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COMPETITIVE ADVANTAGES ANALYSIS FOR SHAANXI PROVINCE BASED ON THE CGE MODEL

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TABLE OF CONTENTS

COMPETITIVE ADVANTAGES ANALYSIS FOR SHAANXI PROVINCE BASED ON THE CGE MODEL

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1. Introduction

Shaanxi is situated in the joint of central and western parts of China. The province is located at the western part of China's eastern and central regions and at the eastern part of China's western regions. It has the advantage as a connecting link between the east and the west and between the north and the south. Judging from its location features and economic position, the province should be regarded as the "first step" in the Western development.

A crisscross highway network has taken shape including 9 state highways and 53 provincial highways centered at Xian and extended to counties and townships. A sub-main highway system of 3,600 kilometers is now being constructed around the province. This system will create a "one-day traffic circle", connecting not only the 10 prefectures and cities within the province but also the surrounding center cities of Taiyuan, Shijiazhuang, Zhenzhou, Wuhan, Hefei, Chongqing, Chengdu, Yinchuan, Baotou, etc.

The railway construction has seen fast development, and has formed a trunk line framework of 2 vertical lines, 6 horizontal lines and 4 hubs. Within the province, there have been 16 trunks and branches with a traffic mileage of 2,821 kilometers including electrified railways of 2,100 kilometers.

Shaanxi is an important aviation hub in the Northwestern regions. The province has 5 civil airports in XiAn, YanAn, Yulin, Ankang and Hanzhong and has two airlines companies—Northwest and Changan.

The levels of equipment and technology of the telecommunications network has linked up with the world new technologies. A large capacity, high-speed digital transmission network has been built with optical cables as the main means supplemented by digital microwave and satellite communications.

The urban facilities have increasingly improved. In 2000, the province completed 246 major municipal engineering projects concerning urban forestation, gas lines, sewage treatment and garbage disposal. 13 large and medium cities have the daily water supply capacity of 311.5 tons. Presently, the installed capacity of power generation of the whole province is 7.4 million kilowatts. With the construction of the thermal power base in northern Shaanxi, development of the step hydroelectric stations along the Han River in southern Shaanxi and the intensification of the 330-kilovolt main power grids, the power supply can not only meet the needs within the province, but also transmit power to north China and other places.

The mineral resources in Shaanxi have many varieties and rich reserves. The reserves of coal, crude oil and natural gas are particularly abundant. The demonstrated reserves of coal amount to 270 billion tons with a potential value of RMB8259.4 billion, ranking the third in China. The prospective reserves of oil are 1.1 billion tons and the proven reserves are 760 million tons. The prospective reserves for natural gas are 6,000-8,000 billion cubic meters.

Within the 50,000 square kilometers at the central part of Shaan-Gan-Ning Basin, the proven reserves of natural gas reach up to 350 billion cubic meters ranking the second in China. With its present production capacity of 2.2 billion cubic meters per year, accelerated development will be of great significance to the establishment of China's future follow-up energy base.

For over two decades since the reform and openness, great achievements have been made in the economic and social development in Shaanxi Province. The national economy has fast grown at an annual speed of 9% since the Ninth Five Year Plan was implemented. In 2001, the GDP of the province reached RMB184.427 billion, of which the primary industry valued at RMB28.724 billion; the secondary industry was RMB81.634 billion and the tertiary industry RMB74.069 billion. The proportions of the primary, secondary and tertiary industries changed from 22.7:40.6:36.7 in 1995 to 15.6:44.3:40.1, with the tertiary industry 6.6 percentage point higher than the national average. An accumulative total investment of RMB269 billion was accomplished in the Ninth Five Year Plan period. With the large-scale investment in fixed assets, a major step has been made forward in the construction of infrastructures, including 550 kilometers of newly constructed railways and 393 kilometers of high-grade highways. Solid progress has been made in the adjustment of industrial structures. A strong momentum has been seen in the development of the industries with local characteristics, such as high technology, tourism and fruits. Remarkable achievements have been made in the enterprise restructuring. A large number of private hi-tech enterprises have emerged, and the share of non-public sectors in the total GDP has increased to 31.3%. In 2001, the per capita GDP of the province was RMB5,024 equaling 66.6% of the national average and the figure at the end of the Eighth Five Year Plan period was 58.6%. The per capita net income of farmers reached RMB1,470 and the per capita disposable income of urban residents reached RMB5,124, increased by RMB557 and RMB2,171 respectively over the year 1995. A social security system has been initially established.

2.The Social Accounting Matrix for Shaanxi, 1997

2.1. A macro social accounting matrix for Shaanxi, 1997

The 1997 Social Accounting Matrix for Shaanxi is a square matrix which encompass every transaction of Shaanxi in 1997, i.e. production, sale, consume, and distribution. The data sources for a SAM come from Shaanxi input-output table, income statistics, and household income and expenditure statistics etc.

A SAM is a square matrix in which each transactor or account has its own row and column. The payments (expenditures) are listed in columns and the receipts in rows. Algebraically, a SAM may be represented as 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.

2.1.1. The structure of the macro SAM for Shaanxi,1997

The 1997 Macro SAM for Shaanxi is a square matrix comprising 15 rows and columns forming separate accounts in the economy. Table 1 and table 2 denote the Macro SAM for Shaanxi,1997. The non-zero intersections between rows and columns in the Macro SAM give the specific flows of funds between various accounts.

A SAM shows the circular flow among the accounts. “Activities” receive incomes from the sale of goods and services produced and distribute these incomes to other production activities,

factors of production, and government. The factors of production (Labor and Capital), transfer income to the institutions (Household and Enterprise) in the economy. Government and extra-budget account earn income by imposing tax and fee on production activities and other institutions (Household and Enterprise), as well as imported goods. The institutions (Households, Enterprise, Government and Extra-budget account) expend income on the production activities through consumption of goods and services. The capital account serves as the reserve of savings from institutions and ROW. Likewise, expenditure from the capital account occurs through the consumption of capital goods from the production activities. The ROW account collects foreign exchange from purchases of foreign goods and services from the production activities. The ROW distributes foreign exchange to the production activities through exports. Furthermore, there are many trivial transactions happens between accounts, e.g. various transfers and subsidies. ROMC account reflects the economic relation between Shaanxi and the rest of the China (mainland of China).

2.1.2. Documentation of cell entries for the macro SAM

The macro SAM is built on the basis of various data, e.g. 1997 Shaanxi Input-Output Table (I/O table), Statistic Yearbook of Shaanxi (1998), Financial Yearbook of China (1998). 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 column “Activities” to the row “Commodities.”. All entries are in 1997 RMB 10,000 Yuan. All non-zero intersections between rows and columns in the Macro SAM will be discussed as following.

Table 1 A Descriptive Macro SAM For Shaanxi, 1997

Receipts	Expenditure															Total
	1. Commodity	2. Activity	3. VA- Labor	4. VA- Capital	5. Households	6. Enterprises	7. Local Gov. Sub	8. Central Gov. Sub	9. Local Gov.	10. Central Gov.	11. Extra-budget	12. Capital Account	13. Stock change	14. Rest of the World	15. Rest of China	
1. Commodity		Intermediate Consumption			Private Consumption				Government Consumption	Government Consumption	Extra-budget Consumption	Gross Fixed Capital Formation	Changes in Inventories	Export	Outflow to ROMC	Total Commodity Demand
2. Activity	Domestic Production															Total Domestic Production
3. VA- Labor		Compensation of Employees														Labor Earning
4. VA- Capital		Depreciation; Operating Surplus														Capital Earning
5. Households			Compensation of employees distr. to HH			Transfers to households			Transfers to households	Transfers to households						Household Income
6. Enterprises				Capital income distr. to Enterprise.												Enterprise income
7. Local Gov. Sub		Subsidy on Production (Negative)							Expenditure of Subsidy							Local Gov. Subsidy
8. Central Gov. Sub		Subsidy on Production (Negative)								Expenditure of Subsidy						Central Gov. Subsidy
9 Local Gov.		Indirect Taxes			Income tax	Income tax				Central Gov. transfer to Local Gov						Local Gov. Revenue
10. Central Gov.	Import tax (incl. Tariff)	Indirect Taxes				Income tax			Local Gov. transfer to Central Gov							Central Gov. Revenue
11. Extra-budget		extra-budget fee														Extra-budget Income
12. Capital Account					Households savings	Enterprise savings			Government saving	Government saving	Extra-budget savings			Foreign Saving	ROMC Saving	Total savings
13. Stock change												Changes in Inventories				Total Changes in Inventories
14. Rest of the World	Imports															Total Foreign Exchange Outlays
15. Rest of China	Inflow for ROMC															Total interregional inflow
Total	Total Commodity Supply	Total Cost of Production	Total Labor Payments	Total Capital Payments	Total Household Expenditure	Total Enterprise Expenditure	Total Local Gov. Subsidy	Total Central Gov. Subsidy	Total Local Gov. Expenditure	Total Central Gov. Expenditure	Total Extra-budget Expenditure	Total Investment Expenditure	Total Changes in Inventories	Total Foreign Exchange Earnings	Total interregional outflow	

Table 2 A Macro SAM For Shaanxi (1997, 10000 yuan)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
		Commodity	Acitivity	VA-Capital	VA-Labor	Households	Enterprise	Local Gov.Sub	Central Gov.Sub	Local Gov.	Central Gov.	Extra-system	Capital Account	Stock Change	ROW	ROMC	
1	Commodity		2064.71			656.36				113.67	43.95	70.62	464.79	83.80	85.34	627.94	4211.17
2	Acitivity	3390.75															3390.75
3	VA-Capital		331.08														331.08
4	VA-Labor		835.37														835.37
5	Households				835.37		19.15			8.15	1.62						864.28
6	Enterprise			331.08													331.08
7	Local Gov.Sub		-9.75							9.75							0.00
8	Central Gov.Sub		-8.22								8.22						0.00
9	Local Gov.		70.07			2.21	8.45				60.07						140.80
10	Central Gov.	3.95	55.60				3.83			0.80							64.18
11	Extra-system		51.89														51.89
12	Capital account					205.71	299.65			8.45	-49.67	-18.73			-29.04	132.23	548.59
13	Stock Change												83.80				83.80
14	ROW	56.30															56.30
15	ROMC	760.17															760.17
	Total	4211.17	3390.75	331.08	835.37	864.28	331.08	0.00	0.00	140.80	64.18	51.89	548.59	83.80	56.30	760.17	

Commodity & Activity

1. **Intermediate consumption (Commodity, Activity)**: — Total intermediate consumption by productive activity (incl. imported intermediate input). *Source: 1997 Shaanxi I/O*.

2. **Final private consumption (Commodity, Household)**: — Total household expenditure on goods and service. *Source: 1997 Shaanxi I/O*.

3. **Local Government consumption (Commodity, Local-Gov.)**: — Total local government expenditure on goods and service is collected from local government budgetary expenditure. *Source*: Financial Yearbook of China (1998).

4. **Central Government consumption (Commodity, Central-Gov.)**: — Total central government expenditure on goods and service is a share of total central governmental expenditure for all China. The share is assumed to be equal to the ratio of Shaanxi GDP to total GDP of all China. *Source*: Financial Yearbook of China (1998) and The China statistical Yearbook (1998).

5. **Extra-budget consumption (Commodity, Extra-budget)**: — The current account expenditure of government and other public sector, which is financed by extra-budget funds, is a residual obtained from netting out "local and central government budgetary expenditure" from total public sectors expenditure ("Social Consumption" in official I/O). *Source: 1997 Shaanxi I/O*.

6. **Fixed capital formation (Commodity, Capital)**:— Gross fixed capital formation. *Source: 1997 Shaanxi I/O*.

7. **Changes in Inventories (Commodity, Stock)**:— Gross changes in stocks with minor adjustment for the balance of commodity account. *Source: 1997 Shaanxi I/O*.

8. **Export (Commodity, ROW)**:23,248 — Total exports of goods and services. Merchandise trade is collected from *Customs Statistics* and service trade from is assumed to zero. *Source*: Customs Statistic, 2000 China I/O.

8. **Interregional outflow (Commodity, ROMC)**:23,248 — Total outflow of goods and services from Shaanxi to the rest of China (the mainland of China) is a residual obtained from netting out "export" from total outflow goods and services ("outflow" in official I/O). *Source*: Customs Statistic, 1997 Shaanxi I/O.

9. **Domestic production (Activity, Commodity)**:— Domestic output. *Source: 1997 Shaanxi I/O*.

Factor

10. **Compensation of employees (VA-Labor, Activity)**: — Labor compensation. *Source: 1997 Shaanxi I/O*.

11. **Depreciation & operating surplus (VA-Capital, Activity)**: — Capital value added includes depreciation and operating surplus. *Source: 1997 Shaanxi I/O*.

Institutions

12. **Compensation of employees distributed to households (Households, VA-Labor)**: — This represents total labor compensation of employees. *Source: 1997 Shaanxi I/O*.

13. **Enterprise transfer to Households (Households, Enterprises)**: — Residual balancing

14. **Local Governmental Subsidy and transfer on Households (Households, Local Gov.)**: — Total local government subsidies on household, is collected from local government budgetary expenditure. *Source*: Financial Yearbook of China (1998).

15. **Central Governmental Subsidy and transfer on Households (Households, Central Gov.)**: — Total central government subsidies on household, is a share of total central governmental expenditure for all China. The share is assumed to be equal to the ratio of the transfer from Central government to local Government to total transfer of central government. *Source*: Financial Yearbook of China (1998).

16. **Capital income distributed to Enterprise (Enterprise, VA-Capital)**: — This represents total capital compensation of enterprise. *Source: 1997 Shaanxi I/O*.

17. **Local Governmental Subsidy on Production (Local Gov.Sub, Activity)**: — Total government subsidies on production (negative), incl. subsidies on prices of grain, cotton and edible oil, and subsidies on loss-making enterprises. *Source*: Financial Yearbook of China (1998).

18. **Central Governmental Subsidy on Production (Central Gov.Sub, Activity)**: — 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. This subsidy is a share of total central governmental subsidy on production for all China. The share is assumed to be equal to the ratio of the transfer from Central government to local Government to total transfer of central government. *Source*: Financial Yearbook of China (1998).

19. **Local Government Subsidy (Gov.Subsidies, Government)**: — Total local government subsidies on production. *Source*: Financial Yearbook of China (1998).

19. **Central Government Subsidy (Gov.Subsidies, Government)**:— Total central government subsidies on production. *Source*: Financial Yearbook of China (1998).

20. **Local Governmental Indirect Taxes (Local Gov., Activity)**:— Total local indirect taxes impose on production, incl. VAT etc. *Source*: Financial Yearbook of China (1998).

21. **Households Income Taxes (Local Gov., Household)**:— Total households income taxes. *Source*: Financial Yearbook of China (2001).

22. **Enterprise Income Taxes (Local Gov., Enterprise)**:— Total enterprise income taxes imposed by local government. *Source*: Financial Yearbook of China (1998).

23. **Inter-government transfer (Local Gov., Central Gov.)**:—The transfer from central government to local government. *Source*: Financial Yearbook of China (1998).

24. **Import Tax (Central Gov., Commodity)**:—The tax imposed on import goods, incl. tariff and other import tax. *Source*: Financial Yearbook of China (1998).

25. **Central Governmental Indirect Taxes (Central Gov., Activity)**:— Total central indirect taxes impose on production, incl. VAT etc. *Source*: Financial Yearbook of China (2001).

26. **Enterprise Income Taxes (Central Gov., Enterprise)**:— Total enterprise income taxes imposed by central government. *Source*: Financial Yearbook of China (1998).

27. **Inter-government transfer (Central Gov., Local Gov.)**:—The transfer from local government to central government. *Source*: Financial Yearbook of China (1998).

28. **Extra-budget Fee (Extra-budget, Activity)**:— Total fee imposed on production at extra-budget level. This represents total net taxes on production less total budgetary taxes and subsidies on production. *Source: 1997 Shaanxi I/O*.

29. **Household saving (Capital Account, Households)**: — Total household saving, incl. annual increase of households deposits, cash in hand, securities and individual investment in fixed assets in rural areas etc. *Source*: Shaanxi Statistical Yearbook(1998).

30. **Enterprise saving (Capital Account, Enterprises)**: —Residual balancing the enterprise account.

31. **Government saving (Capital Account, Local Gov.)**: —Residual balancing the local government account.

32. **Government saving (Capital Account, Central Gov.)**: —Residual balancing the central government account.

33. **Extra-budget saving (Capital Account, Extra-budget)**: —Residual balancing the extra-budget account.

34. **Foreign saving (Capital Account, ROW)**: —Residual balancing the ROW account.

35. **ROMC saving (Capital Account, ROW)**: —Residual balancing the ROMC account.

36. **Changes in Inventories (Capital Account, Stock change)**: —Change in stock. *Source*: *1997 Shaanxi I/O.*

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

27. **Interregional inflow (ROMC, Commodity)**: — Total inflow of goods and services from the rest of China to Shaanxi. The data collection is the same as the "interregional outflow". *Source*: Customs Statistic, Statistic Yearbook of China (1998).

2.2. A micro social accounting matrix for Shaanxi

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 ($n \times n$[1]) in micro SAM.

2.2.1. The structure of the micro SAM

The 1997 micro SAM for Shaanxi contains 32 production sectors, 3 types of labors, 2 representative households by urban and rural, 3 types of labor forces and 3 types of indirect taxes imposed on production by VAT (value-added tax), BT(Business Tax) and other indirect tax. As another production factor, land is imported in the micro SAM. FTC margin account listed in micro SAM denotes the foreign trade corporations (FTC) margin. Furthermore, the import tax is divided by two parts, tariff and import VAT. Table 3 shows all the accounts listed in the micro SAM.

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.

Consumption (intermediate consumption and final consumption)

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

Table 3 Accounts of the micro SAM for Shaanxi,1997

Commodity & activity[2]			
1	Agriculture	17	Transport equipment
2	Coal Mining	18	Electronic machine
3	Crude Oil	19	Electronics
4	Metal Mining	20	Instrument
5	Quarrying	21	Other manufacturing
6	Food	22	Electricity
7	Textiles	23	Gas & water
8	Apparel	24	Construction
9	Sawmill &furniture	25	Transport
10	Social article	26	Telecomm
11	Petroleum refining	27	Commerce
12	Chemical	28	Restaurant
13	Building material	29	Finance
14	Primary metal	30	Social service
15	Metal products	31	Education & health
16	Machinery	32	Public administration
Factor			
	Prof-Labor		
1	Prod-Labor		
	Agri-Labor		
2	Capital		
3	Land		
Household			
1	Rural household		
2	Urben household		
Enterprise			
Government			
1	Local Gov. Subsidies	6	Central Gov. BT
2	Central Gov. Subsidies	7	Local Gov. OT
3	Local Gov. VAT	8	Central Gov. OT
4	Central Gov.VAT	9	Extra-budget
5	Local Gov. BT		
Import & Export			
1	Tariff		
2	Mvat		
3	FTC Margin		
4	Rest of the World (ROW)		
5	The Rest of China (ROMC)		
Saving & Investment			
1	Capital Account		
2	stock change		

As mentioned before, the micro SAM contains 32 production sectors. So the commodity and activity account in macro SAM are disaggregated to 32 sectors. Intermediate consumption in macro SAM is replaced by a 32×32 matrix in micro SAM. The data for this sub-matrix directly comes from 1997 Shaanxi input-output Table, intermediate input matrix. The household consumption is taken from

[2] For the particular description of the production sectors, refer to the annex 1.

Shaanxi I/O tables. For government consumption and extra-budget consumption, the social consumption structure in I/O table is adopted and the macro data become the control figures.

2.2.2. Documentation of data entries in the micro SAM

Compensation of Factors

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 1997 China SAM[3] 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 (*The Labor Statistical Year book, 1998*) and the wage differential between 3 types of labor forces[4]. The capital income is taken from the China 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 based upon the data on government subsidies (*Financial Statistic Yearbook of China, 1998*) and on the loss of loss-making enterprises of industrial sectors (*Shaanxi Statistic Yearbook, 1998*). The VAT (value-added tax) by sectors are estimated based on VAT payable by sectors (*Shaanxi Statistic Yearbook, 1998*). The BT (business tax) by sectors is estimated on the nominal BT rate by sectors. 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 & Export and Inflow & Outflow

As to the exports and imports demand, we aggregated the data of international trade from Chinese customs statistics at 8-digits HS classification to 32 sectors. The exports and imports of service sectors are assumed to zero. The FTC margins for exports by sectors are estimated based on the FTC rate in the 1997 China SAM. Total FTC margins for merchandise exports forms part of the demand of commerce export. The tariff and MVAT (VAT on imported goods) 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 outflow of goods and services from Shaanxi to the rest of China (the mainland of China) is a residual obtained from netting out “export” from total outflow goods and services (“outflow” in official

[3] The 1997 China SAM is available in the website: www.drc.gov.cn

[4] The relation among the wages of 3 types of labor forces is assumed to 0.5:1.0:1.55 (agriculture:unskilled:skilled).

I/O). The inflow of goods and services from the rest of China (the mainland of China) to Shaanxi is a residual obtained from netting out "import" from total outflow goods and services ("intflow" in official I/O).

Household expenditure and income

The household consumption has be discussed before. The income taxes by households are estimated on per capita income taxes (*Shaanxi Statistic Yearbook, 1998*). The saving has be discussed too. Subject to the identity that total expenditure is equal to the income, income of each household group can be derived from the expenditure side. The information on income sources for rural and urban households is 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. Then 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.

3. The industrial competitiveness of Shaanxi

Our CGE model for China is constructed according to two SAMs for the year of 1997. The section outlines the basic features of industrial structure of Shaanxi economy in 1997 based upon the SAMs.

Table 4 summarizes the economic structure of Shaanxi in the base year. The first four columns report the sectoral composition of output, employment and foreign trade. Column 5-10 reports the trade dependence of Shaanxi, both foreign and interregional. In comparison with national economy, Shaanxi is more specialized in service sector and export-oriented labor-intensive manufacturing sector. In 1997 the share of agriculture output was 13.7%, which was the highest among the all of the sectors. The share of construction and manufacture of food products ranked second and third, the share was 9.5% and 7.4% respectively. Agriculture is not important in Shaanxi in terms of output and employment relative to the national average, but there is still more than 60 percent of labor force employed in agricultural sector. So provincial labor productivity of agriculture sector is low (as 60% of national average). The labor productivity of secondary industry is half of national average.

We also calculate sectoral RCA based on SAM (see figure 1) . In previous part RCA analysis is focused on manufacture sectors, but agriculture sector is also included here. RCA of agriculture in Shaanxi is closed to 2. This means that agriculture has strong comparative advantage.

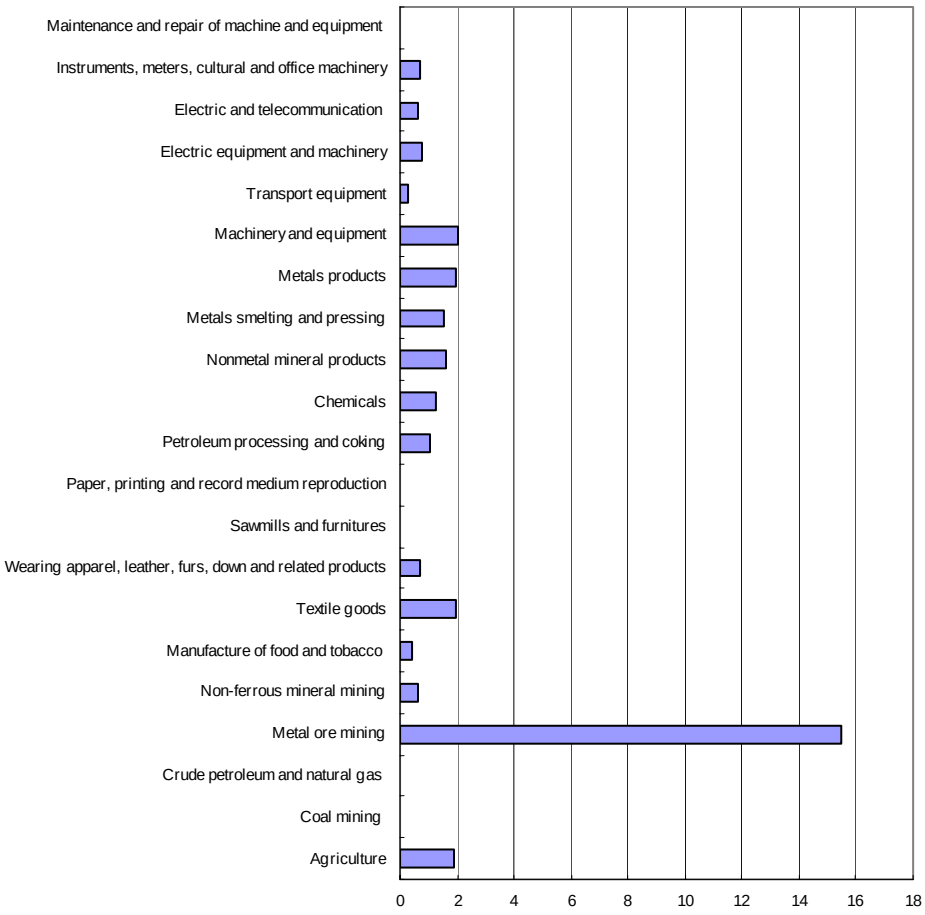

Figure 1. Shaanxi's sectoral RCA based on SAM

Shaanxi is an open economy, 20 percent of its domestic use are import and 25 percent of its products are exported to oversea market. The dependency of Shaanxi's economy on oversea market is higher than that on interregional domestic market. Only 17 percent of its domestic use are from rest of China and 11 percent of its products are sold at the market of rest of China. At industry level, textile, apparel, leather, social articles, electronics and electric machinery are important export sectors, they together contribute 64 percent of Gaundong's exports. Electronics, chemicals and textiles sectors are three largest import sectors, they account for 41 percent of total imports. The electronics, instruments, special equipment and textiles sectors have both high export and import dependency. Shaanxi depends on interregional import for most of energy goods and primary metal, as well as electric machine and electronics. The electric machine and electronics sectors are also the largest sector in terms of interregional exports. Exports to the rest of China are also important for most chemical industries in Shaanxi.

Table 4 Economic Structures in Shaanxi, 1997 (%)

	Output	Employment	Imports	Exports	Import/ Domestic Use	Export/ Outputs	Net Export (bn. Yuan)	RCA	Inter-regional Import	Inter-regional Export	Inter-regional Import/ Domestic Use	Inter-regional Export/ Outputs	Net Inter-region Export (bn. Yuan)
Agriculture	13.7	61.6	6.5	5.5	0.8	1.0	0.11	2.097	1.09	1.87	1.70	2.39	0.33
Coal Mining	1.1	0.9	0.0	0.0	0.0	0.0	0.00		0.09	1.61	2.17	24.91	0.89
Crude Oil	0.7	0.1	0.0	0.0	0.0	0.0	0.00		0.37	0.00	10.50	0.00	-0.27
Metal Mining	3.0	0.2	3.9	1.1	2.1	0.9	-0.13	13.991	0.47	5.09	4.40	29.64	2.68
Quarrying	0.2	0.0	0.0	0.4	0.5	5.2	0.03	0.633	1.45	0.04	64.90	3.44	-1.02
Food	7.4	1.0	1.0	2.2	0.2	0.7	0.13	0.441	17.88	6.02	37.31	14.13	-9.26
Textiles	2.0	1.8	0.8	24.1	1.0	31.0	2.06	2.300	5.21	6.51	80.94	56.77	0.12
Apparel	0.6	0.3	0.1	11.2	0.3	48.0	0.99	0.815	7.23	0.43	86.31	12.36	-4.93
Sawmill &furniture	0.3	0.2	0.0	0.0	0.1	0.2	0.00	0.012	1.42	0.02	48.35	1.23	-1.01
Social article	1.7	0.6	2.0	0.2	1.9	0.4	-0.09	0.038	4.87	0.25	37.86	2.57	-3.34
Petroleum refining	1.6	0.1	0.1	1.4	0.1	2.2	0.11	1.149	0.79	0.64	10.67	7.18	-0.19
Chemical	3.9	1.2	26.1	13.6	10.7	8.5	-0.34	1.270	12.89	16.29	69.51	72.19	0.41
Building material	5.3	0.9	2.0	3.7	0.6	1.7	0.19	1.766	1.88	0.73	7.17	2.40	-0.91
Primary metal	2.1	0.7	7.1	5.1	5.7	6.1	0.03	1.532	8.28	7.98	72.22	67.12	-1.21
Metal products	1.0	0.5	4.6	9.1	9.5	23.5	0.50	2.181	0.23	2.24	10.34	40.84	1.16
Machinery	2.8	1.9	24.9	7.0	13.4	6.0	-0.82	2.115	6.45	12.93	62.46	79.65	3.04
Transport equipment	2.6	1.7	6.5	0.6	3.9	0.5	-0.32	0.253	3.07	12.13	50.94	79.92	4.98
Electricity machine	4.1	0.7	3.5	4.6	1.4	2.8	0.19	0.750	2.02	8.08	13.79	34.10	3.34
Electronics	4.1	0.3	5.1	7.9	2.1	4.8	0.39	0.728	4.12	15.47	40.14	65.66	6.21
Instrument	0.3	0.3	5.6	2.2	25.3	16.6	-0.13	0.866	1.01	1.50	66.66	79.41	0.17
Other manufacturing	0.2	0.0	0.1	0.0	1.0	0.6	0.00	0.064	0.30	0.05	24.29	4.46	-0.18
Electricity	2.3	0.4	0.0	0.0	0.0	0.0	0.00		0.03	0.14	0.27	1.06	0.06
Gas & water	0.1	0.0	0.0	0.0	0.0	0.0	0.00		2.13	0.00	77.58	0.00	-1.53
Construction	9.5	5.5	0.0	0.0	0.0	0.0	0.00		6.39	0.00	12.44	0.00	-4.58
Transport	5.5	2.9	0.0	0.0	0.0	0.0	0.00		0.12	0.00	0.44	0.00	-0.08
Telecomm	1.3	0.7	0.0	0.0	0.0	0.0	0.00		0.00	0.00	0.00	0.00	0.00
Commerce	6.2	4.8	0.0	0.0	0.0	0.0	0.00		0.00	0.00	0.00	0.00	0.00
Restaurant	2.4	2.0	0.0	0.0	0.0	0.0	0.00		0.00	0.00	0.00	0.00	0.00
Finance	1.4	0.5	0.0	0.0	0.0	0.0	0.00		0.00	0.00	0.00	0.00	0.00
Social service	3.0	1.1	0.0	0.0	0.0	0.0	0.00		6.16	0.00	30.27	0.00	-4.42
Education & health	4.7	4.4	0.0	0.0	0.0	0.0	0.00		4.06	0.00	15.31	0.00	-2.91
Public administration	4.7	2.2	0.0	0.0	0.0	0.0	0.00		0.00	0.00	0.00	0.00	0.00
TOTAL	100.0	100.0	100.0	100.0	1.7	2.5	2.90		100.00	100.00	20.56	17.46	-12.47

Table 5 Sectoral Tax/Subsidy Rates for Shaanxi, 1997 (%)

	VAT	Other indirect tax	Production subsidy	Tariff	Import VAT	Fee
Agriculture		2.75	-0.02	9.32		0.13
Coal Mining	9.80	0.84	-0.15			0.08
Crude Oil	11.77	0.42	-0.15			0.02
Metal Mining	4.03	0.20	-0.05	0.86	5.09	2.43
Quarrying	5.45	1.37	-0.15	0.46	2.21	4.00
Food	6.34	4.67	-0.95	6.88	8.29	1.98
Textiles	10.25	0.89	-0.15	0.12	0.13	0.81
Apparel	6.27	0.74	-0.14	0.37	0.28	4.26
Sawmill &furniture	7.87	0.93	-0.15	6.67	4.11	3.54
Social article	6.53	0.93	-0.14	3.79	4.93	3.41
Petroleum refining	11.03	8.14	-0.06	4.15	10.09	0.06
Chemical	9.18	1.19	-0.15	1.80	3.88	0.65
Building material	4.53	2.30	-0.15	1.62	2.33	4.90
Primary metal	7.78	0.64	-0.15	1.27	3.67	1.96
Metal products	6.51	0.89	-0.15	1.79	3.38	4.18
Machinery	7.66	0.41	-0.14	2.16	4.43	0.08
Transport equipment	6.64	1.35	-0.14	1.51	6.99	0.70
Electronic machine	6.95	0.48	-0.14	2.46	3.28	1.39
Electronics	7.79	0.90	-0.15	1.51	3.33	2.28
Instrument	8.79	1.23	-0.15	1.34	3.41	0.73
Other manufacturing	5.54	1.09	-0.13	1.01	0.61	4.74
Electricity	13.66	0.30	-0.15			0.25
Gas & water	10.42	0.12	-0.15			0.10
Construction		2.52	0.00			0.08
Transport		4.90	-1.14			4.31
Telecomm		3.67	0.00			0.20
Commerce	4.80	0.57	-4.09			0.33
Restaurant		3.64	0.00			0.03
Finance		21.32	0.00			11.92
Social service		2.62	0.00			0.29
Education & health		0.31	0.00			0.35
Public administration		0.01	0.00			0.06
TOTAL	6.87	2.22	-0.45	2.51	4.18	1.32

The data for trade balance show that the largest share of foreign trade surplus in Shaanxi comes from apparel, textile, leather, electric machine and electronics. The electric machine sector in Shaanxi also has large surplus from interregional trade. Shaanxi is net importer of energy, chemicals and primary metal.

Table 5 reports the sectoral rates of domestic tax and tariff. It shows that the tax rates are quite diversified across sector. For instance, although the nominal rates of VAT are 17% and 13%, the actual sectoral collection rates ranges from 4% to 13%, due to extensive preferential treatment and tax exemptions. Obviously, the current tax system introduces strong distortionary effects across sector.

This SAM-based data analysis provides an overview of the characteristics of economy structure and intersectoral distortion in Shaanxi. It has important implications for the impact of policy adjustments and facilitates the understanding of simulation results reported later in this paper.

4. Simulations Design and Results

To investigate the implication of removal of distortionary taxes and subsidies, we consider four scenarios which take different assumptions on environment policy and labor market. The first scenario look at the impact of elimination of sector-specific subsidies and taxes, in which we unify import taxes rates across sector, eliminate production subsidies and replace all domestic indirect taxes with a unified VAT. Based on the first scenario, the second scenario further introduces the carbon tax which reduces the carbon emission by 10 percent. Through it we may assess the sectoral competitiveness when environment cost is taken into account. The third scenario considers the impact of employment creation by introducing a fixed shadow wage that is 5 percent lower that market wage, again based on the first scenario. The last scenario combines the second scenario and the third scenario to generate a comprehensive picture from both environment and employment perspectives.

4.1.1. Unification of intersectorally distortionary taxes/subsidies

In the first scenario, the unification of sectoral taxes/subsidies is implemented in a revenue-neutral fashion: the sectoral rates of taxes/subsidies are replaced by a single VAT rate, which is endogenously adjusted to keep the real expenditure and real saving of government constant. This rule of fiscal closure ensure the fiscal neutrality in macro-economy, so that any changes in consumption and investment do not come result from changes in government expenditure and saving. This makes it easy to assess the impacts of changes in sectoral structure of taxes and subsidies.

Table 6 reports the major aggregate results of the first scenario. They are deviations from the base year values. The results show that both China as whole and its Shaanxi province would experience GDP and welfare gain from the elimination of distortionary taxes/subsidies. In scenario 1, China's real GDP will increase 0.15 percent compared with base case. The welfare gains represented by Hicksian equivalent variations (EV), is around half of GDP gain, due to the deteriorated terms of trade. The GDP and welfare gains of Shaanxi are larger than that of China, indicating the more serious distortions embodied in Shaanxi's tax/subsidy structure.

Elimination of distortionary taxes/subsidies would result in more investment and less private consumption, because the changes in functional income distribution are in favor of corporate sector than households sector. As shown in table 8, when a unified VAT is utilized to replace current distornationary taxes/subsidies, the rental rate of capital would increase by 5.58 percent in China and 6.59 percent in Shaanxi, but the wage would decline in China and increase by around only 1 percent in Shaanxi.

Table 6 Major aggregate effects of Scenario 1 (% change with base year)

	China	Shaanxi
EV (% of GDP)	0.07	0.48
GDP	0.15	0.83
Consumption	-0.73	-0.32
Investment	1.43	2.09
Exports	0.07	6.05
Imports	0.00	2.84
Real exchange rate	-1.03	-2.60
Terms of trade	-0.07	-0.92
Factor price		
Agricultural labor	-2.30	0.64
Production worker	-1.44	1.26
Skilled labor	0.10	1.34
Land	-3.53	-0.27
Capital	5.58	6.59

Source: simulation results.

To fully understand pattern of changes in factor price, it is necessary to examine the sectoral impact. Table 7 lists the changes of producer price, gross output, employment and export by sectors in Shaanxi under the first scenario. The changes of sectoral producer prices show that the net tax burden for agriculture, crude oil, metal mining, commerce, post and tele communication as well as some other service sectors are lower than other sectors, their prices would increase by 4-8 percent if a unified VAT is utilized. While financial sector, petroleum refining, electricity and building materials bear heavy tax burden, their prices would decline sharply with removal of current sectoral distortion in tax/subsidy. The prices of food, primary metals and electronics would also have relatively large decline when a unified VAT is utilized.

The changes in sectoral tax burden and prices will result in changes in demand and output. When sectoral distortion of taxes is removed, generally, the output of those sectors with high tax burden would increase, while the output of those sectors with low tax burden will decline. The simulation results in Table 9 shows that output of agriculture and metal mining will fall by 0.8 percent and 6.9 percent respectively, while financial sector will increase its output by 10 percent. The output of most industrial sectors would increase, except chemicals, machinery and transportation equipment.

The changes of sectoral output are driven by not only the sectoral tax rates, but also the factor cost. Since agricultural sector owns 62 percent of total labor forces in Shaanxi, its contraction would lower the wage of agricultural labor and divert some of them to non-agricultural sectors. This will in turn lower the wage of production worker. So the labor-intensive sectors, even those are not highly taxed, such as textile, apparel and Social articles, would experience expansion of production because of lower labor cost.

Table 7 Sectoral effect of Scenario 1, Shaanxi (% change with base year)

	After-tax price	Producer	Output	Employment	Export	Inter-regional Export	RCA*
Agriculture	7.8		-0.8	-0.5	-21.9	0.1	-0.094
Coal Mining	1.2		8.8	9.2		29.7	
Crude Oil	4.6		2.4	3.3			
Metal Mining	3.8		-6.9	-6.3	-11.0	-11.1	-2.047
Quarrying	0.0		-1.1	-1.1	1.5	-4.3	-0.055
Food	-2.6		0.7	1.2	10.1	-1.4	-0.020
Textiles	-1.1		10.2	10.2	8.9	11.4	-0.036
Apparel	-0.7		4.5	5.0	2.2	6.8	-0.001
Sawmill &furniture	-2.1		5.5	5.6	5.0	8.8	0.000
Social articles	0.3		3.2	3.7	-1.0	5.2	-0.001
Petroleum refining	-4.6		1.2	1.2	23.1	-3.9	-0.087
Chemical	-1.6		-3.8	-3.8	7.9	-5.3	-0.130
Building material	-3.3		4.7	4.8	11.9	13.3	0.010
Primary metal	-2.8		6.2	5.9	14.3	6.7	-0.051
Metal products	-2.2		7.0	7.0	11.7	6.8	-0.048
Machinery	0.5		-3.1	-3.1	-2.5	-3.2	-0.163
Transport equipment	0.8		-11.3	-11.2	-5.1	-12.2	-0.033
Electronic machine	-0.9		1.0	1.2	6.1	-2.3	-0.055
Electronics	-2.3		16.6	16.8	12.6	17.8	0.029
Instrument	-0.8		13.4	13.3	3.8	17.1	0.044
Other manufacturing	4.5		6.0	6.6	-19.5	21.3	0.002
Electricity	-3.6		2.2	2.1		18.0	
Gas & water	2.7		21.6	21.6			
Construction	2.1		1.8	1.7			
Transport	0.5		0.8	0.6			
Telecomm	4.2		0.5	0.6			
Commerce	6.5		0.4	0.5			
Restaurant	3.6		0.4	0.4			
Finance	-18.1		10.6	10.6			
Social service	4.3		2.3	2.2			
Education & health	10.0		-5.3	-5.4			
Public administration	8.8		0.0	0.0			

*Change of RCA, not % change.

In the two-region model, inter-regional trade also plays an important role in determining of the sectoral output. The machinery, transportation equipment, electronics and instrument sectors in Shaanxi are very interregional export-oriented, their exports to rest of China account for more than 70 percent of their total output. Due to the different composition of imports of transportation equipment, its weighted tariff rate in rest of China is as high as 11%, much higher than that in Shaanxi. Given this heavy import protection in rest of China, the unification of tariff rate will significantly lower the its import prices, and induce consumers to substitute imports for domestic products, including the inter-regional imports from Shaanxi. The simulation results reported in table 9 shows that the exports of transportation equipment from Shaanxi to rest of China would decline 12 percent, resulting in the contraction of its output. On the contrary, the demand expansion of electronics and instruments in rest of China drive up its inter-regional imports from Shaanxi and induce a dramatic output increase in Shaanxi.

Most major exporting sectors of Shaanxi, such as textiles, chemical, metal products and electronics, will benefit from the removal of intersectorally distortionary taxes/subsides, due to either the reduction of tax burden in those sectors or the favorable changes in their production costs of factor and intermediate input. This enhances the export competitiveness

of these sectors at international market, resulting that their exports will increase by 8-13 percent under the first scenario. Since the export of textiles, chemicals, metal products and electronics account for 55 percent of total exports of Shaanxi in base year, their rapid exports growth strongly contribute the growth of total exports of Shaanxi. The aggregate results in Table 8 show that total exports of Shaanxi would increase by 6 percent, much stronger than that of the rest of China.

When distortionary taxes/subsidies are removed, the RCAs for most sectors in Shaanxi would decline. This indicates that Shaanxi's current export structure is dependent on the current taxes/subsidies system, at least at a certain extent. Without distortionary tax structure, the sectoral structure of exports of Shaanxi would tend to convergence to that of national average.

4.1.2. Introduction of environment tax and fixed wage

The scenario 2, 3 and 4 consider the impacts of introduction of environment tax and a lower fixed wage, given that the distortionary taxes/subsidies have been removed already. Table 8 reports the aggregate results of the three scenarios. They are derivations from scenario 1. In scenario 2 and 4, carbon tax is regional–specific to reduce the carbon emission of each region by 10 percent compared with its base year level. We assume that all revenue from carbon tax will be redistributed to households as a lump sum transfer. In scenario 3 and 4, real wage is fixed to be 5 percent lower than that in scenario 1, and total labor supply is endogenous to clear the labor market.

When carbon tax is introduced, the GDP in both China and its Shaanxi province will decline due to lower energy use. It is not strange that the output loss in Shaanxi is slightly smaller that the rest of China, because the share of agriculture and service in its economy is higher that national average. An interesting finding is that the welfare loss of Shaanxi is smaller than GDP loss. This could be explained by the changes in terms of inter-regional trade. When carbon tax is introduced, the energy demand will decline and the producer price of energy good will also decline. Since Shaanxi is a net exporter of energy-intensive, heavy industry products and net importer of less energy-intensive, light industry products in its inter-regional trade, it will experience improved terms of trade under carbon reduction scenario. While the rest of China will suffer deteriorated terms of trade and its welfare loss is larger than GDP.

The rental rate of capital will decline sharply when carbon tax is introduced, because most carbon-intensive sectors are also capital intensive. Lower capital return reduces the retained earning of firms, so the total investment would decline when carbon tax is introduced. But the household sector would benefit from the transfer of carbon tax revenue. Thus the private

consumption would increase by 3.84 percent and 4.68 percent in China and Shaanxi, respectively.

Table 8 The major aggregate effects of Scenario 2, 3, 4 (% change relative to Scenario 1)

	Scenario 2 Environment tax	Scenario 3 Fixed wage	Scenario 4 Envr. tax & Fixed wage
China			
EV (% of GDP)	-0.58	1.19	1.66
GDP	-0.51	1.20	1.79
Consumption	3.84	-0.40	4.44
Investment	-6.94	4.12	-1.03
Exports	0.92	0.97	3.22
Imports	1.08	1.16	3.80
Real exchange rate	5.84	0.59	8.55
Terms of trade	-0.10	-0.09	-0.35
Factor price			
Agricultural labor	0.91	-5.97	-11.93
Production worker	-0.50	-5.97	-11.93
Skilled labor	-2.50	-5.97	-11.93
Land	2.16	1.80	8.39
Capital	-14.06	8.34	-1.83
Total employment	0.00	2.07	4.48
Shaanxi			
EV (% of GDP)	-0.44	5.92	8.17
GDP	-0.75	6.37	8.36
Consumption	4.68	2.23	9.35
Investment	-7.62	13.87	10.69
Exports	-3.53	6.93	7.05
Imports	0.32	8.58	13.56
Real exchange rate	4.71	0.43	6.57
Terms of trade	0.54	-1.43	-1.56
Interregional trade	0.42	-0.80	-0.35
Factor price			
Agricultural labor	0.88	-6.77	-11.58
Production worker	-0.35	-6.77	-11.58
Skilled labor	-2.80	-6.78	-11.58
Land	2.36	15.68	26.82
Capital	-13.89	13.73	4.79
Total employment	0.00	6.50	10.07

Source: simulation results.

In the third scenario, the total employment is expanded due to lower wage. Since Shaanxi has relatively high labor/capital ratio, the growth effects of lower wage in Shaanxi is larger than that in rest of China. When market is reduced by 5 percent, GDP would increase by 1.2 percent for whole China and 6.37 percent for Shaanxi. The total employment in China and Shaanxi would increase by 2.07 percent and 6.5 percent, respectively.

Due to the static feature of this model, the total capital stock is kept constant, but it could mobile across region to maximize its return. The reduction of market wage would induce more employment and change the pattern of factor price. Since Shaanxi is more labor intensive than rest of China, the employment in Shaanxi would increase more and in turn the price of capital would also increase more. Thus more capital would be diverted to Shaanxi,

resulting that the GDP growth in Shaanxi is almost same with its employment growth, but in rest of China the GDP growth is much smaller than employment growth.

The sectoral results for Shaanxi from scenario 2, 3 and 4 are reported in table 9, 10 and 11. Generally, when carbon tax is introduced, the energy-intensive sectors would shirk since they will face higher cost of intermediate input, while those sectors with less energy input would expand. Moreover, the sectoral output in Shaanxi would be influenced by the price changes in rest of China, especially for those sectors with high dependence of inter-regional dependence. For instance, the machinery sector in Shaanxi is more energy intensive than that in rest of China. Its producer price would rise when carbon tax is introduced, while the price for same sector in rest of China would fall. This results in sharp decline of machinery exports from Shaanxi to rest of China, and induce a large output reduction in Shaanxi.

In scenario 4 with lower wage, almost all sectors in Shaanxi would expand. In general, the labor-intensive sectors would benefits more from the more labor inputs and lower wage. It is noteworthy that factor intensities of some sectors in Shaanxi are quite different with that in rest of China. For instance, the apparel sector is relatively capital intensive in Shaanxi. Its price could only decline by 0.4 percent when lower wage is introduced. This results in the output of apparel in Shaanxi would increase 2.1 percent only in scenario 3. Likewise, the machinery sector is much more labor intensive in Shaanxi than that in rest of China. Its price could fall by 2.1 percent when wage decline by 5 percent and its output and exports to rest of China would increase by more than 20 percent.

Table 9 Sectoral effect of scenario 2, Shaanxi (% change with scenario 1)

	After-tax price	Producer	Output	Employment	Export	Inter-regional Export	RCA*
Agriculture	-0.6		1.8	1.1	1.5	9.1	0.135
Coal Mining	-0.2		-6.9	-7.1		3.4	
Crude Oil	-4.7		2.5	0.2			
Metal Mining	-3.3		10.1	8.4	8.3	20.8	2.917
Quarrying	0.9		-3.8	-3.6	-7.2	-7.4	0.019
Food	-1.4		4.7	3.5	4.6	7.8	0.013
Textiles	-0.2		-1.4	-1.2	3.0	-3.0	-0.021
Apparel	-2.4		11.2	9.7	15.9	7.8	0.045
Sawmill &furniture	2.5		-8.4	-7.8	-9.5	-14.9	0.000
Social articles	-1.3		0.2	-0.5	3.4	3.1	0.002
Petroleum refining	5.1		-1.5	-1.6	-22.8	9.5	0.130
Chemical	3.9		-11.0	-11.0	-17.0	-10.9	-0.015
Building material	7.3		-3.2	-2.9	-29.4	9.4	0.208
Primary metal	4.8		0.3	1.8	-20.1	1.7	0.162
Metal products	1.7		-3.1	-2.9	-9.4	-2.3	0.112
Machinery	1.4		-13.4	-13.2	-10.3	-14.6	-0.048
Transport equipment	-0.3		-3.2	-3.5	-0.9	-3.4	0.009
Electronic machine	0.7		-2.9	-3.3	-5.1	-1.1	0.034
Electronics	-0.8		-2.1	-2.6	4.8	-1.9	0.001
Instrument	0.8		-9.6	-9.5	-3.9	-11.8	-0.032
Other manufacturing	-7.8		7.7	6.2	27.3	27.7	0.011
Electricity	19.7		0.0	3.8		8.3	
Gas & water	1.6		46.8	47.0			
Construction	1.6		-6.6	-6.7			
Transport	-0.7		-0.4	-0.6			
Telecomm	-2.1		-1.0	-1.5			
Commerce	-1.6		-0.5	-0.9			
Restaurant	-2.1		0.5	0.5			
Finance	-1.0		0.4	0.3			
Social service	0.8		-5.3	-5.2			
Education & health	-0.4		2.4	2.3			
Public administration	-0.1		0.0	0.0			

*Change of RCA, not % change.

Table 10 Sectoral effect of Scenario 3, Shaanxi (% change with scenario 1)

	After-tax price	Producer	Output	Employment	Export	Inter-regional Export	RCA*
Agriculture	-2.0		3.9	5.6	10.5	-2.9	-0.105
Coal Mining	-0.9		4.0	6.0		-1.1	
Crude Oil	5.5		2.2	6.1			
Metal Mining	3.5		-3.9	-0.5	-8.3	-13.9	-1.661
Quarrying	-3.6		15.3	16.2	21.9	22.3	0.051
Food	-1.1		4.0	6.5	4.3	1.1	-0.021
Textiles	-1.9		12.6	13.4	11.3	13.0	0.042
Apparel	-0.4		2.1	4.4	3.2	-0.7	-0.037
Sawmill &furniture	-0.4		8.2	9.2	9.5	4.7	0.000
Social articles	-0.3		6.3	8.7	4.8	2.6	-0.001
Petroleum refining	4.1		3.5	3.5	-8.5	-10.3	-0.091
Chemical	-1.3		12.1	12.1	8.1	12.5	0.022
Building material	-0.8		9.9	10.8	6.9	8.1	-0.018
Primary metal	-0.7		7.3	7.8	5.6	6.4	-0.026
Metal products	-0.7		5.1	6.0	4.5	5.7	-0.045
Machinery	-2.2		21.9	22.2	15.2	23.4	0.137
Transport equipment	-0.1		4.5	5.5	2.2	4.0	-0.007
Electronic machine	0.4		5.7	6.9	1.5	1.8	-0.026
Electronics	0.5		2.0	3.2	-1.5	0.9	-0.022
Instrument	-2.9		18.5	18.8	15.2	21.6	0.061
Other manufacturing	6.4		-2.7	-0.6	-12.1	-20.7	-0.009
Electricity	-1.3		6.6	7.4		12.8	
Gas & water	0.2		12.6	13.9			
Construction	0.1		13.7	15.0			
Transport	1.8		5.0	6.5			
Telecomm	0.5		5.9	7.1			
Commerce	-1.1		6.7	7.4			
Restaurant	-1.5		6.1	6.1			
Finance	-4.1		7.2	7.4			
Social service	-2.2		11.6	12.3			
Education & health	-4.4		6.5	6.8			
Public administration	-3.7		0.0	0.1			

*Change of RCA, not % change.

Table 11 Sectoral effect of scenario 4, Shaanxi (% change with scenario 1)

	After-tax price	Producer	Output	Employment	Export	Inter-regional Export	RCA*
Agriculture	-4.9		8.2	10.2	24.8	3.0	-0.053
Coal Mining	-1.3		-3.2	-0.3		0.3	
Crude Oil	3.4		6.5	10.3			
Metal Mining	1.9		2.3	6.4	-6.6	-3.8	0.164
Quarrying	-4.4		17.7	19.8	24.0	24.3	0.098
Food	-4.0		11.4	14.3	16.6	10.5	-0.016
Textiles	-3.5		19.9	21.7	24.7	18.3	0.038
Apparel	-3.7		18.0	20.5	27.1	8.1	-0.012
Sawmill &furniture	2.5		0.0	2.5	0.0	-12.8	-0.001
Social articles	-2.0		9.3	12.5	11.6	7.5	0.001
Petroleum refining	13.2		3.4	3.4	-37.0	-5.3	0.000
Chemical	2.8		4.9	4.9	-9.8	5.8	0.020
Building material	7.9		10.4	12.5	-28.1	25.1	0.198
Primary metal	5.0		11.3	14.5	-17.8	11.9	0.138
Metal products	1.2		3.9	5.6	-5.7	6.2	0.051
Machinery	-1.5		15.0	15.9	8.8	15.7	0.151
Transport equipment	-0.2		3.2	4.6	1.5	2.4	-0.001
Electronic machine	1.8		4.6	6.2	-5.0	1.5	-0.004
Electronics	0.1		0.0	1.5	1.5	-1.1	-0.031
Instrument	-3.4		15.4	16.3	17.4	17.1	0.056
Other manufacturing	0.9		3.5	5.4	3.0	-9.3	-0.003
Electricity	22.2		9.5	16.1		30.2	
Gas & water	2.6		83.1	86.9			
Construction	2.4		11.5	13.5			
Transport	2.3		6.7	9.0			
Telecomm	-1.5		7.0	8.5			
Commerce	-3.5		9.1	9.9			
Restaurant	-5.3		9.5	9.5			
Finance	-6.7		10.9	11.1			
Social service	-2.3		10.9	12.3			
Education & health	-6.4		12.4	13.0			
Public administration	-6.0		0.0	0.2			

*Change of RCA, not % change.

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A1. Two-Region CGE Model of Shaanxi and Rest of China

The two-region Chinese CGE model we employ in this study is an extension of the single region Chinese CGE model that had been used in China's WTO accession study (Development Research Center, 1998; Zhai and Li, 2000). Two regions - Shaanxi province and rest of China - are specified, each with a demand and production structure, and interregional trade in commodities and services. The interregional factor mobility and intergovernmental transfer are also introduced in the model.

Each region in the model has 32 industries, 5 production factors and 2 representative households by urban and rural. Among the factors, labor and capital are used by all sectors, while land is used only by agricultural activities. Labor is disaggregated into three types: agricultural labor, production workers, and professionals.

The model assumes imperfect interregional factor mobility to reflect the policy and institution factors that limit regional factors movement, as well as the location preference of residents. The movement of capital is driven by the relative rental rates across region and the constant elasticity of transformation, and the movement of labor is determined by the relative real income across region and the constant elasticity of transformation. The real income of labor is defined as the wage plus per capita net intergovernmental transfer income.

(1) Production and Factor Markets

All sectors are assumed to operate under constant returns to scale and cost optimization. Production technology is represented by a nesting of constant elasticity of substitution (CES) functions. At the first level, output results from two composite goods: a composite of primary factors plus energy inputs, i.e., value-added plus the energy bundle, and aggregate non-energy intermediate input. At the second level, the split of non-energy intermediate aggregate into intermediate demand is assumed to follow the Leontief specification, i.e. there is no substitution among non-energy intermediate input. Value-added plus energy component is decomposed into aggregate labor and energy-capital bundle. Aggregate labor is further split into 3 types of labor force. And energy-capital bundles are decomposed into energy and capital-land bundles. Finally, the energy bundle is made up of 3 types of base fuel components, and capital-land is split into capital and land in agricultural sector.

All commodity and factor markets are assumed to clear through prices. Capital and labor forces are fully mobile across sectors. Thus there are a single region-wide equilibrating rental rate for capital and wage rate for each labor type. The agricultural laborers work only in

agricultural sectors and production workers work only in non-farm sectors. There is no substitute between agricultural laborer and production worker in production function. In China, although it is increasing reformed, there are still large barriers for rural labor forces to migrate to urban. These barriers include household registration regime, discrimination in employment, education and social security, etc. This segmented labor market is modeled by incorporating partially mobility between agricultural laborer and production worker. We assumed agricultural laborer and production worker could be converted from one to another. A CET function is used here to capture this specification, i.e., this transfer is determined by the relative wage of agricultural labor and production worker, as well as the constant elasticity of transformation.

The model assumes imperfect interregional factor mobility. CET functions are utilized to describe the regional movement of labor and capital. The movement of capital is determined by the relative rental rates and the constant elasticity of transformation, and the movement of labor is determined by the relative real income and the constant elasticity of transformation. The real income of labor is defined as the wage plus per capita net intergovernmental transfer income, deflated by the regional consumer price indices.

(2) Interregional and Foreign Trade

The rest of the world supplies imports and demands exports. Given China's small trade share in the world, import prices are exogenous in foreign currency (an infinite price-elasticity). Exports are demanded according to constant-elasticity demand curves, the price-elasticities of which are high but less than infinite.

The model assumes that there is one representative firm in each sector. The firms allocate their output between export and domestic sales to maximize profits, subject to imperfect transformation between the two alternatives. The domestic sales are further split into local sales and interregional exports using a CET function.

Products are assumed to be differentiated by region of origin, i.e. the Armington assumption (Armington, 1969). A two-level nesting CES aggregation function is specified for each Armington composite commodity. At the top level, agents choose an optimal combination of the aggregate domestic good and imports, which is determined by a set of relative prices and the degree of substitutability. At the second level of the nest, aggregate domestic good are split into local good and interregional import from rest of China.

(3) Income Distribution and Demands

Factor income is distributed to four major institutions: enterprises, households, the government and extra-budget public sector.

Household income derives from capital, labor and land income. Additionally, households receive distributed enterprise profits, transfers from the government and rest of the world. All kinds of import and export quota rent are also allocated to households. Assume the rural households earn all the land returns. 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. When transformation between agricultural labor and production worker occurs, if some agricultural labors transferred to non-agricultural sector and became production workers, their wage would be allocated to rural households. Vice versa, if production workers transferred to agricultural sector and became agricultural labor, their wages are still distributed to urban and rural households according to the distribution share of production worker's wages.

Capital revenues are distributed among households and enterprises. Enterprise earnings equal a share of gross capital revenue minus corporate income taxes. A part of enterprise earnings is allocated to households as distributed profits based on fixed shares, which are the assumed shares of capital ownership by households. Another part of net company income is allocated to extra-budget public sectors as fee. Retained earnings, i.e. corporate savings for new investment and capital depreciation replacement, equals a residual of after-tax enterprise income minus the distributed profits and fee.

Household disposable income is allocated to goods, services, and savings. Households maximize utility using the extended linear expenditure system (ELES) which is an extension of the Stone-Geary demand system. Saving enters the utility function, which is evaluated using the consumer price index. Social consumption and investment final demand follow a fixed share expenditure function.

Stock change is assumed as a demand for domestic products. The intermediate inputs, household consumption, and other final demands constitute the total demand for the same Armington composite of domestic products and imported goods from the rest of the world.

(4) Central and Regional Governments, and Extra-budget Public Sector

An important difference in the model relative to other applied general equilibrium models is the separate treatment of central government and regional governments. The governments collect taxes from the producers, households and foreign sector, transfer money to the household sector, and purchases public goods. There are also transfers between central and

regional governments. Central government derives revenues from direct corporate income taxes, import tariffs, and various types of indirect taxes. Regional government derives revenues from direct corporate income and households taxes, as well as various indirect taxes. Subsidies and export tax rebates enter as negative receipts. There are two types of indirect taxes in the model. The value-added tax, which is the most important part of indirect tax in China after 1994 tax reform, is treated as a tax levied on production factors. Its revenues equal total sector value-added multiplied by a tax rate. Three quarters of value-added tax is allocated to central government and the rest is allocated to regional government. The value-added tax is also levied on imports while firms obtain rebates when they export. The other indirect tax, including various agricultural taxes, and business taxes on construction and services, is treated as a production tax levied on sectoral outputs.

Extra-budget public sectors collect fees from enterprise and households. Their income are allocated to consumption and saving. The consumption of extra-budget public sectors and government spending compose a type of final demand, i.e. the social consumption.

(5) Macro Closure

Macro closure determines the manner in which the following three accounts are brought into balance: (i) the government budget; (ii) aggregate savings and investment; and (iii) the balance of payments.

Real government spending and real government saving are exogenous in the model. All tax rates and transfers are fixed, except the VAT, which endogenously adjust to maintain the balance of government budget. The total value of investment expenditure must equals total resources allocated to the investment sector: retained corporate earnings, total household savings, government savings, extra-budget saving and foreign capital flows. In this model, the aggregate investment is the endogenous sum of the separate saving components. This specification corresponds to the “neoclassical” macroeconomic closure in CGE literature.

The value of imports, at world prices, must equal the value of exports at border prices, i.e., inclusive of export taxes and subsidies, plus the sum of net transfers and factor payments and net capital inflows. An exchange rate is specified to convert world prices, e.g., in dollars, into domestic prices. With foreign saving set exogenously, the equilibrium would be achieved through changing the relative price of tradables to nontradables, or the real exchange rate.

(6) Data

The model is calibrated to the 1997 two-region Chinese Social Accounting Matrices (SAM) developed from the 1997 national and Shaanxi Input-Output tables. The SAM provides a

consistent framework to organize the relevant flow of value statistics to satisfy the requirements of a benchmark data set for CGE modeling. Some key parameters of the model – essentially substitution and income elasticities – were derived from a literature search. All other parameters – mainly shift and share parameters – are calibrated in the base year using the key parameters and the base data.(see annex tables of SAM for China and Shaanxi).