

ECONOMIC POLICY
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EVALUATION OF INDUSTRIAL
COMPETITIVENESS OF YUNNAN
PROVINCE
BASED ON CGE MODEL

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RESEARCH PAPERS ON ECONOMIC DEVELOPMENT

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EVALUATION OF INDUSTRIAL COMPETITIVENESS OF YUNNAN PROVINCE BASED ON CGE MODEL

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1. Introduction

In this report, we have constructed a two-region (Yunnan and the rest of China) CGE model. Based on this model, we have analyzed the effect of trade liberalization and sustainable development policy on the industrial competitiveness of Yunnan Province.

Yunnan Province is located in the southwest of China encompasses 394,000 square kilometers and has a population of 40 million people. It is well known for its pleasant climate, beautiful scenery and colorful ethnic customs. Yunnan is the most southwest region of China bordering the countries of Myanmar, Laos and Vietnam with its borderlines of 4,060 kilometers. Yunnan, being part of the southern Silk Road, links China with her Southeast and South Asian neighbors.

Yunnan Province has a diverse environment, thus enjoying the fame “Kingdom of Plants”, “Kingdom of Wildlife”, and “Kingdom of Nonferrous Metals”. Mineral deposits are widely spread in the province. Of more than 142 ores that are known to have economic value, deposits of 92 minerals have been ascertained and 53 of these rank among the top ten in the country. The reserves of 10 principal non-ferrous ores play important roles in mineralization of China in which the prospective reserves of Iron and manganese rank the first in the country. The province has abundant varieties of Chinese medicinal herbs in a number exceeding 2,000, of which 1,250 are in daily use.

The railway of Yunnan province has a long history since 1900. Now there are 6 trunk lines of Kunming-Hekou, Guiyang-Kunming, Chenddu-Kunming, Nanning-Kunming, Kunming-Yuxi, Guangdong-Dali railways, passenger trains and cargo trains run between Beijing, Shanghai, Xi’an, Chongqing, Guangzhou, Beihai as well as Hanoi in Vietnam. In addition to its highway system, Yunnan has formed a fairly good communication network with Kunming as its central, national and provincial highways as the trunk lines linking up sub-trunk lines, cities and the countryside. By the end of 2001, the mileage of Yunnan highways has reached 163,953 km. It is second only to Sichuan Province in China. There are 6 river systems in Yunnan province consisting of Jinsha-Yangzte River, Lancang-Mekong River, Yuanjiang-Honghe River, Nanpan-Zhujiang River, Nujiang-Salween River and Dulong-Daying-Ruili-Irrawaddy River, which ranks first in terms of water systems in China. Therefore, it is very rich in water resources as its exploitable waterways are over 8,000 kilometers.

The following shows some basic features of China’s economic structure in 1997 based on 1997 SAM. Table 1 summarizes of the sectoral structure and the market openness of Chinese economy in benchmark year. For each of the 34 sectors, the base year data for shares of output, employment, imports, exports, and trade dependence are reported. Column 1-4 in the table are the share of gross output, labor force and trade respectively. From which we may see that agriculture has absorbed 50% of total labor force, but produced only 12% of

the gross output and made up only 3% of total trade volume. In comparison, textile and apparel industry has absorbed 3.3% of the total labor force, but has produced 7.7% of the total gross output and made up over 26% of the total export. Apparel, toys, cultural and educational products, electronic products and instruments are sectors that are most prone to export. They also have over 30% of products relied on international market. Textile is also an export-oriented industry with about 20% of its products sold to international market. Industries that take a large share in import include machinery, electronic and chemical industries, and they each account for over 10% of total import. Wool, instruments, electronic, special equipment and two raw materials sectors (crude oils and ferrous ore mining) boast of high market-sharing rate, while electronic and instruments industries are highly dependent on import and export. All these verify the large proportion of the import and export of these sectors is realized through processing trade. Trade balances listed in Column 7 in the table is a reflection of China's comparative advantages. China is a net exporter in terms of labor-intensive industries and a net importer in terms of capital-intensive industries. The largest proportion of China's trade surplus comes from apparel and textile industry. In terms of agriculture, China is a net grain importer, but it also reports trade surplus for other agricultural products.

On the basis of the 1997 social accounting matrix (SAM) of Yunnan Province, Table 5.2 portrays the economic structure of Yunan Province in benchmark year. The first four columns are the ratio of output and the ratio of labor force and international trade among different sectors. Agriculture plays an important role in Yunnan Province. From data in Table 2, we can find that agriculture generated 17.4% of the total output and 23.8% of the GDP by employing 77.4% of the total labor force in the province in 1997. Moreover, most of outputs in light industry has close relations with agriculture. For example, Yunnan has the largest quality flue-cured tobacco production base in China. Due to the base, the tobacco processing industry is contributing to 18.2% of the province's GDP annually. As for secondary industry,

the table shows that the proportion of secondary industry in the province is obviously lower than the country's average level, and the feature is especially remarkable in industrial sector. The proportion of industrial output among total output in Yunnan Province is 12 percentage points lower than the country's average level in 1997. Meanwhile, compared with other provinces and autonomous regions, industrial structure in Yunnan Province is monotonic, with food and tobacco processing, chemical industry and metals smelting and pressing making up nearly 60% of the total industrial output. However, Yunnan is above the country's average level in terms of proportion of the tertiary industry.

2.The Social Accounting Matrix for Yunnan, 1997

2.1. A macro social accounting matrix for Yunnan, 1997

The 1997 Social Accounting Matrix for Yunnan is a square matrix which encompass every transaction of Yunnan in 1997, i.e. production, sale, consume, and distribution. The data sources for a SAM come from Yunnan 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 Yunnan, 1997

The 1997 Macro SAM for Yunnan 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 Yunnan, 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 Yunnan 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 Yunnan Input-Output Table (I/O table), Statistic Yearbook of Yunnan (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 Yunnan, 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 Yunnan (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		1866.56			806.33				205.24	35.74	72.93	550.83	153.94			3691.57
2	Acitivity	2946.85									5.95				480.84	84.46	3518.10
3	VA-Capital		461.36														461.36
4	VA-Labor		785.78														785.78
5	Households				785.78		267.02			11.65	4.01						1068.47
6	Enterprise			461.36													461.36
7	Local Gov.Sub		-15.64							15.64							0.00
8	Central Gov.Sub		-9.70								9.70						0.00
9	Local Gov.		123.47			2.50	9.80				149.24						285.01
10	Central Gov.	8.82	217.98				42.04			4.00							272.84
11	Extra-system		88.28			0.00											88.28
12	Capital account					259.64	142.50			48.48	68.19	15.35			205.07	-34.46	704.77
13	Stock Change												153.94				153.94
14	ROW	685.91															685.91
15	ROMC	50.00															50.00
	Total	3691.57	3518.10	461.36	785.78	1068.47	461.36	0.00	0.00	285.01	272.84	88.28	704.77	153.94	685.91	50.00	

Commodity & Activity

1. **Intermediate consumption (Commodity, Activity):** — Total intermediate consumption by productive activity (incl. imported intermediate input). *Source: 1997 Yunnan I/O.*
2. **Final private consumption (Commodity, Household):** — Total household expenditure on goods and service. *Source: 1997 Yunnan 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 Yunnan 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 Yunnan I/O.*
6. **Fixed capital formation (Commodity, Capital):**— Gross fixed capital formation. *Source: 1997 Yunnan I/O.*

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

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

Factor

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

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

Institutions

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

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 ($n \times n^{\textcircled{1}}$) in micro SAM.

2.2.1. The structure of the micro SAM

The 1997 micro SAM for Yunnan 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

^① n denotes the number of production sectors in micro SAM

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)

Table 3 Accounts of the micro SAM for Yunnan,1997

Commodity & activity [®]			
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	Urban 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		

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

3	FTC Margin
4	Rest of the World (ROW)
5	The Rest of China (ROMC)
<hr/>	
Saving & Investment	
<hr/>	
1	Capital Account
2	stock change
<hr/>	

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 Yunnan input-output Table, intermediate input matrix. The household consumption is taken from Yunnan 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.

^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).

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 (*Economic and Industrial information of Yunnan, 2001*). The VAT (value-added tax) by sectors are estimated based on VAT payable by sectors (*Yunnan 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 Yunnan 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). The inflow of goods and services from the rest of China (the mainland of China) to Yunnan is a residual obtained from netting out "import" from total outflow goods and services ("inflow" in official I/O).

Household expenditure and income

The household consumption has been discussed before. The income taxes by households are estimated on per capita income taxes (*Yunnan Statistic Yearbook, 1998*). The saving has been 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 Yunnan

Based on SAM of Yunnan Province, Table 4 reflects the industrial competitiveness of China and Yunnan Province, mainly focusing on technological structure of manufacturing value added, technological structure of manufactured exports and outflow of Yunnan province. The first part of Table 4 depicts the manufacturing value added and its technological structure in China and Yunnan Province in 1997. Yunnan province made up about 2% of the country's total manufacturing value added. In terms of technological level of manufacturing industry, Yunnan was much lower than the country's average level. Data in Table 4 shows that the resources-based manufacturing industry made up 64.5% of the total manufacturing value added, which was much higher than the country's average level of 27.2%. As for high-tech industry, its proportion among manufacturing value added was 23.7% in 1997, only half of the country's average level. Technical structure of MVA has fully reflected the fact that Yunnan is comparatively weak in terms of industrial competitiveness, as well as the fact that

the industrial technological level in the province is closely associated with its natural endowment of resources.

Table 4 SAM-based Added Value of Manufacturing Industry and Technical Element in Export of Finished Products of China and Yunnan Province*

Technological structure of Manufacturing value added		
	National	Yunnan
Total of MVA	100.0	100.0
Resource-based MVA	27.2	64.5
Low-tech MVA	28.6	11.8
Medium-tech MVA	39.0	21.4
High-tech MVA	5.2	2.3
Technological structure of manufactured exports		
	National	Yunnan
Total of ME	100.0	100.0
Resource-based ME	13.6	55.4
Low-tech ME	50.4	14.9
Medium-tech ME	19.1	22.5
High-tech ME	16.9	7.2
Technological structure of manufactured Outflows		
	National	Yunnan
Total of MO		100.0
Resource-based MO		82.6
Low-tech MO		6.6
Medium-tech MO		8.5
High-tech MO		2.3

Note: * As the data on technical structure in this paper is based on SAM and it may be different from the data summed up by more detailed sectors.

Table 4 has simultaneously given out the manufactured export and its technical structure in Yunnan Province in 1997. In the year, Yunnan made up 0.33% of China's total export and 0.54% of the country's total manufactured export. Generally speaking, technical structure of manufacture export in Yunnan Province in 1997 is similar to that of manufacturing value added, which are all resource-intensive. Compared with the country as a whole, the proportion of medium-tech and high-tech manufactured products in Yunnan Province is lower than the country's average level, and high-tech ME is 10 percentage points lower than the country's average level. In terms of proportion of resources-based and low-tech manufactured export, the proportion of resource-based ME in Yunnan is comparatively high, while that of low technical ME is comparatively low in Yunnan Province. This has, to certain extent, reflected the fact that the province lacks deep processing for manufactured products directed for export.

Table 5 lists various indirect taxes and tariff rates of different sectors, from which we may find that there is a great discrepancy in tax rates among different sectors. For example, though the nominal rate of VAT is 17% or 13%, effective tax rate practiced by different sectors is between 4-13%. From this, we may see the distorting effect of current taxation system on different sectors.

Table 5 Tax Rate/Subsidy Rate (%) by Sector of Yunnan Province in 1997

	VAT	Other indirect tax	Production subsidy	Tariff	Import VAT	Fee
Agriculture		1.78	-0.02	8.44		2.26
Coal Mining	14.2	0.25	-0.49	2.83	10.3	0.32
Crude Oil	6.7	1.09	-0.15			4.51
Metal Mining	8.1	3.62	-0.07	0.00	8.6	4.49
Quarrying	6.0	6.73	-0.10	2.76	10.9	8.55
Food	14.3	26.78	-0.52	9.10	10.3	3.86
Textiles	12.7	0.65	-0.58	11.65	10.1	1.19
Apparel	8.8	2.87	-0.05	18.48	9.5	3.64
Sawmill & furniture	5.5	2.61	-0.35	2.61	11.0	3.31
Social article	6.0	3.30	-0.14	15.11	9.8	4.19
Petroleum refining	10.9	3.42	-0.07	4.47	10.8	4.32
Chemical	8.5	1.55	-0.32	7.97	10.1	1.89
Building material	9.7	4.05	-0.25	11.16	7.1	5.15
Primary metal	11.9	1.92	-0.11	4.28	10.8	2.44
Metal products	6.9	3.63	-0.03	7.67	10.4	4.61
Machinery	9.6	2.81	-0.24	7.66	10.4	3.57
Transport equipment	13.4	1.38	-0.59	2.84	10.9	1.70
Electronic machine	11.5	1.97	-0.12	11.96	10.0	2.50
Electronics	12.5	1.16	-0.04	7.19	10.5	1.47
Instrument	9.9	2.67	-0.02	5.81	10.6	3.40
Other manufacturing	5.6	1.18	0.00	9.66	7.8	1.17
Electricity	15.8	4.37	-0.35			5.55
Gas & water	10.0	2.73	-1.02			0.63
Construction		0.78	-0.58			4.54
Transport		1.15	-0.59			0.99
Telecomm		0.38	-0.59			1.46
Commerce	16.0	1.68	-0.59			0.49
Restaurant		2.40	-5.15			2.13
Finance		1.54	0.00			3.05
Social service		0.27	0.00			2.37
Education & health		0.09	0.00			0.46
Public administration		0.02	0.00			0.34
TOTAL	6.87	5.68	-0.72	8.44	4.18	2.26

This SAM-based data analysis provides an overview of the characteristics of economy structure and intersectoral distortion in Yunnan. 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 the unification of sectoral taxes/subsidies, environment policy and labor market(see Table 6). Scenario 1 considers eliminating discriminatory taxation and subsidy policies, that is, to introduce unified import tariff for all sectors, abolish production subsidy and use unified VAT in place of various indirect taxes. Scenario 2, on the basis of Scenario 1, has further introduced environment tax, aiming to reduce the discharge of carbon dioxide in benchmark year by 10%. By Scenario 2, we may analyze the competitiveness of different sectors while allowing for the environmental cost. Scenario 3, on the basis of Scenario 1, has introduced a fixed shadow wage to reflect the influence of expanding employment, and the shadow wage is 5% lower than market equilibrium wage in benchmark year. Scenario 4 is a combination of Scenario 2 and Scenario 3 and has allowed for aggregate influence of employment and environment policies.

Table 6 Simulations Design

Scenario	Description
E1	Unification of intersectorally distortionary taxes/subsidies Introduce unified import tariff Abolish production subsidy Use unified VAT in place of various indirect taxes
E2	Introduction of environment tax -E1 -Reduce the discharge of carbon dioxide in benchmark year by 10%
E3	Introduction of fixed wage -E1 -Introduce the shadow wage which is 5% lower than market equilibrium wage in benchmark year
E4	Aggregate Scenario -E1 E2 E3

4.1. Aggregate effects

4.1.1. Unification of intersectorally distortionary taxes/subsidies

In Scenario 1, tax rate and subsidy rate of different sectors are unified in a revenue-neutral fashion, that is, to use a unified VAT rate to replace all indirect taxes on the premise that the real expenditure and real saving of government to remain unchanged. This rule of fiscal closure ensures the fiscal neutrality in macro-economy, and as a result, any changes in consumption and investment do not result from changes in government expenditure and saving. This has made it easier to reflect the influence of change in sectoral structure of taxation and subsidy.

Table 7 lists the major aggregate results of Scenario 1, with all indexes reflecting deviations from the base year values. The results show that both China and Yunnan Province have benefited from the elimination of distorted taxation and subsidy. In Scenario 1, GDP of Yunnan Province will grow 7.09% in real term as compared with in benchmark year, and the social welfare that is measured by EV of Hicksian will grow 5.84%. Compared with the country as a whole, the profit of welfare in Yunnan Province will be much higher than the country's average level. This indicates that taxation and subsidy in Yunnan Province have been seriously distorted.

The elimination of the distorted taxation will keep the return of production factors more in line with that in competitive market. It will be conducive to rational allocation of production elements. Table 7 shows that unified VAT will lead to an increase in investment and return on

capital. As a result, the national investment will increase by 2.42%, while the investment in Yunnan Province will increase by 11.47%. Meanwhile, the rental rate of capital will increase in the whole country, and the wage level will decrease slightly. Due to large-scale expansion of food processing industry, the intermediate demand of Yunnan Province for agricultural products has increased, which in turn has boosted the wage level for agricultural manpower and to certain extent, led to increase of consumption.

Table 7 Major aggregate effects of Scenario 1 (% change with base year)

	China	Yunnan
EV (% of GDP)	0.22	5.84
GDP	0.29	7.09
Consumption	-1.13	5.25
Investment	2.42	11.47
Exports	0.62	-26.92
Imports	0.68	20.55
Real exchange rate	-0.50	-22.26
Terms of trade	-0.11	-1.30
Factor price		
Agricultural labor	-5.17	16.47
Production worker	-3.76	7.87
Skilled labor	-1.32	-27.97
Land	-8.79	41.59
Capital	8.43	67.46

Source: simulation results.

Table 8 portrays the changes of producer's price, total output, employment, export and inter-provincial export of all sectors in Yunnan Province. To better understand the effects, it is necessary to make an analysis in association with the tax burden of all sectors. In view of the tax burdens of all sectors in Yunnan Province in 1997 as shown in Table 6, though different sectors report different tax burdens, tax burden of food (incl. tobacco processing) is much higher than other sectors. The main reason is that the consumption tax rate on tobacco processing is very high, so does the proportion of tobacco processing industry in Yunnan Province.

Changes of tax burdens have direct bearing on production cost and prices of all sectors. Generally speaking, after the distorted taxation and subsidy are removed, the production cost of sectors that reported high tax burdens will drop, while the production cost of sectors that reported low tax burdens will increase. As shown in Table 8, when unified VAT rate is introduced to replace various production taxes, the price of food sector (incl. tobacco processing) in Yunnan Province will drop 18.7%, because it reports high tax burdens. Meanwhile, the prices of other sectors will all rise to different extents. Due to the low tax

burdens, price of some sectors including “Quarrying” (Non-ferrous mineral mining) will only rise slightly.

Price changes lead to the change of demand and aggregate output of different sectors. After the distorted taxation and subsidy are removed, price drop of sectors that reported high tax burdens would result in output increase of these sectors. Data listed in Table 8 shows that the aggregate output of food (incl. tobacco processing) in Yunnan Province will increase by 104.5%, and that of construction and agriculture will increase by 3% and 5.2% respectively. As for other industrial sectors, due to the price rise, their aggregate output will all drop correspondingly. Besides, due to the aggregate output increase, the demand for agricultural products by food sectors will also increase. Price changes also have a bearing on export and inter-provincial outflow: most sectors would cut their export and inter-provincial outflow due to price rise.

Table 8 Sectoral effect of Scenario 1, Yunnan (% change with base year)

	After-tax Producer price	Output	Employment	Export	Inter-regional outflow
Agriculture	31.7	3.0	3.6	-46.5	-58.2
Coal Mining	18.7	-42.7	-41.5	0.0	-51.1
Crude Oil	5.6	-39.8	-39.9	0.0	0.0
Metal Mining	3.9	-22.6	-21.6	-50.0	-18.3
Quarrying	0.3	-6.3	-5.3	-2.0	-6.5
Food	-18.7	104.5	126.4	8.3	167.3
Textiles	17.0	-50.7	-51.0	-47.5	
Apparel	12.6	-11.6	-7.8	-37.4	
Sawmill & furniture	13.2	-10.5	-9.8	-26.2	-42.5
Social articles	13.7	-18.5	-14.0	-32.2	-36.2
Petroleum refining	8.7	-56.4	-56.8	-38.8	-54.1
Chemical	16.7	-47.6	-47.9	-46.7	-67.2
Building material	11.0	-7.0	-5.2	-22.8	-35.9
Primary metal	11.3	-23.3	-21.8	-28.5	-43.8
Metal products	10.0	-0.9	1.0	-18.5	
Machinery	11.4	-33.9	-33.1	-33.9	-45.8
Transport equipment	9.7	-38.2	-37.7	-32.2	-38.0
Electronic machine	14.3	-39.4	-38.0	-39.0	-53.1
Electronics	2.5	-22.9	-21.9	-10.5	-13.2
Instrument	10.3	-12.5	-11.3	-28.4	-33.3
Other manufacturing	39.8	-38.2	-35.6	-66.8	
Electricity	19.6	-24.3	-21.4	0.0	-50.3
Gas & water	23.4	-15.1	-13.0		
Construction	17.7	5.2	6.8		
Transport	25.0	-37.6	-37.1		
Telecomm	32.9	-33.8	-31.9		
Commerce	22.3	-24.2	-21.9		
Restaurant	18.0	-9.5	-9.8		
Finance	39.8	-31.6	-26.9		
Social service	36.4	-55.2	-54.0		
Education & health	18.5	-13.9	-11.5		
Public administration	23.7	-24.8	-23.7		

4.1.2. Environment Tax and Fixed Wage

On the basis of distorted taxation and subsidy being eliminated, Scenario 2, 3 and 4 make an analysis of the effects of introduction of environment tax and lower wage. Table 8 lists the aggregate results of the three scenarios, and they are derivations from scenario 1. In Scenario 2 and 4, carbon dioxide tax has been introduced to cut the discharge by 10% as compared with in benchmark year. Here we presume that all revenue from carbon tax will be redistributed to households as a lump sum transfer. In Scenario 3 and 4, the fixed wage will be set at a level 5% lower than in Scenario 1, and total supply of labor force will endogenous to clear labor market.

Table 9 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)	-0.55	1.14	1.57
GDP	-0.47	1.15	1.71
Consumption	3.88	-0.45	4.36
Investment	-6.81	4.00	-1.14
Exports	0.90	1.02	3.24
Imports	1.04	1.22	3.79
Real exchange rate	5.91	0.53	8.42
Terms of trade	-0.11	-0.09	-0.36
Factor price			
Agricultural labor	0.69	-5.94	-11.85
Production worker	-0.72	-5.94	-11.85
Skilled labor	-2.37	-5.93	-11.85
Land	2.08	2.01	8.75
Capital	-13.64	8.14	-1.82
Total employment	0.00	2.007	4.35
Yunnan			
EV (% of GDP)	-0.94	0.80	-0.56
GDP	0.19	0.71	0.99
Consumption	0.70	0.36	0.89
Investment	-3.45	1.77	-2.61
Exports	-5.55	5.82	3.21
Imports	1.36	-0.59	0.16
Real exchange rate	1.39	2.06	5.51
Terms of trade	-0.86	-0.61	-2.17
Factor price			
Agricultural labor	0.91	-6.59	-9.58
Production worker	-0.35	-6.59	-9.58
Skilled labor	-3.19	-6.59	-9.58
Land	1.54	0.66	-1.28
Capital	-2.84	3.11	-0.65
Total employment	0.00	2.013	2.16

Source: simulation results.

Aggregate effects of Scenario 2 as portrayed in Table 9 show that once carbon dioxide tax is introduced, China's GDP will drop 0.47% due to the decrease in energy consumption. However, there is an exception in which the GDP of Yunnan Province has increased by 0.19% after the introduction of carbon dioxide tax. Meanwhile, we find that the social welfare of the province will decrease. The main reason is the inter-provincial trade and the unique industrial structure of Yunnan Province. Agriculture always takes a higher proportion in economy as a whole in Yunnan Province than the country's average level. As for inter-provincial trade, Yunnan is a net importer in terms of energy-intensive heavy industry and a

net export in terms of non-energy-intensive industries. Therefore, once carbon dioxide tax is imposed, inter-provincial trade conditions of Yunnan Province will worsen, the province's net export will increase, the GDP will increase, and the social welfare will be damaged.

When all revenue from carbon tax will be redistributed to households as a lump sum transfer, individual consumption will increase. As shown in table 9, individual consumption of China and Yunnan Province will increase by 3.88% and 0.7% respectively. Meanwhile, as the proportion of energy-intensive industries in Yunan Province is lower than the country's average level, the growth of individual consumption in the province will also be obviously lower than the country's average level. Most sectors that report large discharge of carbon dioxide are capital-intensive industries. If carbon dioxide tax is introduced, the rental of capital will drop drastically, and decrease in capital gains will lead to decrease in profit retained by enterprises, and the final result is that total investment will drop.

Introduction of carbon dioxide tax will help increase the cost of energy, thus energy consumption will decrease. As shown in Table 10, production of fossil energy in Yunnan Province has decreased. Meanwhile, as there is a substitution relation between non-fossil energy and fossil energy, the scale of power production and supply will enlarge.

In Scenario 3, wage decrease will help enlarge employment, as well as boosting growth of GDP. When market equilibrium wage drops 5%, total employment in China and Yunnan Province would increase by 2.007% and 2.013% respectively, and GDP would grow 1.15% and 0.71% respectively.

As shown in Table 11, almost all sectors in Yunnan Province would expand in Scenario 3. Generally speaking, labor-intensive sectors will benefit more from higher labor input and lower labor cost. It is necessary to point out that some sectors in Yunnan Province are different from their counterparts in other areas in China in terms of intensity of production elements. For example, food and tobacco processing sectors in Yunnan Province are lower labor-intensive than in other areas in China. Therefore, when comparatively low equilibrium wage is introduced, the price of food (incl. tobacco processing) drops only 0.4% in Yunnan Province, while the output drops 2.4%, and export to other parts of China drops 3.4%.

Table 10 Sectoral effect of scenario 2, Yunnan (% change with scenario 1)

	After-tax Producer price	Output	Employment	Export	Inter-regional Export
Agriculture	-0.6	1.8	1.1	1.5	9.1
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
Quarrying	0.9	-3.8	-3.6	-7.2	-7.4
Food	-1.4	4.7	3.5	4.6	7.8
Textiles	-0.2	-1.4	-1.2	3.0	-3.0
Apparel	-2.4	11.2	9.7	15.9	7.8
Sawmill & furniture	2.5	-8.4	-7.8	-9.5	-14.9
Social articles	-1.3	0.2	-0.5	3.4	3.1
Petroleum refining	5.1	-1.5	-1.6	-22.8	9.5
Chemical	3.9	-11.0	-11.0	-17.0	-10.9
Building material	7.3	-3.2	-2.9	-29.4	9.4
Primary metal	4.8	0.3	1.8	-20.1	1.7
Metal products	1.7	-3.1	-2.9	-9.4	-2.3
Machinery	1.4	-13.4	-13.2	-10.3	-14.6
Transport equipment	-0.3	-3.2	-3.5	-0.9	-3.4
Electronic machine	0.7	-2.9	-3.3	-5.1	-1.1
Electronics	-0.8	-2.1	-2.6	4.8	-1.9
Instrument	0.8	-9.6	-9.5	-3.9	-11.8
Other manufacturing	-7.8	7.7	6.2	27.3	27.7
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		

Table 11 Sectoral effect of Scenario 3, Yunnan (% change with scenario 1)

	After-tax Producer price	Output	Employment	Export	Inter-regional Export
Agriculture	-2.0	3.9	5.6	10.5	-2.9
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
Quarrying	-3.6	15.3	16.2	21.9	22.3
Food	-1.1	4.0	6.5	4.3	1.1
Textiles	-1.9	12.6	13.4	11.3	13.0
Apparel	-0.4	2.1	4.4	3.2	-0.7
Sawmill & furniture	-0.4	8.2	9.2	9.5	4.7
Social articles	-0.3	6.3	8.7	4.8	2.6
Petroleum refining	4.1	3.5	3.5	-8.5	-10.3
Chemical	-1.3	12.1	12.1	8.1	12.5
Building material	-0.8	9.9	10.8	6.9	8.1
Primary metal	-0.7	7.3	7.8	5.6	6.4
Metal products	-0.7	5.1	6.0	4.5	5.7
Machinery	-2.2	21.9	22.2	15.2	23.4
Transport equipment	-0.1	4.5	5.5	2.2	4.0
Electronic machine	0.4	5.7	6.9	1.5	1.8
Electronics	0.5	2.0	3.2	-1.5	0.9
Instrument	-2.9	18.5	18.8	15.2	21.6
Other manufacturing	6.4	-2.7	-0.6	-12.1	-20.7
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		

Table 12 Sectoral effect of scenario 4, Yunnan (% change with scenario 1)

	After-tax Producer price	Output	Employment	Export	Inter-regional Export
Agriculture	-4.9	8.2	10.2	24.8	3.0
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
Quarrying	-4.4	17.7	19.8	24.0	24.3
Food	-4.0	11.4	14.3	16.6	10.5
Textiles	-3.5	19.9	21.7	24.7	18.3
Apparel	-3.7	18.0	20.5	27.1	8.1
Sawmill & furniture	2.5	0.0	2.5	0.0	-12.8
Social articles	-2.0	9.3	12.5	11.6	7.5
Petroleum refining	13.2	3.4	3.4	-37.0	-5.3
Chemical	2.8	4.9	4.9	-9.8	5.8
Building material	7.9	10.4	12.5	-28.1	25.1
Primary metal	5.0	11.3	14.5	-17.8	11.9
Metal products	1.2	3.9	5.6	-5.7	6.2
Machinery	-1.5	15.0	15.9	8.8	15.7
Transport equipment	-0.2	3.2	4.6	1.5	2.4
Electronic machine	1.8	4.6	6.2	-5.0	1.5
Electronics	0.1	0.0	1.5	1.5	-1.1
Instrument	-3.4	15.4	16.3	17.4	17.1
Other manufacturing	0.9	3.5	5.4	3.0	-9.3
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		

4.2. The effects on Industrial Competitiveness

To estimate the effects on industrial competitiveness, we may analyze the change of technical structure of manufacturing value added and the technical structure of manufactured export.

Table 13 Technical Structure MVA by Scenario

Technological structure of Manufacturing value added				
	Scenario1	Scenario 2	Scenario 3	Scenario 4
National				
Total of MVA	100.0	100.0	100.0	100.0
Resource-based MVA	25.5	25.4	25.6	25.7
Low-tech MVA	29.2	30.3	29.1	30.4
Medium-tech MVA	39.9	38.6	39.9	38.4
High-tech MVA	5.4	5.7	5.3	5.5
Yunnan				
Total of MVA	100.0	100.0	100.0	100.0
Resource-based MVA	74.4	75.6	73.8	74.9
Low-tech MVA	9.2	8.9	9.3	8.9
Medium-tech MVA	14.5	13.9	15.0	14.5
High-tech MVA	1.9	1.7	1.9	1.7

Table 13 has given out the change of technical structure of manufacturing value added under various scenarios. Compared with benchmark year, the proportion of MVA of resources-based manufacturing industry has increased sharply in Scenario 1, while other indicators have dropped to different extents. Due to elimination of distorted taxation and subsidy, the production scale of food (incl. tobacco processing) keeps expanding in Scenario 1, while that of other manufacturing sectors keeps dwindling. As shown in Table 13, the proportion of MVA of resources-based manufacturing sectors in Scenario 1 has increased by nearly 10%.

Then environment tax is introduced in Scenario 2, as a result, production scale of energy-intensive heavy industry (such as machinery industry) has dropped. Meanwhile, as the energy-intensive industry reports comparatively high technical content, the proportion of high-tech MVA has dropped in Scenario 2 as compared to Scenario 1. Besides, there is an important factor that needs to be considered: as food (incl. tobacco processing) in Yunnan Province is lower energy-intensive than in other parts in China, once carbon dioxide tax is introduced, the province's export of food (incl. tobacco processing) would increase, which may offset the influence resulting from decrease of production of resources-based manufacturing industry in the province.

Wage level in Scenario 3 drops 5% as compared with in Scenario 1. In Scenario 3, production of labor-intensive manufacturing industry is expanding; low-tech manufacturing sectors have gathered most labor forces; and total output of textile sector has increased by 12.9%. Comparing Scenario 3 with Scenario 1, we find the proportion of MVA of low-tech manufacturing is higher in Scenario 3 than in Scenario 1, while the proportion of MVA of resources-based manufacturing sector is lower.

Table 14 Technical structure of Manufactured Export

Technological structure of manufactured exports				
	Scenario1	Scenario 2	Scenario 3	Scenario 4
National				
Total of ME	100.0	100.0	100.0	100.0
Resource-based ME	13.9	12.5	13.9	12.2
Low-tech ME	50.1	51.6	50.7	53.3
Medium-tech ME	19.3	18.7	19.1	18.1
High-tech ME	16.7	17.2	16.3	16.3
Yunnan				
Total of ME	100.0	100.0	100.0	100.0
Resource-based ME	55.8	54.2	55.7	54.1
Low-tech ME	14.8	15.3	14.9	15.7
Medium-tech ME	22.0	22.6	22.1	22.6
High-tech ME	7.4	7.9	7.3	7.6

Table 14 is a list of technical structure of manufactured export under various scenarios. Compared with benchmark year, as distorted taxation and subsidy have been eliminated in Scenario 1, export of most sectors in Yunnan Province, for its unique tax burden structure, has dropped. However, as shown in Table 14, the effect on technical element of ME seems neutral, that is, compared with benchmark year, technical structure in Scenario 1 does not report much changes.

As environment tax is introduced in Scenario 2, the production cost of energy-intensive manufactured products has increased correspondingly, and the export has decreased. As shown in Table 14, the proportion of energy-intensive manufactured products in Scenario 2 has dropped 1.6% as compared with in Scenario 1, while export proportion of manufactured products of other technological levels has all increased.

Decreased wage level in Scenario 3 has led to export increase of all sectors. Similar to Scenario 1, data in Table 14 shows that the effect is neutral.

Table 15 lists technical structure of inter-provincial outflow under various scenarios. Compared with technical structure of ME, an obvious change can be seen in Table 14. In

Scenario 1, inter-provincial outflow of resources-based manufactured products by Yunan Province has increased obviously, and this is in step with the rapid expanding of food (incl. tobacco processing). In Scenario 3, due to decrease of wage level, inter-provincial outflow of labor-intensive manufactured products with low and medium technique has increased by 0.2% and 0.3% respectively.

Table 15 Technical structure of Inter-Provincial outflow by Scenario

Technological structure of manufactured Outflows				
	Scenario1	Scenario 2	Scenario 3	Scenario 4
National				
Total of MO	100.0	100.0	100.0	100.0
Resource-based MO	37.9	38.6	38.1	39.2
Low-tech MO	27.1	27.0	26.8	26.6
Medium-tech MO	24.4	23.8	24.4	23.6
High-tech MO	10.7	10.5	10.7	10.5
Yunnan				
Total of MO	100.0	100.0	100.0	100.0
Resource-based MO	93.0	93.5	92.3	92.6
Low-tech MO	2.9	2.7	3.1	3.0
Medium-tech MO	3.3	3.0	3.6	3.5
High-tech MO	0.9	0.8	1.0	0.9

Figure 1 portrays the changes of share of medium- and high-tech products in ME and activities in MVA under various scenarios. Speaking only to the two indicators, compared with benchmark year, industrial competitiveness is decreasing in Scenario 1 and is increasing to different extents in Scenario 2, 3 and 4.

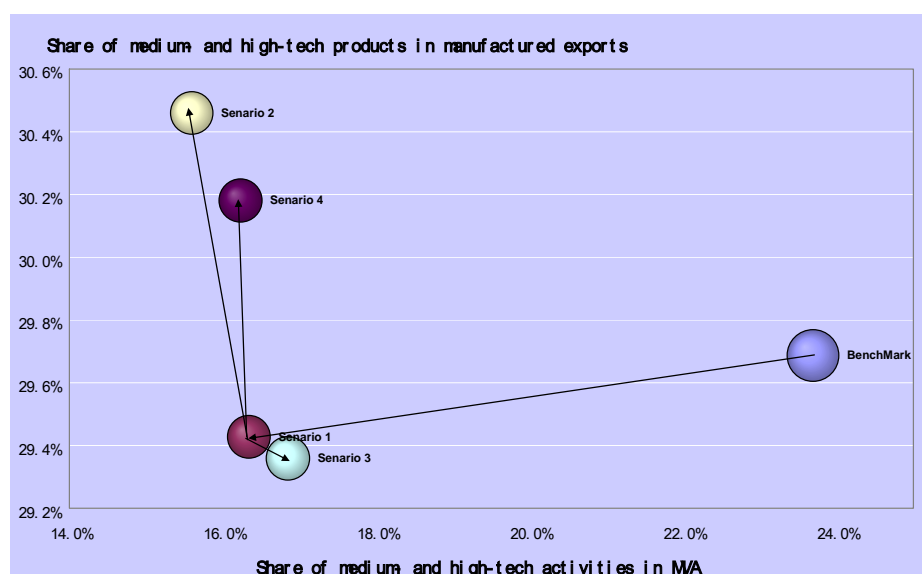


Figure1 Change of Industrial Technological Level by Scenario

5. Conclusion

The results of simulation show that distortion of Chinese economy has, to a large extent, resulted from current taxation and subsidy structure. Both China and Yunnan Province will benefit from eliminating the distorted taxation and subsidy. The elimination will be especially conducive to the GDP growth and social welfare in Yunnan province, which means taxation and subsidy system have been distorted more seriously in Yunnan Province than in other parts of China.

Current taxation and subsidy structure are inconducive to the development of tobacco processing sector. Once the distortion is removed, the production of tobacco processing will expand rapidly. Aggregate results show that elimination of distorted taxation will result in sharp increase of proportion of resources-based manufacturing industry. As the proportion of energy-intensive sectors is low in Yunnan province, once carbon dioxide tax is introduced, the province will benefit from this. If equilibrium wage is lowered, almost all sectors in Yunnan are sure to expand. Study also shows that collecting carbon dioxide tax and lowering equilibrium wage will both, to certain extent, increase the proportion of manufacturing industry with medium and high techniques in Yunnan Province.

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

The two-region CGE model used in this report is built up on China single-region CGE model and two-region (Shaanxi-Rest of China) CGE model. China single-region CGE model was previously used to study and analyze China's WTO accession (the State Council Development and Research Center, 1998; Zhai Fan, Li Shantong, 2000). Two-region (Yunnan and the rest of the China) CGE model covers two regions of Yunnan and the rest of the 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 regions and the constant elasticity of transformation.. The movement of labor is also determined by the relative real income across regions and the constant elasticity of transformation. The real income of labor is defined as the wage plus per capita net intergovernmental transfer income.

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. Additionally, 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 the agricultural sector.

All commodity and factor markets are assumed to clear through prices. Capital and labor forces are fully mobile across sectors. Thus there is 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. Although reforms are expanding in China, there are still large barriers for urban migration of the rural labor force. 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 assume 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. The movement of labor is also 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.

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 the 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, which 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 goods are split into local good and interregional import from the rest of the China.

Income Distribution and Demands

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

Household income is derived from capital, labor and land income. Additionally, households receive distributed enterprise profits, transfers from the government and the rest of the world. All kinds of import and export quota rent are also allocated to households. Assume that rural households earn all the land returns; the 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 were 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 equals to 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, is equal to 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.

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 government collects taxes from the producers, households and foreign sector; transfers 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. Among the government revenues, 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 equals to 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 incomes 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.

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 tradable to non-tradable, or the real exchange rate.

Data

The model is calibrated to the 1997 two-region Chinese Social Accounting Matrices (SAM), which is developed from the 1997 national and Yunnan 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 – are 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 Yunnan.)