(6) deflator for value-added of agriculture
(7) deflator for value-added of industry
(8) deflator for value-added of tertiary industry

The main explanatory variable used in these equations is GDP deflator (gdpD).
Income

We specify two behavioral equations to estimate income per capita of urban households and that of rural households.

In the equation of income per capita of urban households, we choose value-added of the secondary industry and tertiary industry as explanatory variables.

To describe the income per capita of rural households, we choose the value-added of the primary industry, secondary industry and tertiary industry as explanation variables. The estimated equation of rural income is:

\[ y_r^* = 79.63 + 0.63(agradd - agrtax)/rpop + 0.47yr(-1) \]
\[ R^2 = 0.997 \]
\[ t: (2.47) (10.51) (8.17) \]
All variables in the two behavioral equations are measured in current prices. We then use identities to get income per capita of urban households and rural households in constant prices, and get income of urban households and rural households in current and constant prices:

\[ yrR = \frac{yr}{pr} \]

\[ yuR = \frac{yuR}{pu} \]

\[ tyr = yr \times rpop \times 10000 \]

\[ tyu = yu \times upop \times 10000 \]

\[ tyrR = yrR \times rpop \times 10000 \]

\[ tyuR = yuR \times upop \times 10000 \]
Employment

In the employment module, we construct the equations for employment of each industry.

Employment is mainly decided by value-added of the related industries. For example, the estimated equation of employment of the tertiary industry is as follows.

\[
\text{teremp} = 14108.80 - 54.96(\text{sec addR} + \text{agraddR})/\text{teraddR} \times 100 + 0.57\text{gdpR} \\
\]

\[ t: \quad (3.81) \quad (-3.51) \quad (11.87) \]

\[ R^2 = 0.97 \]

Total employment is the sum of three industries:

\[
\text{Temp} = \text{agremp} + \text{secemp} + \text{teremp}
\]
Labor productivity

We use identities to calculate labor productivities for three industries in current and constant prices respectively:

\[ \text{agrlp} = \frac{\text{agrad}}{\text{agremp}} \]
\[ \text{agrlpR} = \frac{\text{agradR}}{\text{agremp}} \]
\[ \text{seclp} = \frac{\text{sec}}{\text{secemp}} \]
\[ \text{seclpR} = \frac{\text{secaddR}}{\text{secemp}} \]
\[ \text{terlp} = \frac{\text{teradd}}{\text{teremp}} \]
\[ \text{terlpR} = \frac{\text{teraddR}}{\text{teremp}} \]
Government finance

In this module, we estimate government revenue and expenditure. In the equation of expenditure, we assume that expenditure is mainly affected by revenue. In the equation of revenue, we assume that revenue is decided by the growth of economy.

At the same time, we use behavioral equations and identities to describe taxes, which is the main source of government revenue.

As an example, the estimated government revenue equation is as follows.

\[ \hat{ngr} = 1266.87 + 0.054gdp - 11535.37D1 + 0.15gdpD \quad \bar{R}^2 = 0.996 \]

\[ t: \quad (1.19) \quad (3.75) \quad (-8.59) \quad (6.62) \]

Where D1 is a dummy variable, D1=0, t<1997; D1=1, otherwise.
In the module of finance, we only specify behavioral equations to describe money supply $M_1$ and $M_0$ at moment. This module needs to be improved.

We choose GDP and interest rate of loan as the explanatory variables for $M_1$, and use the deposit (save) of urban and rural households to explain $M_0$, where save is estimated by

$$\text{Save} = f(\text{tyr} + \text{tyu}, \text{ird})$$

The estimated results of $M_0$ equation is as follows.

$$\hat{m}_0 = 3612.71 + 0.15 \text{save} \quad \bar{R}^2 = 0.99$$

$$t: \quad (10.47) \quad (39.48)$$
Thank you!