ECONOMIC POLICY

RESEARCH PAPER SERIES

# A SOCIAL ACCOUNTING MATRIX AND CGE MODEL FOR BEIJING

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OCTOBER, 2005

Development Research Center

State Council of the People's Republic of China

No. 225. Chaoyangmen Nei Dajie

## RESEARCH PAPERS ON

## ECONOMIC DEVELOPMENT

This report is part of a series of research studies on Chinese regional economic growth and development. Sponsored jointly by the Development Research Center and the World Bank, these studies are intended to contribute to policy dialogue and promote capacity development for policy research.

Special thanks are due to the ASEM fund, administered by the World Bank, for supporting this project, “Capacity for Regional Research on Poverty and Inequality”. To support a new generation of coherent policies addressing poverty and regional inequality, this activity is delivering empirical tools and training to a prominent national Chinese research institution and its regional counterparts. As several of China’s provinces are now among East Asia’s largest economies, more detailed insight into their own growth challenges and their role in national development is essential for both public and private stakeholders. This new capacity will enable the State Council and other Chinese agencies to better understand detailed incidence and facilitate more equitable growth, extending its benefits to the low-income majority of the country. The project includes original data development, research capacity development, collaborative prototype studies, and regional training and dissemination workshops.

The present report was authored by Zhigang DUAN of Peking University, under supervision of Mme, Shantong Li and other DRC staff. Dr. David Roland-Holst, an international consultant retained for this project, has provided ongoing technical support. The author thanks other academic colleagues and seminar participants for many insights and helpful comments. All remaining errors are the author’s, as are any opinions expressed in this document.

# A SOCIAL ACCOUNTING MATRIX AND CGE MODEL FOR BEIJING

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## 1.

## 2.1. INTRODUCTION

Beijing municipality faces of the Bohai Sea, stands at the northern tip of North China Plain. It is surrounded by the Yanshan Mountains on the west, north and east while the small alluvial plain of the Yongding River lies to its southeast. As the capital of China, Beijing, with area of 394,000 $KM^2$ in which is divided into 10 districts and 8 counties, is one of the four mega-cities under the direct jurisdiction of the Chinese central government. The population of Beijing reaches approximately 15 million, about half of which live on the outskirt. Beijing have had been the capital of China for nearly six hundreds years ever since 1421 in the Ming Dynasty period. Moreover, Beijing is famous not only for its Chinese historical heritage scenery and architecture, but also for its highly condensed and unique Chinese traditional culture and conventions.

According to the World Bank classification, China is a low-middle annual income country yet with roughly US $1300 GDP per capital and Beijing can be unanimously accepted as the fairly developed region in China. In 2003, Beijing's Gross Domestic Product (GDP) had an increase of 10.7 percent for the sixth year in a row since 1997, and was valued at 366 billion Yuan ($44.3 billion) which almost equal 2.7% of the national total. The Per capita GDP, increased at the rate of 9.2 percent in the last decades amounted to 32061 Yuan in 2003 (US$3,876). That is almost 3.5 times of the national average. Table 1 listed the main index of the

## Table 1 Main index of the Beijing development

| | Beijing | China | Percentage to national average/total (%) |
|---|---|---|---|
| GDP (100 million RMB) | 3,663 | 135,539 | 2.7 |
| Population (10 thousand) | 1,456 | 129,227 | 1.13 |
| Per GDP (RMB Yuan) | 32,061 | 9,101 | 352.3 |
| Labor (10 Thousand) | | | |
| Economic Structure (GDP %) | | | |
| Primary Industry | 2.6 | 14.6 | |
| Secondary Industry | 35.8 | 52.2 | |
| Tertiary Industry | 61.6 | 33.2 | |
| Employment (10 Thousands ) | | | |
| Primary Industry | 67 | 36,546 | 0.18 |
| Secondary Industry | 280 | 16,077 | 1.74 |
| Tertiary Industry | 512 | 21,809 | 2.35 |
| Employment Structure (%) | | | |
| Primary Industry | 7.8 | 49.1 | |
| Secondary Industry | 32.6 | 21.6 | |
| Tertiary Industry | 59.6 | 29.3 | |
| Foreign Trade Volume (100 Millions $) | 313 | 8510 | 3.7 |

| | | | |
|---|---|---|---|
| Export (100 Millions $) | 100 | 4382 | 2.3 |
| Import (100 Millions $) | 214 | 4128 | 5.2 |
| Trade Independence (%) | 70.8 | 52.0 | |
| | | | |
| Household Income (RMB Yuan) | | | |
| Urban | 13,883 | 8,472 | 163.9 |
| Rural | 5,602 | 2,622 | 213.6 |
| | | | |
| FDI in 2003 (100 Million $) | 17.3 | 524.7 | 3.3 |
| Total FDI (100 Million $) | 463.3 | 11,173.5 | 4.1 |
| Number of Foreign Funded Enterprise | 9,185 | 226,373 | 4.1 |

economical and social development of both Beijing and the nationwide.

Although accounted for 2.6 percent of the GDP share, the agriculture employs 7.8% (about 670 thousand) of the total labor force in Beijing. The secondary and the tertiary industry accounts for 35.8% and 61.6% of the GDP share, and each have 32.6% (2800 thousands) and 59.6% (512 thousands) of local total employment. The employment in the secondary and tertiary industry in Beijing is about 0.18%, 1.74% and 2.35% individually of the national total.

In 2003, the total turnover of Beijing foreign trade is $31.33 billion (according to the commodity statistics by Places of Destination or Origin in China by Region) among which $9.96 billion is export and imports amount to $21.37 billion. The total trade volume, import and export value accounts for around 3.7%, 2.3% and 5.2% of the national total respectively. Electrical machinery and mechanical equipment, textiles, garments, household

electrical appliances, telecommunication equipment, pharmaceuticals, steel products, etc are the main export commodities.

Beijing has accumulated a total of $46.3 billion foreign direct investment (FDI) in 2003, which were invested by 9185 foreign registered enterprises and accounted for 4.1% of the national total FDI. More than 300 out of the 500 world power companies have established their branch or company in Beijing. In 2002, Beijing was quartered to 181 foreign-funded R&D centers. The Zhongguancun Science and Technology Park (ZSTP), Haidian Park of the ZSTP and Yizhuang are fundamental structures in forming Beijing's "headquarters economy."

In 2001, Beijing's successful bid for the 2008 Olympic Games enhance the authorities' ambitions to build the international level of Beijing municipality to even greater heights. As part of the greater Bohai Sea economic area, Beijing is getting more attention from transnational enterprises that plan to establish headquarters here. Beijing is aimed to become the financial and modern service center of China.

The main purpose of this report is to construct a Social Accounting Matrix (SAM) for Beijing to serve as a database for the forthcoming Computable General Equilibrium (CGE) model accommodated to the characteristics of the Beijing economy. The first part will provide the general information about Beijing, and then the conceptual framework of SAM will be presented followed by a set of full data resource description on the Beijing SAM. The report precedes to analyze the Beijing economic structure and subsequently proposes some potential research aspects by using the existing SAM or the CGE model.

## 3.2 SOCIAL ACCOUNTING MATIRX (SAM)

The origin of Social Accounting Matrix (SAM) can be traced back to the pioneering work of Sir Richard Stone in the 1960s. A SAM is defined as the presentation of SNA accounts in a matrix that elaborates the linkages between the supply and the use of table and institutional sector

accounts (SNA, 1993). It is a particular representation of the macro and micro economic accounts of a socio-economic system, which capture the transactions and transfers between all economic agents in the system (Pyatt and Round, 1985; Reinert and Roland-Holst, 1997).

The concept of SAM is the synthesis of two well-known ideas in economics. The first idea derives from the input-output figure, which portrays the system of inter-industrial linkages in the economy. The purchase of an intermediate input by one sector represents the sale of that same input by another sector. While this transaction is entered in a single cell in the input-output figure, it appears in the accounts of the two different sectors using traditional double-entry bookkeeping. Each cell in the SAM shows the payment from the account of its column to the account of its row. The incomes of an account appear along its row and its expenditures along its column. (Round, Jeffery, 2003).

The second idea embodied in the SAM, derived from national income accounting, is that income always equals expenditure. Although true for the economy as a whole, the SAM requires a balance in the accounts of every factor in the economy. For example, the income of the household from all resources must equal its total expenditures on the income tax, consumption on commodity & services, savings deposit and transference to both other habitants and foreign countries. Traditionally, this is captured in double-entry bookkeeping by the requirement that the two sides of the ledger must be equal. In the SAM, incomes appear along the rows, and expenditures down the columns; thus the budget constraints require that the sum of the row (income) must equal the sum of the column (expenditure).

Generally speaking, the SAM is a simple and efficient framework to organize economic data in such a way that every income should correspond to its outlay or expenditure; both the receiver and the sender of every transaction must be identified. To summarize in a more technical way, SAM is a square matrix in which each account is represented by a row and a column. Algebraically, a SAM may be represented by the following square matrix:

$$T = \{t_{ij}\}$$

where $t_{ij}$ is the value of transaction with income accruing to account *i* from expenditure by account *j*. The underlying principle of double-entry accounting requires that, for each account in the SAM, total revenue (row total) equals total expenditure (column total). In that case,

$$\sum_j t_{ij} = \sum_i t_{ij} \quad \text{when } i=j$$

## 4.3 STRUCTURE OF BEIJING SAM

Table 1 shows an aggregated Macro SAM for Beijing with verbal explanations in the cells. The SAM usually encompasses every transaction of an economy such as production, sale, consumption, and distribution within a given period of time for instance a year. The data sources for a SAM come from input-output tables, national income statistics, financial flow statistics, customer statistics, taxation yearbook and household income and expenditure statistics etc. The 1997 Macro SAM for Beijing is a square matrix that comprised of 13 rows and columns forming separate accounts in the economy. The non-zero intersections between rows and columns in the Macro SAM give the specific flows of funds between various accounts.

**Table 2 A Descriptive Macro SAM For Beijing, 1997**

| Receipts | Expenditure | | | | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1.Activity* | *2. Commodity* | *3.VA- Labor* | *4.VA- Capital* | *5.VA- Land* | *6.Households* | *7.Enterprises* | *8.Gov. Subsidies* | *9.Government* | *10.Capital Account* | *11.Stock change* | *12 Rest of China* | *13.Rest of World* | |
| *1.Activity* | | Domestic Production | | | | | | | | | | | | Total Domestic Production |
| *2.Commo-dity* | Intermediate Consumption | | | | | Private Consumption | | | Government Consumption | Gross Fixed Capital Formation | Changes in Inventories | Commodity & service Outflow | Export | Total Commodity Demand |
| *3.VA-Labor* | Compensation of Employees | | | | | | | | | | | | | Labor Earning |
| *4.VA-Capital* | Depreciation; Operating Surplus | | | | | | | | | | | | | Capital Earning |
| *5.VA-Land* | Land reward | | | | | | | | | | | | | Land Income |
| *6. Households* | | | Compensation of employees distr. to HH | Capital income distr. to HH | Land income distr. to HH | | Transfers to households | Subsidy on households | Transfers to households | | | | Earning from ROW | Household Income |
| *7. Enterprises* | | | | Capital income distr. to Enterprise. | Land income distr. to Enterprise. | | | | | | | | | Enterprise income |
| *8.Gov. Subsidies* | Subsidy on Production (Negative) | | | | | | | | Expenditure of Subsidy | | | | | Government Subsidy on Household |
| *9. Government* | Indirect Taxes | Import tax (incl. Tariff) | | | | Income tax | Income tax | | | Government Deficits. | | Transfer from ROC | Earning from ROW | Government Revenue |
| *10.Capital Account* | | | | | | Households savings | Enterprise savings | | Government saving | | | Regional Trade Surplus | Foreign Saving | Total savings |
| *11.Stock change* | | | | | | | | | | Changes in Inventories | | | | Total Changes in Inventories |
| *12 Rest Of* | | | Reward paid | Capital | | | | | Government | | | | | Total ROC |

In our Beijing SAM, we distinguish two different effects between "*activities*" and "*commodities*". First, it permits more than one type of activities to produce the same commodity, thereby allowing for different production technologies. For example, small- and large-scale farmers may produce the same crop (a single "commodity") but with different factor intensities (two or more "activities"). Second, this treatment addresses several difficult problems that arise from dealing with imports. Domestic demand will consist of both types of goods if imports are at all competitive with domestically produced goods (which is usually the case). However, only domestic goods are exported. Separating activity accounts (or the domestic production of goods) from commodity accounts (the domestic demand for goods) enables us to portray this difference.

Reading from across the *activity row* in the schematic SAM in table 2, it is observed that total income derives exclusively from domestic sales to the commodity account. The *activity column* contains all expenditures on inputs into the production process: on intermediate consumption, on value added and on net indirect taxes (production subsidy works as a negative item of the indirect taxes). The sum of these input expenditures should equal gross output sales. The commodity account can be thought of as a supermarket that carries both foreign and domestic goods. The *commodity column* shows purchases of domestic products from the activity account and purchases of imports from the rest of the world and from the rest of China; and it also pays import tariffs to the government (although the incidence is on consumers, the market prices are higher by the amount of the tariffs). The *commodity row* shows how the total supply of commodities is demanded by domestic purchasers, including intermediate inputs, household and government consumption, investment (includes stock change) goods and export to the rest of world and the rest of China.

In the *factors account*, the value added received by factors of production is allocated between households and enterprises (via the allocation matrix). The *household account* shows that households divide this income as well as any transfers from the government, between private

consumption of goods, income taxes, and private savings. Similarly, in the *government account*, the government receives income from taxes (including tariffs, indirect taxes, and income taxes) and spends it on consumption, transfers to households, and savings. The *capital account* reflects the equality between savings (the row, comprised of private, government, and foreign components), and investment (the column). The last two rows and columns contain similar accounts identities. The *rest of the world account* represents the equality between foreign exchange expenditures (imports) and foreign exchange earnings (exports plus foreign savings). The *rest of China account* records the trade transaction of each sector between the region and the rest of China.

The construction of a SAM is not only an exercise in putting together a complete data set, but also an estimation process on the basis of insufficient and partly inconsistent data (Marzia Fontana & Peter Wobst, 2001). The SAM construction can be divided into two steps: First, a highly aggregated SAM (macro SAM) is constructed. It represents the macroeconomic framework of the Beijing economy. Second, the macro SAM is disaggregated into a micro SAM. Its sub-matrices are constructed from various data sources with macro SAM entries serving as control totals for the adjustment of the raw data.

Above, we have described the framework of the Macro SAM and economic meaning of each cell. Subsequently, we will illustrate the construction process with full details of the data resources in the SAM. Table 2 shows the completed macro Beijing SAM in 1997.

## Table 3 1997 Beijing Social Accounting Matrix (SAM)

(Unit: 100 Million Yuan)

| | 1 Activity | 2 Commodity | 3 Labor | 4 Capital | 5 Land | 6 Household | 7 Enterprise | 8 Government | 9 Subsidy | 10 Investment | 11 St. Change | 12 ROC | 13 ROW | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Activity | | 5546.5 | | | | | | | | | | | | 5546.5 |
| 2 Commodity | 3736.4 | | | | | 953.5 | | 345.5 | | 937.3 | -195.7 | 1095.8 | 201.2 | 7073.8 |
| 3 Labor | 995.2 | | | | | | | | | | | | | 995.2 |
| 4 Capital | 711.1 | | | | | | | | | | | | | 711.1 |
| 5 Land | 8.6 | | | | | | | | | | | | | 8.6 |
| 6 Household | | | 995.2 | 412.4 | 8.6 | | 49.6 | 25.7 | | | | | | 1491.6 |
| 7 Enterprise | | | | 298.6 | | | | | | | | | | 298.6 |
| 8 Government | 460.6 | 24.9 | | | | 38.3 | 108.6 | | | | | | | 632.3 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 Subsidy | -365.4 | | | | | | | 365.4 | | | | | | 0.0 |
| 10 Saving | | | | | | 499.8 | 140.4 | *-104.2* | | | | *152.3* | *53.3* | 741.6 |
| 11 St. Change | | | | | | | | | | -195.7 | | | | -195.7 |
| 12 ROC | | 1248.0 | | | | | | | | | | | | 1248.0 |
| 13 ROW | | 254.5 | | | | | | | | | | | | 254.5 |
| SUM | 5546.5 | 7073.8 | 995.2 | 711.1 | 8.6 | 1491.6 | 298.6 | 632.3 | 0.0 | 741.6 | -195.7 | 1248.0 | 254.5 | |

Note: The italic underlined numbers are the account residue used to balance the account income and expenditure.

## 5.4 DOCUMENTATION FOR BEIJING MACROSAM

The macro SAM is built on the basis of various data, e.g. 1997 Beijing Input-Output Table (I/O table), Statistic Yearbook of Beijing (1998), Financial Yearbook of Beijing (1998) and Flow of Funds Table (1997). The following describes the macro SAM cell entries and identifies their sources. The cell entries are referenced by their "row-column" location, i.e., “Commodities, Activities” represents an expenditure flow from the “Activities” column to the “Commodities” row. **All entries are in 1997 RMB 100 million**. All non-zero intersections between rows and columns in the Macro SAM will be discussed as the following.

***Commodity & Activity***

1. **Total Domestic Supply (Activity, Commodity)**: 5,546.5 — Beijing total regional output sales domestically. *Source*: Balancing item determined by the accounts row sum.

2. **Intermediate Consumption (Commodity, Activity)**: 3,736.4 — Regional total intermediate consumption supplied by productive activity (incl. imported intermediate input). *Source*: 1997 Beijing Input-Output Table.

3. **Final private consumption (Commodity, Household)**: 953.3 — Total household expenditure on goods and service. *Source*: 1997 Beijing Input-Output Table.

4. **Government consumption (Commodity, Government)**: 345.5 — Total government expenditure on goods and service. *Source*: 1997 Beijing Input-Output Table.

5. **Fixed capital formation (Commodity, Investment)**: 937.3 — Regional gross fixed capital formation. *Source*: 1997 Beijing Input-Output Table.

6. **Changes in Inventories (Commodity, St. Change)**: -195.7 — Gross changes in stocks with minor adjustment for the balance of commodity account. *Source*: 1997 Beijing Input-Output Table.

7. **Regional commodity outflow (Commodity, ROC)**: 1095.8 — Total outflows of goods and services to the other regional in China. *Source*: Balance item between the Input-output table total expert column and the expert mentioned below.

8. **Expert (Commodity, ROC)**: 201.2 — Total exports of goods and services. Merchandise trade is collected from *Customs Statistics* and service trade from official I/O. *Source*: 1997 China Customs Statistic.

***Factor***

9. **Labor wage (Labor, Activity)**: 995.2 — Labor compensation. *Source*: 1997 Beijing Input-Output Table.

10. **Depreciation & operating surplus (Capital, Activity)**: 711.1 — Capital value added includes depreciation and operating surplus. *Source*: 1997 Beijing Input-Output Table.

11. **Land rent (Land, Activity)**: 8.6 — Land rent in the production activity, assumed exclusive in the agriculture sector. *Source*: estimation deduced from the national proportion.

***Institution***

11. **Labor wage distributed to households (Households, Labor)**: 995.2 — This represents total labor compensation is less than compensation of employees paid to the rest of the world, while the latter is assumed to be zero temporarily. *Source*: 1997 Beijing Input-Output Table.

12. **Capital income distributed to Households (Households, Capital)**: 412.4 — Net income from properties of households. *Source*: Flow of Funds Table (1998 Beijing Statistic Yearbook).

13. **Land rent distributed to household (Household, Land)**: 8.6 — Balance item of land accounts.

14. **Enterprise transfer to Households (Households, Enterprises)**: 49.6 — Residual item balancing the household account.

15. **Government transfer to Households (Households, Government)**: 25.7 — Total government transfer to household, e.g. pensions, expenditure in social security. *Source*: Beijing statistic yearbook (1998).

16. **Capital income distributed to Enterprise (Enterprise, Capital)**: 298.6 — Residual item balancing the Capital account.

17. **Indirect Taxes (Government, Activity)**: 460.6 — Total indirect taxes impose on production, incl. VAT etc. *Source*: China Tax Statistic Yearbook (1998).

18. **Import taxes (Government, Commodity)**: 24.9 — Total import taxed incl. tariff and import VAT. *Source*: Estimation deduced according to the national customer commodity nominal import rate.

19. **Household Income Taxes (Government, Household)**: 38.3 — Total income taxes impose on household. *Source*: China Tax Statistic Yearbook (1998).

20. **Enterprise Income Taxes (Government, Enterprise)**: 108.6 — Total income taxes impose on enterprises. *Source*: China Tax Statistic Yearbook (1998).

21. **Earning from ROW (Government, ROW)**: 0 — Total current transfers to governments from ROW and personal income tax paid by foreigners. Assumed to be zero for the moment.

22. **Subsidy on Production (Subsidies, Activity)**: -365.4 — Total government subsidies on production (negative), incl. subsidies on prices of grain, cotton and edible oil, subsidies on loss-making enterprises and tax rebate to foreign trade company. *Source*: Financial Yearbook of China (1998).

23. **Government Subsidy (Subsidies, Government)**: 365.4 — Total government subsidies on production and household, subsidies on production plus subsidies on household. *Source*: Balancing item used to clear subsidy accounts.

***Saving and investment***

24. **Household saving (Saving, Households)**: 499.8 — Total household saving. *Source*: Beijing Statistic Yearbook 1998.

25. **Enterprise saving (Saving, Enterprises)**: 140.4 — Total enterprise savings. *Source*: Residual item balancing the enterprise account, equal to the enterprise total income minus transference to household and income taxes paid to government.

26. **Government saving (Saving, Government)**: -104.2 —Total government savings. *Source*: Balancing item of the government account, residue of the government total income and government expenditure.

27. **Domestic saving (Saving, ROC)**: 152.3 — Deficit/surplus of Beijing regional trade. *Source*: Residual balancing the ROC account.

28. **Foreign exchange saving (Saving, ROW)**: 53.3 — Deficit/surplus of international trade. *Source*: Residual balancing the ROW account.

29. **Changes in Inventories (St. change, Investment)**: -195.7 — Change in stock. *Source*: Balancing item of St. change account.

30. **Commodity Outflow (ROC, Commodity)**: 1248.0 —Total inflow of goods and services from ROC. Source: Residue between 1997 Beijing Input-Output table outflow column and import item mentioned below.

31. **Imports (ROW, Commodity)**: 254.5 — Total import of goods and services. The data collection is the same as the exports. *Source*: Customs Statistic, Statistic Yearbook of China (1998).

32. **Capital income paid to ROW (Row, Capital)**: 0 — Investment Profit from ROW. *Source*: assumed to be zero for the moment.

## 5 MICRO SAM FOR BEIJING, 1997

In this section, the disaggregation of micro social account matrix will be discussed. To get micro SAM, some cells in macro SAM will be extended to sub-matrices. For instance, intermediate consumption (Commodity, Activity) in macro SAM become input-output matrix ($40\times40$[1]) in micro SAM,

### *SECTOR DISAGGREGATION*

The 1997 micro SAM for Beijing contains 40 production sectors, 3 types of primary factors and 3 kinds of labor, 12 urban and rural household representatives, 3 types of indirect taxes imposed on production by VAT (value-added tax), BT (Business Tax) and other indirect taxes. As another production factor, land is imported in the micro SAM. Table 3 shows all the accounts listed in the micro SAM.

### *DOCUMENTATION OF MICRO SAM DATA*

For each corresponding cell of the macro SAM, the micro SAM either presents the same data entry or a sub-matrix of corresponding data entries derived from raw data and structural information for data disaggregation and adjustment. This section focuses on the sub-matrices in micro SAM. Most the disaggregation is related to the Commodity & Activity accounts.

[1] 40 denotes the number of production sectors in micro SAM

## Table 4 Accounts of the micro SAM for Beijing 1997

| *Commodity & activity* | | **Description** |
|---|---|---|
| 1 | Agriculture | Agriculture |
| 2 | Coal | Coal mining and processing |
| 3 | Oil | Crude petroleum and natural gas products |
| 4 | Mine | Metal ore mining |
| 5 | Non-ferrous | Non-ferrous mineral mining |
| 6 | FoodTobacco | Manufacture of food products and tobacco processing |
| 7 | Textile | Textile goods |
| 8 | ApparelLeather | Wearing apparel, leather, furs, down and related products |
| 9 | Sawillsfurniture | Sawmills and furniture |
| 10 | RecordMedium | Paper and products, printing and record medium reproduction |
| 11 | OilRefine | Petroleum processing and coking |
| 12 | Chemical | Chemicals |
| 13 | Non-Metal | Nonmetal mineral products |
| 14 | MetalProcess | Metals smelting and pressing |
| 15 | MetalProduct | Metal products |
| 16 | Machinery | Machinery and equipment |
| 17 | TransEquipment | Transport equipment |
| 18 | ElecMachinery | Electric equipment and machinery |
| 19 | Electron | Electronic and telecommunication equipment |
| 20 | Instrument | Instruments, meters, cultural and office machinery |
| 21 | Maintain | Maintenance and repair of machinery and equipment |
| 22 | OtherManufacture | Other manufacturing products |
| 23 | Waste | Scrap and waste |
| 24 | Power | Electricity, steam and hot water production and supply |
| 25 | Gas | Gas production and supply |
| 26 | Water | Water production and supply |
| 27 | Constructure | Construction |
| 28 | Ware | Transport and warehousing |
| 29 | Post | Post and telecommunication |

| | | |
|---|---|---|
| 30 | Retail | Wholesale and retail trade |
| 31 | Rst | Eating and drinking places |
| 32 | Passenger | Passenger transport |
| 33 | Financial | Finance and insurance |
| 34 | RealEstate | Real estate |
| 35 | SocialServer | Social services |
| 36 | HealthSanitary | Health services, sports and social welfare |
| 37 | Education | Education, culture and arts, radio, film and television |
| 38 | SciResearch | Scientific research |
| 39 | GeneralTech | General technical services |
| 40 | Administration | Public administration and other sectors |

***Factor***

| | | | | |
|---|---|---|---|---|
| | | Prof-Labor | 2 | Capital |
| 1 | Labor | Prod-Labor | 3 | Land |
| | | Agri-Labor | 4 | Resource |

***Household***

| | | | |
|---|---|---|---|
| 1 | Rural | Low Income Household | 20% of Population |
| 2 | Rural | Lower Middle Income Household | 20% of Population |
| 3 | Rural | Middle Income Household | 20% of Population |
| 4 | Rural | Upper Middle Income Household | 20% of Population |
| 5 | Rural | High Income Household | 20% of Population |
| 6 | Urban | Lowest Income Household | Fist decile |
| 7 | Urban | Low Income Household | Second decile |
| 8 | Urban | Lower Middle Income Household | Second quintile |
| 9 | Urban | Middle Income Households` | Third quintile |
| 10 | Urban | Upper Middle Income Household | Fourth quintile |
| 11 | Urban | High Income Household | Ninth decile |
| 12 | Urban | High Income Household | Tenth decile |

***Government***

| | | | |
|---|---|---|---|
| 1 | Government PT (Production Tax) | 4 | Import Tax |
| 2 | VAT | 5 | Export Tax Reduction |

| | | | |
|---|---|---|---|
| 3 | Government Production Subsidy (PS) | 6 | Government |

***Import & Export***

| | | | |
|---|---|---|---|
| 1 | Tariff | 3 | Rest of the World (ROW) |
| 2 | Rest of China (ROC) | | |

***Saving & Investment***

| | |
|---|---|
| 1 | Capital/Investment Account |
| 2 | Stock Change |

### *Consumption (intermediate consumption and final consumption)*

As mentioned before, the micro SAM contains 40 production sectors, therefore the commodity and activity accounts in macro SAM are disaggregated to 40 sectors. Intermediate consumption in macro SAM is replaced by a 40×40 matrix in micro SAM. The data for this sub-matrix directly comes from the 1997 Beijing input-output Table, intermediate input matrix. The household consumption is taken from Beijing I/O tables. For government consumption, the public consumption structure in I/O table is adopted and the macro data works as the control figures.

### *Compensation of Factor*

For the micro SAM, land is listed as another production factor, as well as labor and capital. Unlike the other two production factors, land is used only by agricultural activities. Land return is estimated using return rates in GTAP database and is separated from the compensation of labor in macro SAM. Labor in micro SAM is split into 3 types of labor forces, agriculture labors, production works (unskilled labor) and professional works (skilled labor). The income of three types of labor forces is estimated based on the Labor Statistic Yearbook and the wage differential between 3 types of labor forces. The capital income is taken from the Beijing I/O tables.

### *Net taxes on production*

The net taxes on production refer to the difference of the taxes on production minus the subsidies on production. Subsidies on production by sectors are estimated upon the data on Beijing government budget in 1997 (Financial Statistic Yearbook of China, 1998) and on the loss of loss-making enterprises of industrial sectors (Industrial Census of 1995). The VAT (value-added tax) by sectors is estimated based on the VAT income by sectors (Tax Statistic Yearbook of China, 1998) and VAT payable by sectors (Statistic Yearbook of Beijing, 1998).

The other indirect taxes and extra-budget fee by sectors are calculated as the residual of sectoral net taxes on production in input-output table.

***Import and Export***

As to the exports and imports demand from the rest of the world, we aggregated the data of international trade from Chinese customs statistics at 8-digits HS classification to 40 SSB input-output sectoral classifications for all merchandise sectors. The exports and imports of service sectors are collected from the service export in the input-output table. The tariffs are estimated on the nominal taxes calculated with the import from customs statistics at 8-digits HS classification and nominal tax rate by HS classification.

The export and import from the rest of China are treated as the residues between the total export and import in the IO table and from the rest of the world.

***Household expenditure and income***

The household consumption has been discussed before. Household income taxes are estimated on the person income taxes by category (*Tax Statistic Yearbook, 1998*). Household savings are estimated upon the change of deposits and financial asset (e.g. Treasury Bonds) and individual investment in fixed assets financed by fundraising funds (*Statistical Yearbook of Beijing, 1998*) with the control of total household savings in macro SAM. Subject to the identity that total expenditure equal income, income of each household group can be derived from the expenditure side. The information on income sources for rural and urban households are available in the household survey data (*Household Survey*). In addition, we assume that rural households earn their labor income from both agricultural labors and production workers, while urban households obtain their wages from both production and professional workers. The income matrix by different income sources for rural and urban households is estimated using the RAS procedure with income sources vector in macro SAM and household income vector as control totals.

## 6.6 POTENTIAL POLICY ISSUE

The SAM discussed earlier provides a schematic portrayal of the circular flow of income in the economy: from activities and commodities, to factors of production, to institutions, and back to activities and commodities again. This dataset is useful for the economic modeling analysis, especially for the CGE model. After completing the construction of Beijing SAM, we will also use the dataset for the economic analysis of policy related issue in Beijing.

Since 2001, Beijing has accelerated its modernization pace owing to its successful bid for the 2008 Olympic Games. The investment on the gymnasium and related infrastructure such as environmental protection, transportation system improvement, telecommunication broadcasting equipment upgrade, etc, will continue to boost its economic growth. In order to analyze the macro impact of the Olympic effects, Beijing CGE model will be established as an analytical tool to simulate the macroeconomic effects of the Olympic economic system. Two scenarios were then designed for the analytical purposes.

The first scenario, business as usual (BAU), assumes no Olympic games will be hold in Beijing. No Olympic factors will be introduced to the CGE model and Beijing will keep the growth trend as it was likewise in the last seven years. While the second scenario, as the opposite of the first, assumes that the Olympic will be hold by Beijing and that the Olympic economic influential factors as the construction investment, foreign demands increment, etc, reflected by the change of certain model parameter and variable, would be introduced to the CGE model. Table 5 lists the main scenario assumption.

**Table 5 Description on the main assumption of two scenario**

| | |
|---|---|
| **(No Olympic)**<br>**Business As Usual (BAU)** | ⊙ Regional GDP growth rate exogenous determined, and equal to the average level of last 7 years;<br>⊙ TFP endogenous to fit the pre-specified GDP growth rate;<br>⊙ Without Olympic related investment;<br>⊙ Standard Neoclassic Macroclosure; |
| **(Olympic Game): Comparative Scenario** | ⊙ Regional GDP growth endogenous determined;<br>⊙ TFP exogenous fixed, equal to the BAU calibrated value;<br>⊙ Olympic related gymnasium and infrastructure begins;<br>⊙ Investment from Government expenditure increase; |

| | |
|---|---|
| | ⊙ Travel related and service industries export demand parameter increase;<br>⊙ Modified Neoclassic Macroclosure; |

Although the fast economic growth benefits the regional habitant, it will impose more pressures on the energy and resources which threaten the regional ecological system and set constrains to the economic development. Water shortage, for example, always becomes an obstacle to the implementation of the Beijing's harmonic and sustainable development plan. In order to alleviate the water shortage in the northern China, including Beijing, Chinese government had decided to launch the South Water North Transference Project (S2N). S2N water transfer project is one of the four China's huge trans-century projects aimed to transfer water from Southern China to Northern China to meet the increasing demand for water resource of Northern China, where the storage of water has been a serious constraint to the regional economic development and the consequential slower development. When the S2N project accomplished in 2008, there will be a total of 1.02 billion $M^3$ water transferred to Beijing annually, which will account for about of 25% of total concurrent water usage in Beijing.

In order to analyze the social-economic impacts of China's S2N Water Transfer project to Beijing region, another four scenarios based on the modified CGE model will be designed. Table 6 lists the main scenario assumptions in each scenario.

**Table 6 Description on the main assumption of S2N scenarios**

| | **Unsustainable Water Use Pattern** | **Sustainable Water Use Pattern** |
|---|---|---|
| **Without S2N** | **B1 Scenario**:<br>• Without sustainable development strategy;<br>• Keep water use pattern as 1990s;<br>• With excessive pumping groundwater;<br>• And keep surface water utilization rate as high as 80%;<br>• Ecological water use keep zero;<br>• Household per capita water use increase 2% annually. | **B2 Scenario**:<br>• Adopt sustainable development policy;<br>• Stop the excessive pumping of groundwater which causes regional total water supply decreased by 0.426billion $M^3$ consequently;<br>• Lower surface water utilization rate below 60%;<br>• Increase the regional ecological water use from 0 in 1997 to 0.92 billion $M^3$ in 2020 by a linear increment;<br>• Household per capita water use increase 2% annually. |

| | | |
|---|---|---|
| **With S2N** | **S1 scenario**:<br>• From year 2008, the transferred water $\Delta S_w$=1.021* 108 M3 is added to the regional water supply conditional on B1 scenario.<br>• The transferred water will be first for household use, then allocated for industrial use. | **S2 scenario**:<br>• From year 2008, the transferred water $\Delta S_w$=1.021* 108 M3 is added to the regional water supply conditional on B2 scenario.<br>• The transferred water will be first for household use, then allocated for industrial use. |

## 7. References


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