

China: An Input-Output Modeling System



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Inter-provincial Modeling System

- Static model for 1997
- 29 of 31 provinces (Tibet and Hainan omitted)
- 33 industries
- Bilateral Inter-provincial exports and imports by sector
- Four categories of Final demand: Households, Government, Fixed Investment, Inventory Change
- Four Categories of Value Added: Wages, Depreciation, Indirect Taxes, Surplus

Modeling System (continued)

- Fully consistent with provincial accounts
- Nearly* consistent with reported foreign exports and imports in yearbook

- * Except for Beijing and Fujian

Input-Output Data

	Type	Other Final Demand	Pub Admin Int Input = 0	Trade Columns
Beijing	io		no	4
Tianjin	io		no	4
Hebei	io		yes	2
Shanxi	fd		no	2
Inner Mongolia	fd,io33		no	2
Liaoning	io		no	4
Jilin	fd		yes	2
Heilongjiang	fd		yes	1
Shanghai	io		yes	4
Jiangsu	io		no	4
Zhejiang	fd		yes	2
Anhui	fd,io17		no	1
Fujian	fd		no	2
Jiangxi	fd,io6		no	2
Shandong	fd	yes	no	1

Input-Output Data (continued)

	Type	Other Final Demand	Pub Admin Int Input = 0	Trade Columns
Henan	io		no	2
Hubei	fd		no	2
Hunan	fd		yes	2
Guangdong	io		yes	4
Guangxi	fd		no	4
Hainan				
Chongqing	fd		no	1
Sichuan	io	yes	no	2
Guizhou	io		yes	1
Yunnan	fd	yes	yes	2
Tibet				
Shaanxi	io		yes	2
Gansu	io		yes	2
Qinghai	fd		yes	4
Ningxia	io		no	4
Xinjiang	io		no	4

Input-Output Data: Summary

- 14 provinces have at least a compatible 33 sector input-output table (52% of provincial GDP)
- 3 provinces have an input-output table of smaller dimensions (7%)
- 12 provinces have only final demand and output portions of the table available (41%)

Trade Data

- Four Columns: Foreign exports, foreign imports, domestic exports, domestic imports (10 provinces)
- Two Columns: Exports (foreign and domestic combined) and imports (14)
- One Column: Net Exports (5)

Creating Missing Input-Output Data

- 15 provinces
- Have total gross output by sector
- Have national input-output table and some provincial tables in same sector definitions
- Begin with national table and use RAS procedure to create provincial table

Creating Missing Trade Data

- 19 of the provinces were missing some portion of the trade data
- Maintained Net exports, total exports and total imports by sector
- Maintained total foreign exports and imports (by province) as published in the Statistical Yearbook
- Obtained from IDE-Jetro the Multi-regional Input-Output Model for China for 2000 (7 regions, 30 commodities)

Two Column Case: Exports

- Estimated Foreign exports use appropriate regional IDE ratios of exports/output by sector
- Control sum of foreign exports to Yearbook figures
- Estimate Domestic exports using IDE ratios
- Compare to Exports as published
- Adjust both
- Readjust to Yearbook foreign exports
- Manually adjust ratios where necessary

Two Column Case: Imports

- Begin with foreign import to domestic demand (output + imports) ratio from IDE and estimate foreign imports
- Estimate domestic imports similarly
- Adjust foreign to Yearbook
- Adjust domestic imports to known total imports
- Use manual adjustments where necessary

Example of a Trade Matrix: Guangdong

	1997	Net Export	Ttl Export	Dom Export	For Export	Ttl Import	Dom Import	For Import
1	Agricult	-167.1	256.3	102.1	154.2	423.4	247.7	175.6
2	Coal mng	-152.7	1.2	0.2	1.0	154.0	153.5	0.5
3	Oil & Gas	-25.5	62.3	0.1	62.3	87.9	0.4	87.5
4	Fe ore	-37.7	28.8	9.6	19.2	66.5	29.2	37.4
5	NFe ore	-63.2	8.1	0.2	7.9	71.3	55.4	15.9
6	Food & Be	112.8	376.9	243.3	133.6	264.1	180.4	83.8
7	Textiles	-192.8	287.1	75.0	212.2	479.9	244.4	235.5
8	Apparel	1097.9	1277.2	105.6	1171.6	179.3	46.9	132.4
9	Sawmills	-90.5	150.7	33.5	117.3	241.2	195.5	45.7
10	Paper Proc	290.3	593.4	95.4	498.0	303.1	89.8	213.4
11	OilRefinin	-296.4	174.0	81.5	92.5	470.4	272.0	198.4
12	Chemicals	-371.7	1176.3	489.3	687.0	1548.0	556.3	991.7
13	Blt Mtls	31.3	188.2	79.2	109.0	156.9	116.6	40.3
14	Mtl Smelt	-626.3	202.9	57.9	145.0	829.2	463.0	366.2
15	Metal prod	131.7	186.7	100.4	86.3	55.0	48.0	7.0
16	Machinery	-125.9	335.0	55.2	279.9	460.9	83.2	377.7

Trade Matrix of Guangdong (Continued)

	1997	Net Expor	Ttl Export	Dom Expc	For Expor	Ttl Import	Dom Impc	For Import
17	TransEquip	79.2	184.7	53.4	131.3	105.5	56.5	49.0
18	Elec Mach	712.2	1157.8	558.0	599.8	445.6	242.0	203.6
19	Electronic	121.9	1198.0	385.6	812.4	1076.1	371.9	704.2
20	Instrumnt	210.9	315.9	39.2	276.6	104.9	7.6	97.3
21	Mfg, nec	-57.7	408.7	22.4	386.3	466.4	48.8	417.6
22	Electricit	15.8	27.4	22.2	5.2	11.6	11.5	0.0
23	Gas	-0.3	0.1	0.1	0.0	0.4	0.4	0.0
24	Tap water	-1.2	0.0	0.0	0.0	1.2	1.2	0.0
25	Construct	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	Trans&PT	-227.1	94.8	13.4	81.4	321.9	220.4	101.6
27	Commerce	24.0	150.5	53.0	97.6	126.5	86.8	39.8
28	Fin & Ins	-0.2	0.4	0.1	0.3	0.6	0.1	0.5
29	RE& SocS	79.0	79.0	0.0	79.0	0.0	0.0	0.0
30	Health	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	Ed & Cult	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	Sci Res	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	Public Adr	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	470.6	8922.5	2675.7	6246.8	8451.9	3829.5	4622.4

Interprovincial Flows: General Approach

- Following Isard we have used a gravity modeling approach
- Estimated flow is the push*pull/distance
- Push is domestic exports; pull is domestic imports
- The measure of distance is key

Interprovincial Flows: Distance measures

- Common measure is geographic: measure the distance in kilometers between the provinces
- Another is to measure the distance in time— i.e. the number of hours it takes to get from point A to point B
- Provincial capitals are assumed to be provincial “centers”
- We have used distance expressed in hours.

Distance in Hours: Selected Provinces

	Heilongji	Shanghai	Jiangsu		Jiangxi	Shandong	Henan		
Hebei	16.4	17.4	13.3		19.8	4.3	3.9		
Shanxi	24.6	22.7	18.4		24.8	9.8	10.9		
IMAR	25.2	30.1	26.1		28.6	17.5	20.3		
Sichuan	44.9	36.8	32.8		23.2	35.0	20.4		
Guizhou	46.5	32.5	45.1		30.7	38.3	24.2		
Yunnan	62.3	43.9	58.3		43.9	47.2	36.4		

	FOOD														
	Bilateral Interprovincial Flows, 100M yuan														
1997	Beijing	Tianjin	Hebei	Shanxi	IMAR	Liaoning	Jilin	Heilongji	Shanghai	Jiangsu	Zhejiang	Anhui	Fujian	Jiangxi	Shandong
Beijing	0.00	0.10	0.01	0.01	0.00	0.02	0.01	0.02	0.02	0.00	0.00	0.02	0.00	0.00	0.06
Tianjin	6.40	0.00	2.10	2.12	0.71	6.77	3.73	4.60	5.19	0.59	0.42	5.97	1.13	0.93	23.62
Hebei	1.98	5.67	0.00	3.12	0.44	3.64	1.99	2.57	2.75	0.31	0.25	3.15	0.70	0.69	12.48
Shanxi	0.01	0.05	0.03	0.00	0.01	0.03	0.03	0.03	0.04	0.00	0.00	0.05	0.01	0.01	0.11
IMAR	0.01	0.05	0.01	0.03	0.00	0.03	0.03	0.04	0.04	0.00	0.00	0.02	0.01	0.01	0.07
Liaoning	0.60	3.42	0.68	0.68	0.21	0.00	0.58	8.32	1.97	0.20	0.17	1.81	0.60	0.63	4.34
Jilin	0.03	0.12	0.02	0.04	0.01	0.04	0.00	0.93	0.09	0.01	0.01	0.08	0.03	0.02	0.17
Heilongji	0.71	3.15	0.65	1.05	0.42	11.27	19.57	0.00	2.52	0.25	0.27	2.35	0.82	0.63	4.63
Shanghai	0.98	4.86	0.95	1.78	0.54	3.66	2.49	3.45	0.00	3.68	8.72	15.55	3.89	3.27	15.06
Jiangsu	0.08	0.46	0.09	0.16	0.04	0.31	0.21	0.28	3.07	0.00	0.18	1.92	0.20	0.18	1.51
Zhejiang	0.10	0.39	0.09	0.17	0.06	0.31	0.26	0.37	8.73	0.22	0.00	1.45	0.53	0.49	1.44
Anhui	1.57	8.70	1.70	2.92	0.49	5.21	3.52	5.00	24.14	3.57	2.25	0.00	4.63	7.44	27.69
Fujian	0.03	0.14	0.03	0.07	0.02	0.14	0.10	0.15	0.51	0.03	0.07	0.39	0.00	0.18	0.33
Jiangxi	0.06	0.28	0.08	0.15	0.05	0.37	0.20	0.27	1.05	0.07	0.16	1.54	0.45	0.00	0.94
Shandong	2.63	16.94	3.31	3.55	0.80	6.16	3.75	4.85	11.52	1.38	1.10	13.64	1.95	2.24	0.00
Henan	2.97	10.80	6.35	5.50	1.20	9.77	5.91	8.00	18.71	2.29	1.20	17.60	3.56	4.21	29.29
Hubei	0.61	2.00	0.98	0.91	0.37	2.54	1.62	2.27	4.03	0.42	0.54	6.37	1.85	3.55	4.21
Hunan	0.42	1.45	0.62	0.68	0.29	1.92	1.26	1.77	3.98	0.30	0.54	2.26	1.56	2.94	3.65
Guangdong	1.97	6.86	2.54	4.71	0.81	9.78	6.60	9.53	17.08	1.14	2.18	16.50	7.96	9.29	14.88
Guangxi	0.75	6.21	1.81	3.55	1.12	7.24	5.20	7.51	11.10	0.92	1.37	11.45	5.54	4.49	12.04
Chongqing	0.02	0.11	0.03	0.06	0.02	0.12	0.08	0.13	0.14	0.01	0.02	0.13	0.07	0.06	0.16
Sichuan	0.60	2.71	0.81	1.72	0.62	2.77	1.92	2.90	4.02	0.38	0.37	3.78	2.15	1.83	4.75
Guizhou	0.16	0.74	0.22	0.43	0.14	0.84	0.60	0.88	1.43	0.09	0.18	1.04	0.64	0.43	1.37
Yunnan	0.41	1.90	0.53	1.13	0.38	2.21	1.54	2.27	3.65	0.23	0.44	2.67	1.48	1.05	3.81
Shaanxi	0.23	0.68	0.35	0.90	0.16	0.84	0.56	0.87	1.71	0.18	0.12	1.39	0.41	0.37	2.26
Gansu	0.01	0.06	0.02	0.04	0.02	0.04	0.03	0.07	0.11	0.01	0.01	0.12	0.03	0.03	0.13
Qinghai	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.01
Ningxia	0.05	0.20	0.05	0.11	0.12	0.21	0.14	0.21	0.22	0.02	0.02	0.21	0.07	0.05	0.36
Xinjiang	0.24	1.11	0.31	0.72	0.33	1.36	0.99	1.40	2.03	0.18	0.21	1.82	0.72	0.53	2.34
Total	23.63	79.17	24.37	36.31	9.38	77.61	62.93	68.70	129.86	16.48	20.80	113.29	40.99	45.55	171.71

	FOOD														
	Bilateral Interprovincial Flows, 100M yuan														
	Henan	Hubei	Hunan	Guangdong	Guangxi	Chongqing	Sichuan	Guizhou	Yunnan	Shaanxi	Gansu	Qinghai	Ningxia	Xinjiang	Exports
Beijing	0.03	0.01	0.01	0.03	0.00	0.02	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.13
Tianjin	6.85	1.27	1.19	6.21	1.37	5.85	2.11	0.03	0.35	3.57	0.80	0.40	0.65	1.24	32.16
Hebei	10.90	1.68	1.37	6.22	1.08	4.90	1.70	0.03	0.26	5.04	0.66	0.33	0.41	0.93	99.79
Shanxi	0.08	0.01	0.01	0.10	0.02	0.08	0.03	0.00	0.00	0.11	0.01	0.01	0.01	0.02	40.23
IMAR	0.05	0.02	0.02	0.05	0.02	0.07	0.03	0.00	0.00	0.06	0.02	0.01	0.03	0.02	0.81
Liaoning	3.14	0.82	0.80	4.47	0.81	3.44	1.09	0.02	0.21	2.23	0.25	0.21	0.34	0.77	18.95
Jilin	0.12	0.03	0.03	0.19	0.04	0.15	0.05	0.00	0.01	0.10	0.01	0.01	0.01	0.04	25.00
Heilongji	3.48	0.99	1.00	5.90	1.14	4.78	1.55	0.03	0.29	3.13	0.62	0.30	0.47	1.07	26.35
Shanghai	11.13	2.41	3.07	14.49	2.30	7.01	2.93	0.06	0.63	8.45	1.33	0.59	0.67	2.13	105.49
Jiangsu	1.14	0.21	0.19	0.81	0.16	0.39	0.23	0.00	0.03	0.73	0.11	0.05	0.06	0.16	73.15
Zhejiang	0.71	0.32	0.41	1.85	0.28	0.81	0.27	0.01	0.08	0.61	0.14	0.06	0.07	0.23	14.54
Anhui	16.26	5.89	2.70	21.72	3.68	10.38	4.29	0.07	0.72	10.68	2.35	0.82	1.01	2.96	98.14
Fujian	0.28	0.14	0.16	0.88	0.15	0.48	0.20	0.00	0.03	0.26	0.05	0.02	0.03	0.10	101.61
Jiangxi	0.80	0.68	0.72	2.52	0.30	0.92	0.43	0.01	0.06	0.59	0.11	0.06	0.05	0.18	9.62
Shandong	13.33	1.92	2.15	9.65	1.91	6.53	2.65	0.05	0.50	8.57	1.24	0.54	0.84	1.88	57.43
Henan	0.00	11.50	7.66	29.63	4.89	16.79	7.86	0.12	1.13	31.66	3.20	1.52	1.63	3.95	195.36
Hubei	11.48	0.00	8.89	16.08	2.36	10.40	3.53	0.06	0.49	5.49	0.71	0.41	0.47	1.24	188.97
Hunan	5.92	6.89	0.00	16.43	2.62	3.98	11.71	0.06	0.49	3.66	0.53	0.31	0.37	1.03	86.27
Guangdong	20.80	11.31	14.91	0.00	16.70	27.61	8.41	0.20	3.04	15.95	2.90	1.61	2.01	6.04	155.13
Guangxi	14.03	6.79	9.73	68.30	0.00	16.41	8.40	0.31	5.58	11.42	2.54	1.18	1.61	4.60	262.73
Chongqing	0.19	0.12	0.06	0.45	0.07	0.00	0.48	0.01	0.05	0.23	0.05	0.03	0.03	0.08	1.85
Sichuan	6.40	2.88	12.34	9.76	2.38	34.29	0.00	0.14	1.76	12.17	1.77	0.99	1.19	2.52	89.75
Guizhou	1.70	0.80	1.13	3.78	1.48	11.48	2.27	0.00	0.90	1.67	0.32	0.14	0.18	0.58	57.76
Yunnan	3.88	1.69	2.19	14.90	6.69	16.37	7.44	0.23	0.00	5.13	1.10	0.57	0.51	2.09	71.98
Shaanxi	3.81	0.66	0.57	2.73	0.48	2.44	1.80	0.01	0.18	0.00	0.62	0.34	0.40	0.70	14.74
Gansu	0.15	0.03	0.03	0.20	0.04	0.22	0.11	0.00	0.02	0.25	0.00	0.17	0.08	0.11	12.44
Qinghai	0.02	0.00	0.00	0.03	0.00	0.03	0.01	0.00	0.00	0.03	0.04	0.00	0.01	0.01	0.91
Ningxia	0.32	0.09	0.09	0.56	0.11	0.54	0.28	0.00	0.03	0.64	0.31	0.11	0.00	0.23	3.38
Xinjiang	2.24	0.71	0.75	4.88	0.91	3.97	1.75	0.02	0.34	3.32	1.29	0.62	0.66	0.00	23.50
Total	139.24	59.87	72.18	242.82	51.99	190.34	71.62	1.47	17.18	135.77	23.08	11.41	13.80	34.91	1079.97

The Model:
For each of the 29 provinces
we have

- $q = Aq + f + e - m$
- where
- q is domestic provincial production,
- A is a matrix of direct input-output coefficients
- f , e and m are defined below.

Final Demand

- $f = hhc + g + v + vc$

- *where*

- *hhc is a vector of household consumption*

- *g is vector of government consumption*

- *v is a vector of investment and*

- *vc is a vector of inventory change.*

Exports

$$(3)e = fe + \sum_{j=1}^{np} x_j$$

where fe is a vector of foreign exports
and x_j is a vector of exports to each
province j . There being “ np ” provinces.

Imports

$$(4) m = fm + \sum_{j=1}^{np} m_j$$

- where fm is a vector for foreign imports
- and m_j is a vector of imports from province j .

Imports (continued)

- For each province and sector total imports (foreign and domestic) are determined as a constant fraction of domestic demand (output + imports – exports).
- Foreign imports are then a constant fraction of total imports with domestic imports as a residual

Employment

- Employment is product of the gross output required times an employment coefficient that is determined as the ratio of gross output to employment in 1997
- Thus, employment moves exactly as does gross output.

Sample Exercises

- What are the output and employment requirements for foreign exports?
- What are the output and employment requirements for investment?
- How much of the western provincial production is required to meet coastal needs?

Foreign Export Requirements

- All of China: 16% of output and 10% of employment
- Highest province: Guangdong with 40% of output and 27% of employment
- Lowest province: Sichuan with 4% of output and 3% of jobs
- Other Coastal provinces range from 17-24 of output and 13-23% of employment
- Other Inland provinces range 5-9% of output and 2-10% of employment

Output and Employment Requirements for Foreign Exports by Province

	Output			Employment			Output			Employment	
	Total	For Expor	Percent	10,000	Percent		Total	For Expor	Percent	10,000	Percent
Beijing	5630	319	6	35	5	Henan	10473	860	8	278	6
Tianjin	4590	1081	24	100	21	Hubei	9908	785	8	182	7
Hebei	6737	649	10	263	8	Hunan	6933	437	6	188	5
Shanxi	3329	396	12	91	6	Guangdong	22423	8909	40	1024	27
Inner Mongolia	2493	173	7	55	5	Guangxi	4274	516	12	196	8
Liaoning	11067	1970	18	297	15	Chongqing	3671	300	8	118	7
Jilin	3715	320	9	108	9	Sichuan	7857	334	4	117	3
Heilongjiang	5617	669	12	140	9	Guizhou	1777	108	6	57	3
Shanghai	10695	2619	24	180	23	Yunnan	3512	219	6	105	5
Jiangsu	22315	4284	19	492	13	Shaanxi	3231	301	9	121	7
Zhejiang	16046	3204	20	458	17	Gansu	2046	102	5	27	2
Anhui	6738	737	11	316	10	Qinghai	528	52	10	17	6
Fujian	7933	1384	17	239	15	Ningxia	413	35	9	11	5
Jiangxi	3764	291	8	157	8	Xinjiang	2400	224	9	64	10
Shangdong	19008	2689	14	561	12	China	209122.4	33968	16	5997	10

Coastal Demand Requirements

- Low connectivity? 9% of output of inland provinces output produced for consumption in coastal provinces
- Ranging from a low of 2% in Sichuan to a high of 14% in Jiangxi
- Guangdong's relatively low dependence (51%) is a result of its high dependence on foreign exports.

Requirements for Coastal Demand

	Output 1997	Coastal	Percent	Employe	Percent		Output 1997	Coastal	Percent	Employe	Percent
Beijing	5630	146	3	15	2	Hubei	9908	745	8	240	9
Tianjin	4590	2525	55	296	61	Hunan	6933	524	8	390	11
Hebei	6737	5506	82	2847	84	Guangdong	22423	11327	51	2482	66
Shanxi	3329	244	7	61	4	Guangxi	4274	659	15	384	16
InnerMongol	2493	241	10	104	10	Chongqing	3671	524	14	285	17
Liaoning	11067	7895	71	1549	77	Sichuan	7857	188	2	93	2
Jilin	3715	132	4	33	3	Guizhou	1777	80	5	62	3
Heilongjiang	5617	659	12	202	13	Yunnan	3512	119	3	64	3
Shanghai	10695	6696	63	506	65	Shaanxi	3231	205	6	83	5
Jiangsu	22315	16677	75	3060	82	Gansu	2046	63	3	32	3
Zhejiang	16046	12157	76	2131	79	Qinghai	528	52	10	23	8
Anhui	6738	1327	20	762	23	Ningxia	413	20	5	9	4
Fujian	7933	6286	79	1317	82	Xinjiang	2400	204	8	56	9
Jiangxi	3764	372	10	292	14	China	209122	91766	44	21573	35
Shangdong	19008	15106	79	3816	82	Coastal	120813	84175	70	18005	78
Henan	10473	1087	10	377	8	Non-coastal	88309	7591	9	3568	9