Quantitative Analyses of the Impact of Price Adjustments in China

By
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Abstract

Following a period of rapid growth between 1992 and 1993, China's economy grew again at a high growth rate of 11.8%, and major reforms in the fiscal and financial system, foreign trade, and foreign exchange system, as well as in price and wage systems were carried out smoothly in 1994. Meanwhile, market prices increased by a wide margin, with the consumer-price index increasing by 24.1%. Such a high rate of inflation was due to many factors. This paper attempts to analyze the impact of price adjustments on the general level of prices. By using MUDAN II (MUlti-sectoral Development ANalysis Model for China; version II), quantitative analyses of the impact of price-changes on inflation have been conducted.

For this purpose, simulation tests and analyses were made in three areas. First, the price in each sector was raised and its impact on the prices in other sectors and the effect on consumer-price indexes was calculated. Second, simulation tests for the price adjustments in grain, cotton, coal, electric power, crude oil and processed oil made by the central government in 1994 were conducted. The impact of the price adjustments in those sectors on prices in other sectors, and on the general level of consumer price-index was estimated. The impact of price adjustment on inflation was separated from that of other factors. Third, alternative options for future price reform were designed and the possible impacts were analyzed.

1. The Basic Structure of the MUDAN II

The multi-sectoral development model applies the modeling techniques of Input-Output-based structure analysis and regression-based econometrics. The final demand and value-added results in the Input-Output tables are determined by behavioural equations which are estimated with econometric techniques at sector level. The output and prices in each sector are determined by the Input-Output balance relationship. Therefore, it is not only an interindustry connection model, but also a dynamic econometrical model. In general, this kind of model has the following specific characteristics:

(1) The behavioural equations describe the behaviour patterns of consumers, producers and other decision makers, and are estimated for detailed sectors, as functions of sector-specific variables.

(2) Explicit Input-Output equations are used. This guarantees accounting consistency

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among the final demand, intermediate use and total output figures of products. It also guarantees accounting consistency in the cost of raw materials; the value added, and the producer's price of products. Therefore, action in one industrial sector is linked, in a consistent manner, with the rest of the economy.

(3) The model is dynamic and the Input-Output coefficient matrix, and various bridge matrices, change year by year.

(4) The model traces the development of the economy over time. It dose not pay special attention to an equilibrium state at some future point.

(5) The model determines both the variables at sector level; and the variables at aggregate level such as GDP, income, savings, employment and inflation, etc. The macro-economic quanta are aggregated from the variables at sector level instead of obtaining the quanta first and then allocating them into different sectors.

Professor Clopper Almon, of the University of Maryland, has been engaged in the study of multi-sectoral dynamic models since the early 1960s and developed the U.S. model. Project INFORUM, INterindustry FORecasting at the University of Maryland, was set up in 1967. So far, the INFORUM family has many members, such as models for Austria, Belgium, Canada, France, Germany, Italy, Japan, Korea, Mexico, Poland, Spain and Russia as well as MUDAN. Under the guidance, and with the participation, of Professor Almon we developed the MUlti-sectoral Development ANalysis Model for China version 1.1 in 1992 (MUDAN 1.1) and revised it in 1993 (MUDAN 2.0).

In 1994, a new version —the MUDAN II was developed on the basis of MUDAN 2.0. There is no major change in the basic structure, and improvements have been made in expanding of the number of sectors as well as in the data base. The MUDAN II disaggregated the economy into 63 sectors, including five sectors in agriculture, 42 in mining and manufacturing industries and 16 in tertiary industry (see Appendix A for detailed division of sectors). The number of sectors was determined according to the availability of the time series data from various statistical yearbooks published in China. The basic structure of MUDAN II is illustrated in Figure 1, where $\mathbf{A}^T$ is the transfer of matrix A.

2. Analysis of the Impacts of the Sectoral Price Changes

By using the MUDAN model, we analyzed the impact of the sectoral price changes, i.e. the impact of the price increase in each sector on the changes of other sectors' prices and on changes in the consumer-price index.

2.1. Method Used in Analyzing the Impacts of Price Changes

In the MUDAN model, prices are obtained by a Seidel iterative procedure of the equation *(1)* as follows:

$$\mathbf{p} = \mathbf{A}^T\mathbf{p} + \mathbf{unitva} \qquad (1)$$

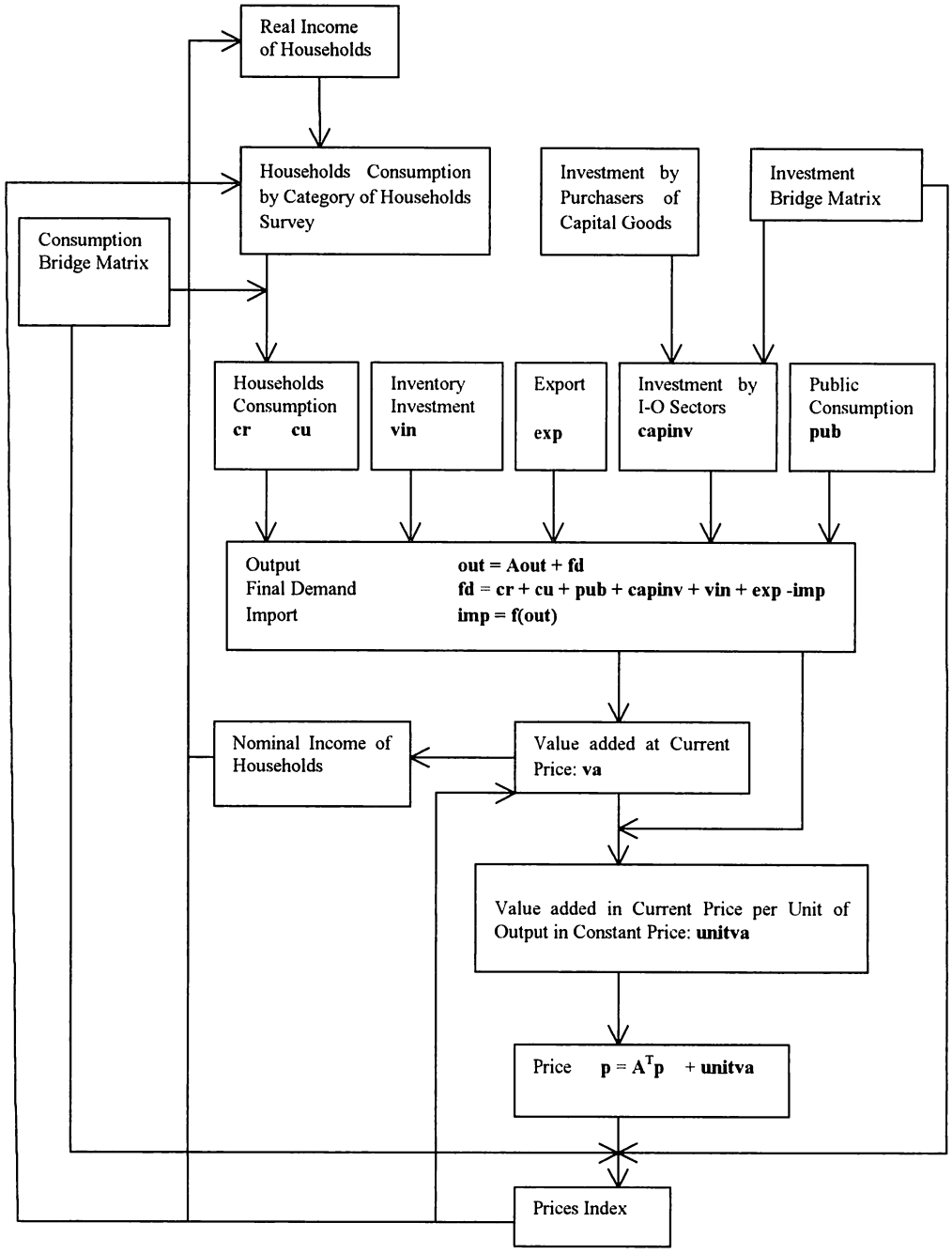

Figure 1: The Basic Logical Structure of MUDAN Model

where **p** is the vector of prices, A is the Input-Output coefficient matrix and **unitva** is the vector of value-added at current price per unit of output at constant price.

The above equation basically reflects the price formation. $\mathbf{A}^{\mathrm{T}}\mathrm{p}$ is the intermediate input and the **unitva** is depreciation, wage, profit, tax and the other part of unit value-added.

It can be assumed that the sector in which the price changes actively is sector one and the range of the price increase is 10%. We rewrite the equation (1) as follows:

$$\begin{pmatrix} p_1 \\ \mathbf{p}_m \end{pmatrix} = \begin{pmatrix} a_{11} & \mathbf{A}_{1m} \\ \mathbf{A}_{m1} & \mathbf{A}_{mm} \end{pmatrix}^{\mathrm{T}} \begin{pmatrix} p_1 \\ \mathbf{p}_m \end{pmatrix} + \begin{pmatrix} unitva_1 \\ \mathbf{unitva}_m \end{pmatrix} \tag{2}$$

in which

$$\mathbf{p}_m = \begin{pmatrix} p_2 \\ \cdots \\ \cdots \\ p_{63} \end{pmatrix}, \qquad \mathbf{A}_{m1} = \begin{pmatrix} a_{2,1} \\ \cdots \\ \cdots \\ a_{63,1} \end{pmatrix}, \qquad \mathbf{A}_{mm} = \begin{pmatrix} a_{2,2} & \cdots & a_{2,63} \\ \vdots & \ddots & \vdots \\ a_{63,2} & \cdots & a_{63,63} \end{pmatrix},$$

$$\mathbf{unitva}_m = \begin{pmatrix} unitva_2 \\ \vdots \\ unitva_{63} \end{pmatrix},$$

$$\mathbf{A}_{1m} = (a_{1,2}, \ldots\ldots, a_{1,63}),$$

From the equation (2) above, we can obtain either the value of the price-vector **p** corresponding to some given value of vector **unitva,** or the value of the vector **unitva** corresponding to some given value of vector **p**. Furthermore, for the given value of the first sector's price, p_1, and the latter 62 sectors' value added per unit of output, $\mathbf{unitva}_m$, we can obtain the first sector's value added per unit of output, $unitva_1$, and the latter 62 sectors' prices, $\mathbf{p}_m$, from the solution of equation (2) which is in the algebraic formula as follows:

$$unitva_1 = p_1 - a_{11}p_1 - \mathbf{A}_{m1}^{\mathrm{T}}\,\mathbf{p}_m \tag{3}$$

$$\mathbf{p}_m = (\mathbf{I} - \mathbf{A}_{mm}^{\mathrm{T}})^{-1}(\mathbf{A}_{1m}^{\mathrm{T}}p_1 + \mathbf{unitva}_m) \tag{4}$$

It can be seen from the formula above, given the price p_1 and $\mathbf{unitva}_m$, the solution of $unitva_1$ and $\mathbf{p}_m$ can be found. This means that when the price in a sector changes, we can find the price changes in other sectors if the level of value added per unit of output of these sectors remains unchanged. This can also be regarded as the role of the price change in the first sector in determining the prices in the other sectors. Given the p_1 and the calculated $\mathbf{p}_m$, the change in consumer-price indexes for urban and rural households can be calculated through a corresponding consumption bridge matrix respectively.

2.2. The Results of the Calculation

By the method indicated above and for i = 1, 2, ..., 63, assuming that the price in sector i is rising by 10%, the price changes in the other 62 sectors and the changes in the consumer-price indexes are calculated.

The results calculated have shown that the price change in some sectors had considerable, while others had very little, impact on other sectors; and the scale of impact remained basically stable in the period between 1987-1992. We regarded the sector in which price changes actively as the active sector, and the other 62 sectors as passive sectors. The passive sectors in which price changes take place over 1% resulted from the 10% price rising of the active sectors are called responsive sectors. The responsive sectors as well as their active sectors are listed in Table 1.

It can be seen that several sectors have a large number of responsive sectors in price change. They are: commerce (with 27 responsive sectors); chemical industry (21 R.S.); plantation (12 R.S.); machinery industry (12 R.S.); metallurgical and processing of ferrous metal (10 R.S.); electricity, steam and hot water supply (9 R.S.); textile industry (9 R.S.); petroleum refineries (6 R.S.); food manufacturing (5 R.S.); etc. These 11 sectors above also have strong, forward and backward linkages with other sectors in economy.

From Table 2, it can be seen that the sectors in which price changes have a considerable impact on consumer-price index include plantation, livestock production, food manufacturing, textile industry, chemical industry and commerce. There are two determinants in this respect. One is related to the industrial structure and the linkage between industries, and the other is related to the household consumption structure. For instance, the price change in the plantation sector affects the consumer-price index in two ways. On the one hand, it directly influences the price of grain products purchased by residents. On the other hand, it causes changes in other passive sectors, and therefore a change in the consumer-price index. In China, the cost of food for urban households accounts for over 50% of their total expenditure (Composition of urban households consumption expenditure in 1994). Thus, a price change of 10% in the plantation sector resulted in a 4% rise in the urban household consumer-price index. Our simulation, therefore, was to observe the impact of the inter-sectoral price changes through the linkage between sectors. It was also only an effect-analysis of price changes between sectors, and the change of consumer-price index, from the angle of cost changes. In general, this effect is not the actual range of price changes.

Table 1: The Impacts of Price Change in Active Sectors (1987-1992)

	Active Sector (Price Rising 10%)	Responsive Sectors
1	Crops	Forage, FoodProc, Beverages, Livestock, Textiles, Restaurant,Fishing,Tobacco, Paper, Medicine, Apparel Leather
2	Forestry	Rubber
3	Livestock	Leather, FoodProc, Restaurant, Apparel, Textiles
4	OthAg	Paper
5	Fishing	Restaurant
6	CoalMin	Coking, ElecProd, IronSteel
7	CrudeOil	RefPet, RoadTr, WaterTr, RoadPass, WaterPass
9	NonFerOre	NferProd
12	Logging	Sawmills
14	FoodProc	Restaurant, Forage, Leather, Beverages, Livestock
15	Forage	Livestock, Fishing
18	Textiles	Apparel, SocActProd, Rubber, Funiture, Plastic, OthInd, Commerce, Paper, Leather
21	Sawmills	Furniture
23	Paper	Printing
26	ElecProd	NferProd, WaterDIst, FerOreMin, IronSteel, NonFerOre, Coking, MetalProd, BuildMat, Quarrying
27	RefPet	RoadTr, WaterTr, AirTr, RoadPass, WaterPass, AirPass
29	Chemical	Plastic, ChemFibre, Crops, Printing, Paper, Rubber, ElecMach, Sawmills,MetalProd, Textiles, Leather, Furniture, Forage, Medicine, NferProd, OthInd, Apparel, SocActProd, FerOreMin, NonFerOre, BuildMat
31	ChemFibre	Textiles
32	Rubber	RoadVeh
34	BuildMat	Construct
35	IronSteel	MetalProd, RailVeh, ShipBuild, Machinery, Construct, Aircraft, OthInd, Furniture, ElecMach, RoadVeh
36	NferProd	ElecMach, MetalProd
38	Machinery	ShipBuild, Aircraft, RailVeh, IronSteel, OthInd, RoadVeh, FerOreMin, MetalProd, AirPass, CrudeOil, ElecMach,WaterPass
40	RoadVeh	OthInd
41	ShipBuild	Waterpass
42	Aircraft	AirPass, AirTr
43	ElecMach	Machinery, ShipBuild, Railveh
54	Commerce	Leather, Apparel, Textiles, MetalProd, NferProd, Paper,Printing, RefPet, OthInd, ElecMach, Rubber, SocAcrProd, IronSteel, Restaurant, Plastic, Machinery, Sawmills, Furniture, Coking, Chemical, Medicine, ChemFibre, BuildMat, RailVeh, RoadVeh, ShipBuild, Aircraft
61	SocServ	RailPass, RoadTr
62	FinServ	Commerce

Table 2: The Impacts of 10% Rising of Sectoral Price on Urban and Rural Consumer-Price Indexes

Active Sector		Consumer-Price Indexes 1987	1988	1989	1990	1991	1992
Crops	Urban	4.09	4.03	4.18	3.97	3.94	3.85
	Rural	2.99	2.88	3.04	2.79	2.77	2.70
Livestock	Urban	1.74	1.99	2.06	1.97	2.03	2.03
	Rural	1.07	1.28	1.34	1.24	1.32	1.33
FoodProc	Urban	1.02	1.17	1.22	1.02	1.15	1.21
	Rural	1.96	2.07	2.11	1.92	2.05	2.09
Textiles	Urban	0.82	0.83	0.93	0.88	0.90	0.97
	Rural	1.01	1.02	1.10	1.01	1.04	1.12
Chemical	Urban	0.84	0.92	1.08	0.83	0.95	1.06
	Rural	0.76	0.83	0.95	0.74	0.84	0.91
Commerce	Urban	0.89	0.89	1.00	0.78	0.87	0.84
	Rural	0.89	0.89	0.99	0.75	0.83	0.80
PubUtil	Urban	0.53	0.61	0.57	0.41	0.47	0.39
	Rural	1.04	1.08	1.09	0.94	0.98	0.95
SociServ	Urban	0.52	0.52	0.51	0.47	0.46	0.38
	Rural	1.02	1.00	1.00	0.97	0.96	0.86

The range of the actual price changes is affected not only by the cost-push but also the demand-pull. When the demand is insufficient, the actual price change may be smaller than the price change calculated from the cost-push. For example, although the price system saw a big adjustment in 1991 in China, the consumer-price index was as low as 2-3%, because the market demand was sluggish. When there is over-demand, the effect of the cost-pushed price hikes will be fully seen. The enlightenment we have gained from the simulation in this section is that the price changes listed above have made a considerable contribution to the rise of the general price level. We should, therefore, pay attention to any possible price rises in these sectors which result from either some price adjustment policy made by the government or other causes, such as the influence of international market price changes, because it may cause an obvious increase in the general price level.

3. An Analysis of the Impacts of Price Adjustment on Inflation

3.1. An Analysis of the Contributing Factors of Inflation in China

China's economy has experienced a rapid rate of growth, with an average annual growth rate of 9.5% in GDP since 1978. Meanwhile, however, national economic development has been impeded by inflation. In the past 16 years, there have been three periods of major

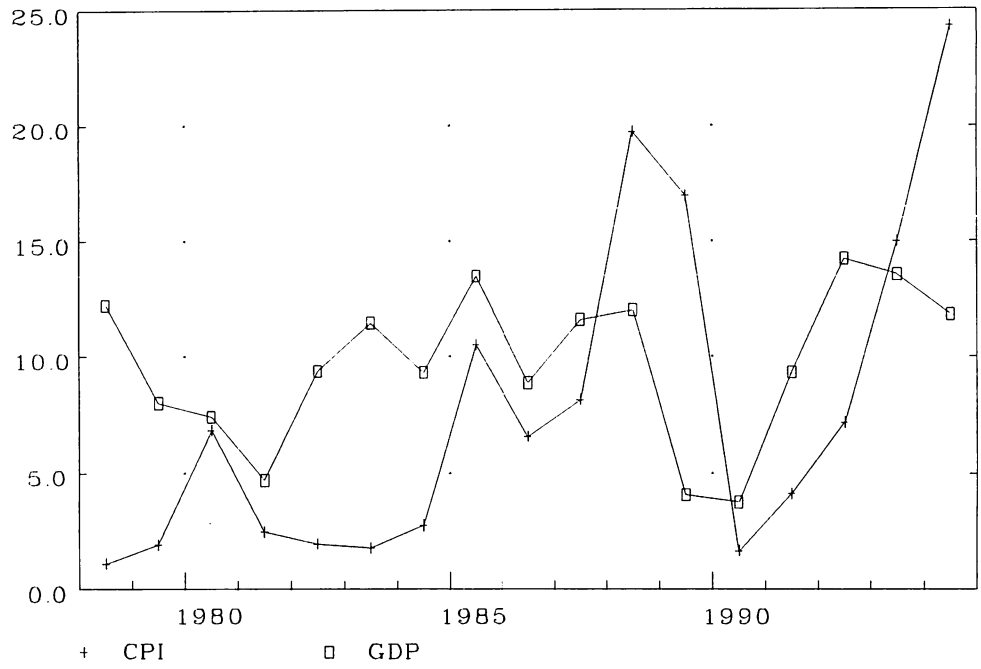

Figure 2: Economic Growth and Inflation in 1978-1994 (%)

inflation in China. As illustrated in Figure 2, the first period of inflation was between 1977 and 1980; the second one was between 1984 and 1989. The third period of inflation has taken place since 1993, with the consumer-price index reaching a record 24.1% in the 16 years since the reform and open-policy programmes were initiated.

Certain contributory factors regarding inflation in China are determined by the actual national conditions and the characteristics during a transitional period in the economic system. They operate over a long time and create potential inflationary pressure. Some others are long-term factors, such as major economic fluctuations, changes in macro economic policies or unexpected external factors, leading to escalating prices.

The long-term factors affecting price levels in China include:

(1) The long-term trend of the increase in relative prices for agricultural and resource products, which is due to a large population, limited farmland, the long-standing gap between the supply of, and demand for, farm products; as well as the relative inadequacy of natural resources such as energy, minerals and water.

(2) The long-term process for China to transform from a mid-term, planned economy into a "socialist market" economy. The rapid change in the economic system, and the imperfect market mechanism will often result in an increase in the "social transaction cost".

(3) The inevitable trend of the increase in labour costs along with economic

development, since wage levels in China are still very low.

(4) The structural problems such as bottlenecks in energy, transport and material sectors, which can not be solved in a short time. The short supply of products in these sectors will also result in a price increase in other productive sectors.

With regard to the situation in 1994, there were many factors which caused the inflation. On the one hand, capital investment was as high as 42.6% and 58.6% when the economic growth rates were over 13% during the years 1992 and 1993. The over-demand had not only strongly pushed prices up in those years, but also had a large impact on prices increases in 1994. It can be determined from the simulation in 1994 that the role of investment in pulling the prices had been retarded to some extent with the capital investment increase by 27.8%; while prices had been pulled by consumer-demand and foreign demand, with a rapid increase in the resident income and a high export growth of 31.9%. In addition, an excessively rapid growth in money supply had been seen in 1992 and 1993, with $\mathbf{M}_1$ increasing by 35.7% and 21% and $\mathbf{M}_2$ by 31.3% and 24%, respectively. The large increase in foreign exchange reserve and the change in exchange settlement, which had resulted in the fast-growing monetary base and excessive money supply, were also major causes of high inflation.

On the other hand, there was the huge pressure of increasing production costs, which resulted from the price adjustments of agricultural and some other sectors' products; the increase of import prices caused by exchange-rate depreciation; the structural increase of the tax burden caused by taxation reform; the rise in labour costs led by wage increases, as well as the added burden of the enterprises, as a result of the rise in the interest rates. With the demand-pull, this pressure had generated hikes in current prices. By applying the MUDAN II model, a preliminary analysis as to what extent the price adjustments had affected the increase of the prices has been made on the basis of the simulation of the economic operations in 1994.

3.2. An Analysis of the Impact of the Price Adjustments in 1994

In 1994, there was a major adjustment, by the central government, of the prices of grain, cotton, coal, electric power, crude oil and processed petroleum products, on the basis of the price reforms in 1993. Among the 63 sectors of the MUDAN II model, these products belong to the sectors 1, 6, 26, 7 and 27 respectively. In order to analyze the impact of simultaneous changes of the prices in several sectors on the prices in other sectors, we rewrote the price equation as follows:

$$\begin{pmatrix} \mathbf{P}_n \\ \mathbf{p}_m \end{pmatrix} = \begin{pmatrix} \mathbf{A}_{nn} & \mathbf{A}_{nm} \\ \mathbf{A}_{mn} & \mathbf{A}_{mm} \end{pmatrix}^{\mathrm{T}} \begin{pmatrix} \mathbf{p}_n \\ \mathbf{p}_m \end{pmatrix} + \begin{pmatrix} \mathbf{unitva}_n \\ \mathbf{unitva}_m \end{pmatrix} \tag{5}$$

In the equation above, $\mathbf{p}_n$ was the price sub-vector constituted by the sectors in which "active" price changes take place and $\mathbf{p}_m$ was the price sub-vector constituted by remaining

passive sectors. Similar to the equation (3) and (4), we got following equation (6) and (7) from (5):

$$\mathbf{unitva}_n = \mathbf{p}_n - \mathbf{A}_{nn}\mathbf{p}_n - \mathbf{A}^T_{mn}\mathbf{p}_m \tag{6}$$

$$\mathbf{p}_m = (\mathbf{I} - \mathbf{A}^T_{mm})^{-1}(\mathbf{A}^T_{nm}\mathbf{p}_n + \mathbf{unitva}_m) \tag{7}$$

The values of the actual prices of the previously mentioned five sectors in which price adjustment were made by the central government in 1994 were regarded as the values of the sub-vector $\mathbf{p}_n$; and the value added per unit output of the other 58 sectors in the previous year were regarded as the values of the sub-vector $\mathbf{unitva}_m$. Under these circumstances, the price changes in the 58 passive sectors and the changes of the consumer price index were solved by equations (6) and (7). The results are listed in Table 3.

It can be seen from the table that the price increases in the five sectors of plantation, coal mining, crude petroleum production, petroleum refineries and the electricity generating industry had resulted in the cost-pushed price hikes in the other 58 sectors. For example, the price in livestock production increased 10.99%, the price in the iron and steel sector increased 11.28%, and so on. The price increases in all these sectors had led to a 15.37% rise in the rural consumer-price index, and a 11.95% rise in the urban consumer price index, which made up 63.3% and 48.0 of the total increases of the rural and urban consumer price indexes respectively.

It should be explained that the impact of the price changes in the five sectors defined by the method above were the general and common impacts of the levels of actual price increases in these sectors, instead of the impact of the range of the price adjustment for these sectors. In the actual economic operations, the initial price adjustments for the five sectors will have an impact on the prices in the other 58 sectors, which in turn will cause further price changes in these five sectors. If these five sectors wish to keep the rising range of the additional value added per unit of output from the initial price adjustments, the further price changes in these sectors will promote the price changes in the other 58 sectors. This mutual promotion, in turn, continues until the reported level on the closing day for statistics at the end of the year. The basic motivation of the price increase, in turn, is that every sector wishes to increase (for the "active" sector) or to maintain (for the "passive" sectors) the level of the value added per unit of output respectively.

Thus, if the data about the initial price adjustments in "active" sectors are available, the final impact of the initial price adjustments can be found through the analysis which starts from the increased level of the value added per unit of output corresponding to the initial price adjustments in the "active" sectors and solves the equation (5) under the condition that the value added per unit of output in the "passive" sectors remains unchanged. The final impacts are not only the ones on prices for the "passive" sectors, but also the ones on the prices in the "active" sectors themselves. We did not carry out this kind of analysis in our simulation because we were lacking the data on the initial price adjustments in the five sectors in 1994.

Table 3: The Impact of Price Change in Five Sectors on Prices in Other Sectors and on Consumer-Price Index (1994)

	Sector	Change of Price (%)		Sector	Change of Price (%)
1	Crops	34.5	33	Plastic	7.81
2	Forestry	2.00	34	BuildMat	9.88
3	Livestock	10.99	35	IronSteel	11.28
4	Fishing	4.58	36	NferProd	12.06
5	OthAg	6.14	37	MetalProd	9.87
6	CoalMin	22.2	38	Machinery	6.26
7	CrudeOil	48.7	39	RailVeh	6.49
8	FerOreMin	10.62	40	RoadVeh	4.43
9	NonFerOre	8.97	41	ShipBuild	5.91
10	Quarrying	7.58	42	Aircraft	4.41
11	SaltMin	4.16	43	ElecMach	6.47
12	Logging	3.43	44	Electron	1.24
13	WaterDist	7.37	45	Instrumnt	3.99
14	FoodProd	17.00	46	OthInd	6.78
15	Beverages	12.04	47	Construct	6.73
16	Tobacco	6.89	48	RailTr	7.46
17	Forage	20.89	49	RadTr	11.32
18	Textiles	11.34	50	WaterTr	10.42
19	Apparel	8.27	51	AirTr	9.96
20	Leather	8.99	52	PipeTr	5.62
21	Sawmills	7.87	53	Communic	2.67
22	Furniture	6.49	54	Commerce	5.50
23	Paper	10.22	55	Restaurant	10.95
24	Printing	7.14	56	RailPass	6.67
25	SocActProd	6.34	57	RoadPass	10.17
26	ElecProd	39.5	58	WaterPass	9.48
27	RefPet	48.7	59	AirPass	8.38
28	Coking	17.54	60	PubUtil	1.31
29	Chemical	10.46	61	SocServ	4.37
30	Medicine	7.32	62	FinServ	0.43
31	ChemFibre	8.67	63	PubAdmin	2.59
32	Rubber	5.56			

Impact on rural consumer price index:	15.37
Share in the change of rural consumer price index :	63.3
Impact on urban consumer price index:	11.95
Share in the change of urban consumer price index :	48.0

4. The Measurement of the Effect of the Price Adjustment in the Ninth Five Year Plan Period

4.1. The Design of Scenarios

Since 1978, remarkable achievements have been made in price reform. A new price formation mechanism has been established, and most products have been open to market pricing along with a gradually reduced proportion of direct government pricing. Up to the end of 1993, the proportions of market pricing for the domestic retail sales of commodities, for the purchases of farm and sideline products and for the sales capital goods were 95%, 90% and 86% respectively; while the government still controlled the pricing of some important production materials (such as crude petroleum), for some major industrial inputs (such as electric power and railway transport) and for some products closely related to the basic living requirements of the people (such as grain and cotton). In the Ninth Five Year Plan period, the price reforms for these commodities will be carried out by combining adjustment and liberalization, but with adjustment as the main method. Making production prices marketable is a slow process in China and will also be a difficult task in the Ninth Five Year Plan period. Due to limited resources and availability of time in our study, we only considered the reform of commodity prices, and did not include the price reform of services.

To determine the scenarios to be used in this study, we first made a preliminary analysis of the range and trend of the price adjustments in the major commodities priced by central government.

The price of grain and cotton increased dramatically in the last two years. Some agricultural commodity prices have approached, or even surpassed, the prices in international markets. According to the development experiences in Japan, Korea and Taiwan province, on the one hand, the existence of a large population, combined with limited farmland has meant that agricultural commodity prices in China will be higher than those on the international market, in order to protect the livelihood of Chinese farmers. On the other hand, however, because the streamlined circulation fields and the rationalized scale of agricultural operations are the potential factors in reducing the cost of agricultural commodities, and the fact that the cost of rural labour is still quite low, the agricultural commodity prices in China will not be like those in other Asian countries, which are much higher than the prices on the international market.

In this case, we assumed that the grain purchase price index would increase by 3-4% annually and would exceed the price in the international market during the Ninth Five Year Plan period. Taking into account the rate of inflation in the current year, the increases in grain prices were set at 14% and 18%, respectively. Two scenarios were postulated for the price adjustment of cotton, too. The lower scenario was to maintain a 5-10% difference between the cotton price on the international market; and the higher one was to have a similar level to the prices on the international market. Considering the ratio of grain and cotton in the plantation sector, the scenarios for the price change in the sector of crops cultivation were 7% and 9%, respectively, corresponding to the scenarios for grain and cotton above.

After merging the planned price into the domestic market price for crude oil in 1994, the price ratio between crude oil and coal, and the price-ratio between crude oil and gasoline,

tend to be more reasonable; but there is still an obvious disparity between prices in the domestic and international markets. It is still impossible to make the price of petroleum marketable, because the principal part of the market system for oil has not been well-established at present in China. With regards to the next step of the reform in oil prices, the following price-adjustment scenario has been proposed with respect to the impact of oil price increases on other products' prices.

The oil price should be increased by about 10% by 1997, and increased gradually between 1997-2000 in order to reduce the gap between the prices in the domestic and international markets. A 10% price difference should be maintained by the year 2000, provided that the exchange rate remains stable. If the depreciation of RMB is taken into account (say US$1 = RMB10), the price of crude oil can be increased by 20% before 1997, and by 15% or so in the years between 1997 and 2000.

Transportation costs, mainly the rail transport costs, have been relatively low; the present price per tonnage-kilometer for railway freight transportation, including the charge for the Railway Development Fund, being merely 0.053 yuan. We reckon that the cost of railway freight transportation could be increased by a relatively wide margin during the next several years, on the premise that the macro-economic situation is stable, and the growth in transport capacity and volume is maintained at present levels. The increase in the cost of per tonnage-kilometer can be 0.01 yuan in 1996. The additional income from the price increase should not be put into the Railway Development Fund, temporarily, in order to maintain a simple reproduction. A further increase of 0.005 yuan for per tonnage-kilometer should be made in 1998; and 50% of the additional income from the price rise should be included in the Railway Development Fund. Another increase of 0.005 yuan for per tonnage-kilometer should be implemented in the year 2000, and 30% of the additional income from the price rise should be included in the RDF.

There was a relatively rapid development in the power industry during recent years. Having adopted different prices for different power transmission networks, the development of the power industry has been accelerated. The power prices vary among different power operating units at present. Different ex-station costs have been adopted for the power stations run by counties, cities or provinces. The selling-prices are often the average prices between the locally-run power stations and the state-run power transmission network. Because the price of electricity from the state-run power transmission network is relatively low, the selling-price of electricity in some places is often lower than the price of the electricity from local ex-stations. The goal for the adjustment of electricity prices can be attained by adjusting the electricity price of the state-run power transmission network. At present, the main source of energy for the power industry has been coal, and therefore, the price of coal should be referred to the change in power prices. Tentatively, we assumed that the range of adjustment of electricity prices was between 5% and 7%.

To sum up, we designed two scenarios for price adjustment in the Ninth Five Year Plan period. Tables 4 and 5 show the range of price adjustments of the two scenarios for crop cultivation, crude petroleum, power industry and railway transport; which are numbers 1, 7, 26 and 48 in the 63 sectors of the MUDAN II respectively.

Table 4: Range of Price Adjustment in the Four Sectors (Scenario I)

%

	1996	1997	1998	1999	2000
Crops	7	7	7	7	7
CrudOil	0	10	10	10	10
Electricity	5	6	6	6	5
Rail Transportation	18.5	13.5	8.5	7.8	7

Table 5: Range of Price Adjustment in the Four Sectors (Scenario II)

%

	1996	1997	1998	1999	2000
Crops	9	9	9	9	9
CrudOil	0	20	20	18	15
Electricity	5	6	6	6	5
Rail Transportation	18.5	13.5	8.5	7.8	7

4.2. The Results

According to the development goals for the Ninth five Year Plan period, we have worked out a base-run of the MUDAN II in which the annual growth rates of GDP, in comparable price, were around 8-9% and inflation (the GDP deflator) was less than 10%. On the basis of the base-run, the two scenarios of price adjustments in the four sectors listed in Tables 4 and 5 were carried out and, comparing the results from base-run, the percentage changes of the corresponding price indexes of the 63 sectors, the percentage changes of the urban and ruralconsumer price indexes and the percentage change of the GDP deflator were calculated. The results are shown in Tables 6 and 7.

From Tables 6 and 7, we can see that the price changes resulting from the price-adjustment in the four sectors are not that strong when compared to base run. Related bigger changes occurred in sector 3 (Livestock, around 2%); sector 14 (Food Manufacturing, around 3-4%); sector 17 (Forage Manufacturing, around 4-6%); sector 15 (Beverages, around 2-3%); sector 18 (Textile, around 2%); and sector 55 (Restaurants, around 2% or a little more); except the four active sectors themselves. It is due to these sectors using products from crops as their main raw materials. On the other hand, even if the prices of crude oil and railway transportation increase considerably, the price changes in other sectors are not so big, because the input structure of China's economy does not strongly depend upon crude oil and railway transportation at the moment; except sector 27 (Petroleum Refineries) which uses crude oil as its main raw material.

From the bottom of the Tables 6 and 7, we can also see that the results from the two scenarios show that the price adjustments in the four sectors may possibly result in a 2-4% additional increase in the consumer price index with the GDP deflator related to the basis of the price rising level, connected with the base run. The impact on rural consumers is stronger

than on urban consumers, and this is due to the difference in consumption rates between rural and urban people. The fact is that food constitutes a large percentage of the Chinese peoples' expenditure budget, and that the rural population consumes more grain than people in urban areas.

5. Conclusion

From the above results, we reached the conclusion that the influence of the further price reforms on inflation would not be as serious as before. After the price reforms of the last 16 years, the prices of most commodities have been market ones. The few other prices controlled by government, having been subjected to a number of adjustments, are gradually approaching market levels, and there will be no major adjustment (such as 50% or more) in these prices apart from exceptional cases. Therefore, the major influence on inflation in future will come from macro-economic factors.

Table 6: The Results of Scenario I

N	Sector	1996	1997	1998	1999	2000
1	Crops	1.074	1.076	1.076	1.076	1.076
2	Forestry	1.002	1.004	1.004	1.003	1.003
3	Livestock	1.020	1.021	1.020	1.020	1.019
4	Fishing	1.007	1.009	1.009	1.008	1.008
5	OthAg	1.011	1.013	1.013	1.012	1.012
6	CoalMin	1.006	1.008	1.008	1.008	1.007
7	CrudeOil	1.004	1.105	1.105	1.105	1.105
8	FerOreMin	1.008	1.011	1.012	1.010	1.009
9	NonFerOre	1.007	1.010	1.011	1.010	1.009
10	Quarrying	1.007	1.010	1.010	1.010	1.009
11	SaltMin	1.004	1.006	1.006	1.006	1.005
12	Logging	1.003	1.006	1.006	1.006	1.006
13	WaterDist	1.008	1.011	1.012	1.011	1.009
14	FoodProd	1.033	1.035	1.034	1.034	1.033
15	Beverages	1.022	1.024	1.024	1.023	1.023
16	Tobacco	1.012	1.012	1.012	1.012	1.012
17	Forage	1.044	1.045	1.044	1.044	1.043
18	Textiles	1.017	1.018	1.018	1.018	1.017
19	Apparel	1.011	1.013	1.013	1.012	1.012
20	Leather	1.012	1.014	1.014	1.013	1.013
21	Sawmills	1.008	1.012	1.012	1.011	1.010
22	Furniture	1.008	1.010	1.010	1.010	1.009
23	Paper	1.013	1.016	1.016	1.015	1.014
24	Printing	1.009	1.011	1.011	1.010	1.010
25	SocActProd	1.009	1.011	1.011	1.010	1.010
26	ElecProd	1.054	1.069	1.079	1.069	1.058
27	RefPet	1.006	1.055	1.055	1.055	1.054
28	Coking	1.011	1.017	1.017	1.015	1.014
29	Chemical	1.011	1.016	1.016	1.015	1.001
30	Medicine	1.011	1.012	1.012	1.012	1.012
31	ChemFibre	1.008	1.013	1.013	1.013	1.012
32	Rubber	1.008	1.009	1.009	1.009	1.009
33	Plastic	1.009	1.012	1.012	1.012	1.011
34	BuildMat	1.009	1.013	1.014	1.013	1.012
35	IronSteel	1.008	1.012	1.012	1.011	1.001
36	NFerProd	1.010	1.013	1.014	1.013	1.011
37	MetalProd	1.008	1.011	1.012	1.011	1.010
38	Machinery	1.007	1.009	1.009	1.009	1.001
39	RailVeh	1.006	1.008	1.008	1.008	1.007

40	RoadVeh	1.005	1.007	1.007	1.007	1.006
41	ShipBuild	1.006	1.008	1.008	1.008	1.007
42	Aircraft	1.005	1.007	1.007	1.006	1.006
43	ElecMach	1.007	1.010	1.010	1.009	1.008
44	Electron	1.001	1.001	1.001	1.001	1.001
45	Instrumnt	1.004	1.005	1.005	1.005	1.005
46	OthInd	1.007	1.009	1.009	1.009	1.008
47	Construct	1.006	1.009	1.009	1.009	1.008
48	RailTr	1.189	1.146	1.096	1.089	1.080
49	RadTr	1.004	1.013	1.013	1.013	1.012
50	WaterTr	1.003	1.013	1.013	1.013	1.013
51	AirTr	1.003	1.010	1.010	1.009	1.009
52	PipeTr	1.007	1.011	1.012	1.011	1.010
53	Communic	1.003	1.004	1.004	1.004	1.003
54	Commerce	1.005	1.007	1.007	1.007	1.007
55	Restaurant	1.019	1.020	1.020	1.019	1.019
56	RailPass	1.004	1.009	1.009	1.008	1.008
57	RoadPass	1.004	1.012	1.012	1.011	1.011
58	WaterPass	1.004	1.013	1.012	1.012	1.012
59	AirPass	1.004	1.009	1.009	1.009	1.008
60	PubUtil	1.001	1.002	1.002	1.002	1.002
61	SocServ	1.005	1.006	1.006	1.005	1.005
62	FinServ	1.000	1.001	1.001	1.001	1.001
63	PubAdmin	1.002	1.004	1.004	1.004	1.004
	Impact on Urban Consumer Price Index	1.028	1.028	1.028	1.027	1.026
	Impact on Urban Consumer Price Index	1.019	1.021	1.021	1.020	1.019
	Impact on GDP Deflator	1.016	1.018	1.018	1.017	1.016

Table 7: The Results of Scenario II

N	Sector	1996	1997	1998	1999	2000
1	Crops	1.095	1.099	1.099	1.098	1.076
2	Forestry	1.003	1.005	1.005	1.005	1.003
3	Livestock	1.025	1.027	1.026	1.026	1.019
4	Fishing	1.009	1.011	1.011	1.011	1.001
5	OthAg	1.014	1.017	1.017	1.0016	1.012
6	CoalMin	1.006	1.010	1.010	1.0009	1.001
7	CrudeOil	1.004	1.207	1.207	1.186	1.105
8	FerOreMin	1.008	1.014	1.015	1.013	1.009
9	NonFerOre	1.007	1.013	1.014	1.012	1.009
10	Quarrying	1.007	1.013	1.014	1.012	1.009
11	SaltMin	1.004	1.008	1.008	1.007	1.005
12	Logging	1.004	1.010	1.010	1.009	1.006
13	WaterDist	1.009	1.013	1.014	1.012	1.009
14	FoodProd	1.042	1.045	1.044	1.043	1.033
15	Beverages	1.028	1.031	1.031	1.030	1.023
16	Tobacco	1.015	1.016	1.016	1.016	1.012
17	Forage	1.055	1.058	1.057	1.056	1.043
18	Textiles	1.021	1.024	1.024	1.023	1.017
19	Apparel	1.014	1.017	1.017	1.016	1.012
20	Leather	1.015	1.018	1.018	1.017	1.013
21	Sawmills	1.009	1.016	1.016	1.015	1.010
22	Furniture	1.008	1.014	1.014	1.013	1.009
23	Paper	1.015	1.020	1.020	1.019	1.014
24	Printing	1.010	1.014	1.014	1.013	1.010
25	SocActProd	1.0011	1.014	1.014	1.013	1.010
26	ElecProd	1.054	1.075	1.085	1.073	1.058
27	RefPet	1.006	1.105	1.105	1.095	1.054
28	Coking	1.012	1.023	1.022	1.020	1.014
29	Chemical	1.012	1.022	1.022	1.020	1.014
30	Medicine	1.013	1.016	1.016	1.015	1.012
31	ChemFibre	1.009	1.018	1.019	1.017	1.012
32	Rubber	1.009	1.013	1.013	1.012	1.009
33	Plastic	1.010	1.016	1.016	1.015	1.011
34	BuildMat	1.010	1.018	1.018	1.017	1.012
35	IronSteel	1.009	1.015	1.016	1.014	1.010
36	NFerProd	1.010	1.017	1.017	1.015	1.011
37	MetalProd	1.009	1.015	1.015	1.013	1.010
38	Machinery	1.007	1.012	1.012	1.011	1.008
39	RailVeh	1.006	1.011	1.011	1.010	1.007

40	RoadVeh	1.006	1.009	1.001	1.009	1.006
41	ShipBuild	1.006	1.011	1.011	1.010	1.007
42	Aircraft	1.005	1.009	1.009	1.008	1.006
43	ElecMach	1.007	1.013	1.013	1.012	1.008
44	Electron	1.001	1.001	1.001	1.001	1.001
45	Instrumnt	1.004	1.007	1.007	1.006	1.005
46	OthInd	1.007	1.012	1.012	1.011	1.008
47	Construct	1.007	1.012	1.012	1.011	1.008
48	RailTr	1.189	1.152	1.0103	1.094	1.080
49	RadTr	1.004	1.023	1.023	1.020	1.012
50	WaterTr	1.003	1.023	1.024	1.021	1.013
51	AirTr	1.003	1.017	1.017	1.015	1.009
52	PipeTr	1.007	1.015	1.016	1.014	1.010
53	Communic	1.003	1.005	1.0005	1.005	1.003
54	Commerce	1.006	1.010	1.010	1.009	1.007
55	Restaurant	1.023	1.026	1.026	1.025	1.019
56	RailPass	1.004	1.014	1.014	1.013	1.008
57	RoadPass	1.004	1.020	1.020	1.018	1.011
58	WaterPass	1.005	1.021	1.021	1.019	1.012
59	AirPass	1.004	1.014	1.014	1.013	1.008
60	PubUtil	1.002	1.003	1.003	1.003	1.002
61	SocServ	1.005	1.008	1.008	1.007	1.005
62	FinServ	1.001	1.001	1.001	1.001	1.001
63	PubAdmin	1.003	1.006	1.006	1.006	1.004
	Impact on Rural Consumer Price Index	1.034	1.037	1.036	1.035	1.026
	Impact on Urban Consumer Price Index	1.024	1.027	1.027	1.026	1.019
	Impact on GDP Deflator	1.019	1.024	1.024	1.022	1.016

Appendix A . The Sectors of MUDAN II Model

1	Crops	Crop cultivation
2	Forestry	Forestry
3	Livestock	Livestock production
4	Fishing	Fishing
5	OthAg	Other agricultural production
6	CoalMin	Coal mining
7	CrudeOil	Crude petroleum and natural gas production
8	FerOreMin	Ferrous ore mining
9	NonFerOre	Non-ferrous ore mining
10	Quarrying	Non-metal minerals
11	SaltMin	Salt mining
12	Logging	Logging and transport of timber and bamboo
13	WaterDist	Production and supply of water
14	FoodProd	Food manufacturing
15	Beverages	Beverages
16	Tobacco	Tobacco manufacture
17	Forage	Forage manufacture
18	Textiles	Textiles
19	Apparel	Wearing apparel
20	Leather	Leather fur and related products
21	Sawmills	Sawmills and bamboo etc. products
22	Furniture	Furniture
23	Paper	Paper and paper products
24	Printing	Printing industries
25	SocActProd	Cultural, education, sports arts and craft articles
26	ElecProd	Electricity steam and hot water production and supply
27	RefPet	Petroleum refineries
28	Coking	Coking manufacture of gas and coal products
29	Chemical	Chemical industries
30	Medicine	Medicines
31	ChemFibre	Chemical fibres
32	Rubber	Rubber products
33	Plastic	Plastic products
34	BuildMat	Building materials and other non-metallic mineral products
35	IronSteel	Primary iron and steel manufacturing
36	NferProd	Primary non-ferrous metals manufacturing
37	MetalProd	Metal products
38	Machinery	Machinery
39	RailVeh	Railroad equipment

40	RoadVeh	Motor vehicles
41	ShipBuild	Ship building
42	Aircraft	Aircraft
43	ElecMach	Electric machinery and instrument
44	Electron	Electronic and communication equipment
45	Instrumnt	Meters and other measuring equipment
46	OthInd	Industries not elsewhere classified
47	Construct	Construction
48	RailTr	Railway freight transport
49	RadTr	Highway freight transport
50	WaterTr	Water freight transport
51	AirTr	Air freight transport
52	PipeTr	Pipeline transport
53	Communic	Communications
54	Commerce	Commerce
55	Restaurant	Restaurants
56	RailPass	Railway passenger transport
57	RoadPass	Highway passenger transport
58	WaterPass	Water passenger transport
59	AirPass	Air passenger transport
60	PubUtil	Public utilities and services to household
61	SocServ	Cultural, education, health and scientific research institutions
62	FinServ	Finance and insurance
63	PubAdmin	Public administration

Appendix B. A Brief Introduction to INFORUM Model

INFORUM (INterindustry FORecasting at the University of Maryland) model is a kind of multisectoral econometric model which describes the behaviour of the economy not only at macro level, but also at sector level. Input-output tables and time series from the System of National Account are the basis in building an INFORUM style multisectoral model. The theoretical framework of a INFORUM model normally has steps for year t as following:

(1) Determine the components of final demand by sectors in constant price which includes :
household consumption, marked as vector c,
government expenditure, marked as vector g,
fixed investment, marked as vector i,
inventory change, marked as vector r,
export, marked as vector x,
import, marked as vector m.

(2) Determine gross output by sectors in constant price which is marked as a vector variable; for example, q and the calculation formula is:

$$\sum_{j=1}^{n} a_{ij} q_j + c_i + g_i + i_i + r_i + x_i - m_i = q_i, \quad i = 1,2, \cdots, n \qquad (1)$$

where A is the technical coefficient matrix in constant price and has dimension $n \times n$, i.e, the sector number is n. Of course, all the vectors above have the same dimension n.

(3) Determine the components of value added by sectors in current price which is marked as vector v and includes:
depreciation, marked as vector d,
wages, marked as vector w,

labour and other income, marked as vector o,
taxes, marked as vector t,
operating surplus, marked as vector u,
subsidies, marked as vector s,

Therefore, this is written as:

$$v_j = d_j + w_j + o_j + t_j + u_j - s_j, \quad j = 1,2,\cdots,n$$

(4) Determine the gross output price index by sectors, marked as vector p, by following

formula

$$\sum_{i=1}^{n} a_{ij} p_i + b_j = p_j, \quad j = 1,2,\cdots,n \qquad (2)$$

where

b is the unit value added vector defined as value added in current prices per unit of output in constant prices, i.e., there is

$$b_j = v_j / q_j, \quad j = 1,2,\cdots,n$$

(5) Determine other relative variables such as productivity and employment at sector level. Determine the values of some macro economic variables such as GDP in both current and constant prices, GDP deflator, household income, consumer price index, national income, government revenue, and so on, at aggregation level.

(6) According to some criteria, go back to step 1 to repeat the whole process or go to year $t+1$.

It can be seen that it is not an easy task to build an INFORUM multisectoral model. On the one hand, the number of behaviour equations to be estimated is very large, because each component of the final demand and value added is a vector which has n sectors and each sector should have an individual regression equation. On the other hand, input-output tables are available for selected years only in many countries; whereas annual series are required for regressions of various behaviour equations. Furthermore, the input-output tables are often compiled at current price levels; whereas constant price tables are needed for model building. The time series from SNA with special sector categories and specific definitions which are different from the sector classifications and definitions in input-output table. A typical example is the time series for investment by sectors. Normally, the investment data by sectors from SNA are the data investigated from purchasers, but not those from producers as situated in the input-output table.

Some techniques are used to solve these problems in the INFORUM model. There is an approach called across-the-rows which has tables that will be consistent with all the final demand data and value added data from SNA for the years when there is a lack of tables. As for the problem of the time series from SNA having different sector classifications and definitions from the input-output table, there are bridge matrix methods to convert from the SNA category classifications into input-output sector classifications. For example, there are only time series data for household consumption from families investigated in China. These data have different categories from the sectors of the input-output table. There are 19 categories of commodities and services for urban households and 11 for rural; but the input-output table used in building MUDAN II has 63 sectors. Two different bridge matrices, one of 63×19 and another of

63×11 are used for converting the categories of the time series from families investigated into the sector classifications of input-output table.

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