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**A SPATIAL ANALYSIS OF MARKET ECONOMY
IN THE PEOPLE'S REPUBLIC OF CHINA:
EXEMPLIFIED BY RURAL INDUSTRIAL DEVELOPMENT**

by

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B.Sc. (BNU) Geography; M.Sc. (BNU) Geography

**Submitted to the School of Graduate Studies
and Research in Partial Fulfilment of
the Requirements of the Degree of
Doctor of Philosophy**

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Ottawa, Ontario**

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Abstract

China's economic reforms have been underway for 16 years. Among its effects, it has created a fast growing market economy in which rural industry is the most important sector. The spatial effects of China's market-oriented reform is analyzed in this research through the experience of rural industrial development.

Rural industry has existed since the foundation of the People's Republic of China. Most recently, as the result of the economic reforms of 1978, rural industry, as represented by millions of individual entrepreneurs, has become the fastest growing industrial sector in China. There were 58 million labourers engaged in rural industries in 1991 which accounted for a 300% increase since 1980. The seven million rural industrial establishments in 1990 accounted for a tenfold increase since 1978.

The spatial distribution of rural industry is very unbalanced in China. At the provincial level, the most highly developed area is concentrated on China's east coast. A factor analysis has been used to develop three overall indicators from twelve variables. The regional rural industrial development level is classified by those three indicators. Using multiple regression, this research has revealed the links between the degree of rural industrialization and a region's overall economic performance. The high correlation with household expenditure, transportation facilities, and the degree of rural industrial development identifies the market characteristics of rural industry, and illustrates how they reflect characteristics of China's region.

At the regional level, Chinese rural industry is constrained by the relative closure of a rural region. Chinese rural entrepreneurs were only allowed to establish enterprises in nearby market towns but not in large metropolitan areas. The objective of the policy is to restrain population growth in the larger metropolitan regions. After twelve years' development, the distribution of rural industry in Beijing has shown a very clear

bias to suburban areas and the existence of transportation facilities. A GIS map overlay analysis has been applied to identify the relationship between existing rural industrial location and location criteria. The result shows the high concentration of rural industry in the suburban area and the correlation between rural industrial development and regional market and transportation accessibility. Although government policy was obviously attempting to diffuse the process of rural industrialization as much as possible throughout the national territory, the Chinese economy did not escape the concentrating effects of market forces, even in the highly controlled national capital region.

The spatial analysis of rural industrial development not only reveals the spatial behaviour of market economic development in China, but also provides a better understanding of the link between political shifts and industrial change in space in a reforming socialist country. This research also shows that a combination of GIS and statistical analysis methods can provide us with powerful tools for spatial analysis.

Résumé

Les réformes économiques entreprises en Chine depuis 16 ans ont provoqué une croissance de l'économie de marché, marché occupé en majeure partie par l'industrie rurale. Les effets de la réforme du marché chinois sur l'organisation spatiale sont analysés dans cette recherche à partir de l'expérience du développement de l'industrie rurale.

L'industrie rurale est présente sur le territoire chinois depuis la fondation de la République Populaire de Chine. Plus récemment, suite aux réformes économiques de 1978, l'industrie rurale, constituée de millions d'entrepreneurs individuels, est devenue le secteur industriel présentant la plus forte croissance au pays. En 1991, la main-d'oeuvre totale de l'industrie rurale chinoise représentait 58 millions de travailleurs, soit un accroissement de 300% depuis 1980 alors que les établissements industriels ruraux ont décuplé de 1978 à 1990 pour atteindre 7 millions d'exploitations.

En Chine, la distribution spatiale des industries rurales est fortement débalancée. Au niveau provincial, les régions les plus développées se retrouvent sur la côte est. Dans le cadre de cette recherche, l'analyse factorielle a été appliquée à douze variables pour en dégager trois indicateurs généraux. Ces indicateurs ont par la suite permis de classifier le développement industriel rural au niveau régional. A l'aide de la régression multiple, cette recherche a démontré les liens existant entre le degré d'industrialisation rurale et la performance économique générale des régions. La forte corrélation entre les dépenses des ménages, les infrastructures de transport et le degré de développement industriel rural identifient les caractéristiques du marché de l'industrie rurale et reflètent les caractéristiques régionales de la Chine.

Au niveau régional, l'industrie rurale chinoise subie des contraintes en raison du cloisonnement relatif des régions rurales. Les entrepreneurs ruraux ne peuvent établir leurs entreprises que

dans les villes situées en banlieue, excluant les grandes régions métropolitaines, l'objectif étant de limiter la croissance urbaine dans ces régions. Après douze années de développement, la distribution des industries rurales à Beijing présente une nette tendance vers les banlieues et les régions avec infrastructures de transport. La superposition de cartes à l'aide d'un système d'information géographique a été utilisée pour identifier les relations existant entre la localisation des industries rurales et les critères de localisation. Les résultats démontrent une forte concentration d'industries rurales dans les banlieues et une corrélation entre le développement de l'industrie rurale, les marchés régionaux et les infrastructures de transport. Bien que la politique gouvernementale ait été de disperser l'industrialisation rurale à l'ensemble du territoire national, l'économie chinoise n'a pas échappé aux tendances à la concentration des forces du marché, même dans la très fortement contrôlée région de la capitale nationale.

En plus de révéler le comportement spatial du développement du marché économique en Chine, l'analyse spatiale a également permis de mieux comprendre le liens existant entre les courants politiques et les changements industriels sur le territoire dans un pays socialiste en réforme. Cette recherche démontre également que la combinaison système d'information géographique - analyse statistique représente un outil puissant pour l'analyse spatiale.

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Abbreviations and Terminology

Chinese terms, transliterated according to the Pinyin system, are in brackets.

SSBC	The State Statistical Bureau of China (Guojia Tongji Ju)
DREMAC	The Department of Rural Enterprise of the Ministry of Agriculture of China (Nongye Bu Xiangzhen Qiye Si)
SCC	The State Council of China (Guowu Yuan)
RMRB	People's Daily (Overseas Edition) (Renmin Ribao, Haiwai Ban)
NOCPUCC	The National Office of Census of Population Under the State Council of China (Guowu Yuan Renkou Pucha Bangongshi)

Units of measure

RMB Yuan	Currency unit. RMB (Renminbi) stands for People's Currency. CAN \$1 = RMB Y1.42.9 (1981) (SSBC. 1981. p.393) CAN \$1 = RMB Y3.0188 (1988) CAN \$1 = RMB Y3.1773 (1989) (SSBC. 1990. p.652) CAN \$1 = RMB Y4.0946 (1990) CAN \$1 = RMB Y4.6335 (1991) CAN \$1 = RMB Y4.5731 (1992) (SSBC. 1993. p.646) CAN \$1 = RMB Y6.3617 (1994) (RMRB. March 19, 1994)
Mu	Area unit. 1 mu = 0.1647 acres = 0.0667 hectares

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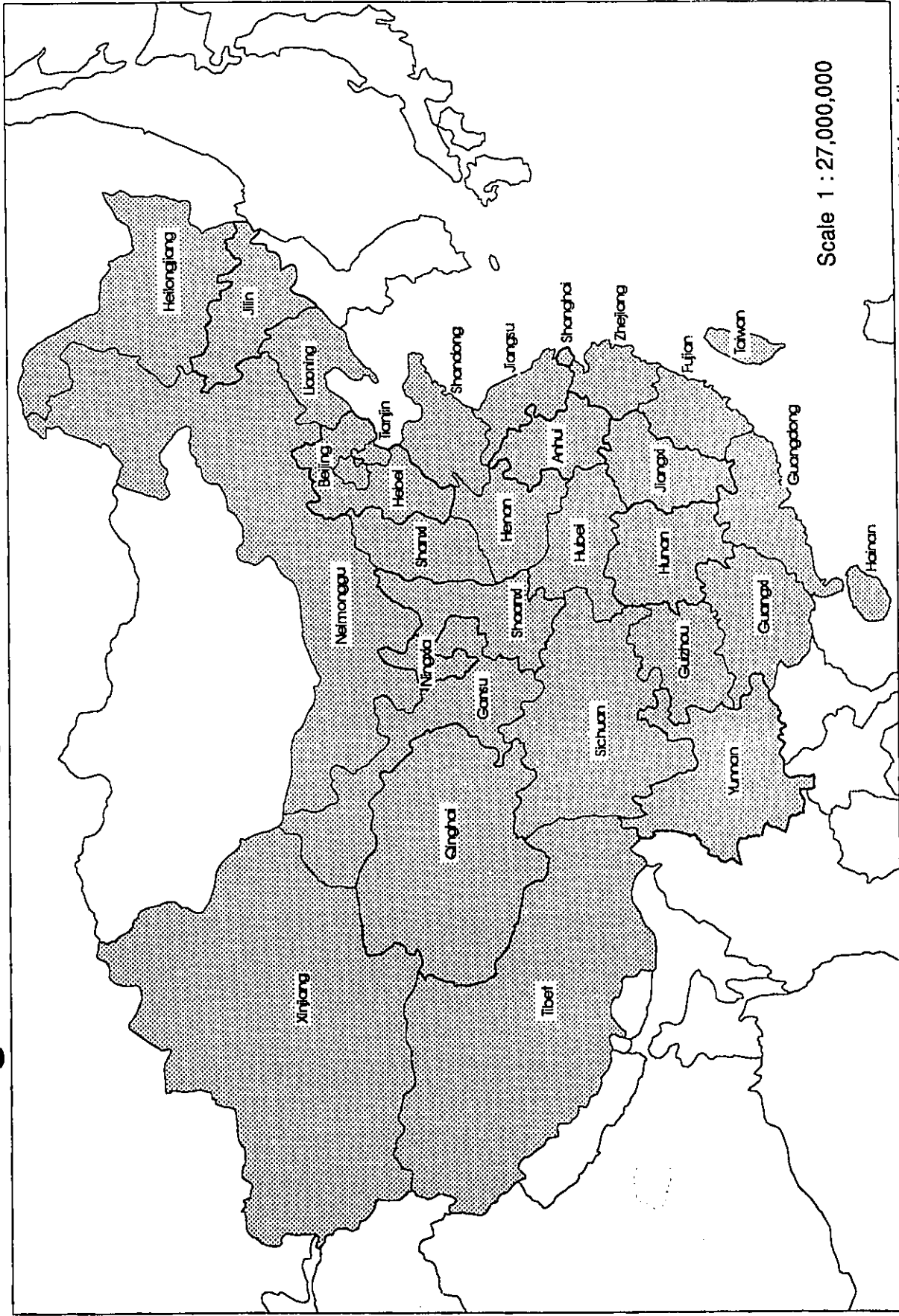
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I. Introduction

The restructuring of the world economy presently underway is touching every national economy to some degree. One of the fundamental changes is the market oriented restructuring in the formerly centrally planned economies. This phenomenon is changing international economic relations, the global political map, and the spatial organization of national economies. China, often cited as the envy of socialist countries, has been introducing fundamental reforms for 16 years. This reform, which is described as the 'second revolution' by Deng Xiaoping, has accelerated China's economic growth. Among its effects it has integrated China more and more into the world economic system, has created a fast growing market economy in which rural industry is the most important representative, and has changed national industrial structures and the characteristics of industrial distribution.

China's experience is interesting not only because it throws light on the link between political shifts and industrial change, but also because it promises to enhance our empirical understanding of the interaction between the core and the periphery and in particular impacts on a reforming socialist country. This research has analyzed the effects of China's market oriented reform on the spatial form of rural industrial development in China. Fig I-1 shows the study area: the People's Republic of China.

Fig I-1 The People's Republic of China



Source: China Cartographic Publishing House, 1990. Map of the People's Republic of China. Beijing: China Cartographic Publishing House.

1. Rural Industry - the Largest Market Economic Sector in China

In a socialist country, the market economy can be defined mainly by ownership, plus its relation to the central plan, and the management authority of products and workers. Although China's rural industry¹ has existed since the foundation of the People's Republic of China and had some booming periods between 1949 and 1978, it has no publicly owned (or state owned) enterprises, and has existed outside the central plan system. No matter who owns² it, rural industry's production is adjusted by market conditions and its survival depends on profit. These characteristics clearly classify China's rural industry as a market economic sector.

China's market economy has sectors besides rural industry: urban collective owned, privately owned, jointly owned, and foreign owned enterprises. According to the statistics, the industrial output of a market economy accounted for 51.9 percent of the national total of industrial output in 1992. Within the market economy, rural industry produced 62.6 percent of the industrial output in 1992, which almost doubled the output from all of other three market economic sectors. In 1993, rural industry itself had 37 percent share in national total industrial output, and the share

¹ In this research, rural industry includes all peasants (agricultural residents) owned industrial enterprises that are township owned, village owned, below the village level's community owned, jointly owned and private industrial enterprises. Rural construction, transportation and non-farm activities other than industry are not included. A detailed explanation will be given in Chapter 3.

² Please refer to footnote 1.

was 5 percent more than that in 1992. It is very obvious that rural industry is the largest and most important market economic sector in China. "Without rural industrial development, the achievements of China's economy would not be possible" (RMRB. November 29, 1994).

2. Rural Industry - the Fastest Growing Industrial Sector

China's rural industry, which is an important sector of the market economy, has experienced very rapid growth since 1978 (Graph I-1), and has developed in almost all of the industrial sectors³ in 1989 (Graph I-2). There were 58 million labourers engaged in rural industries in 1991 which accounted for a 300% increase since 1980. The 7.4 million rural industrial establishments in 1991 accounted for a tenfold increase since 1978.

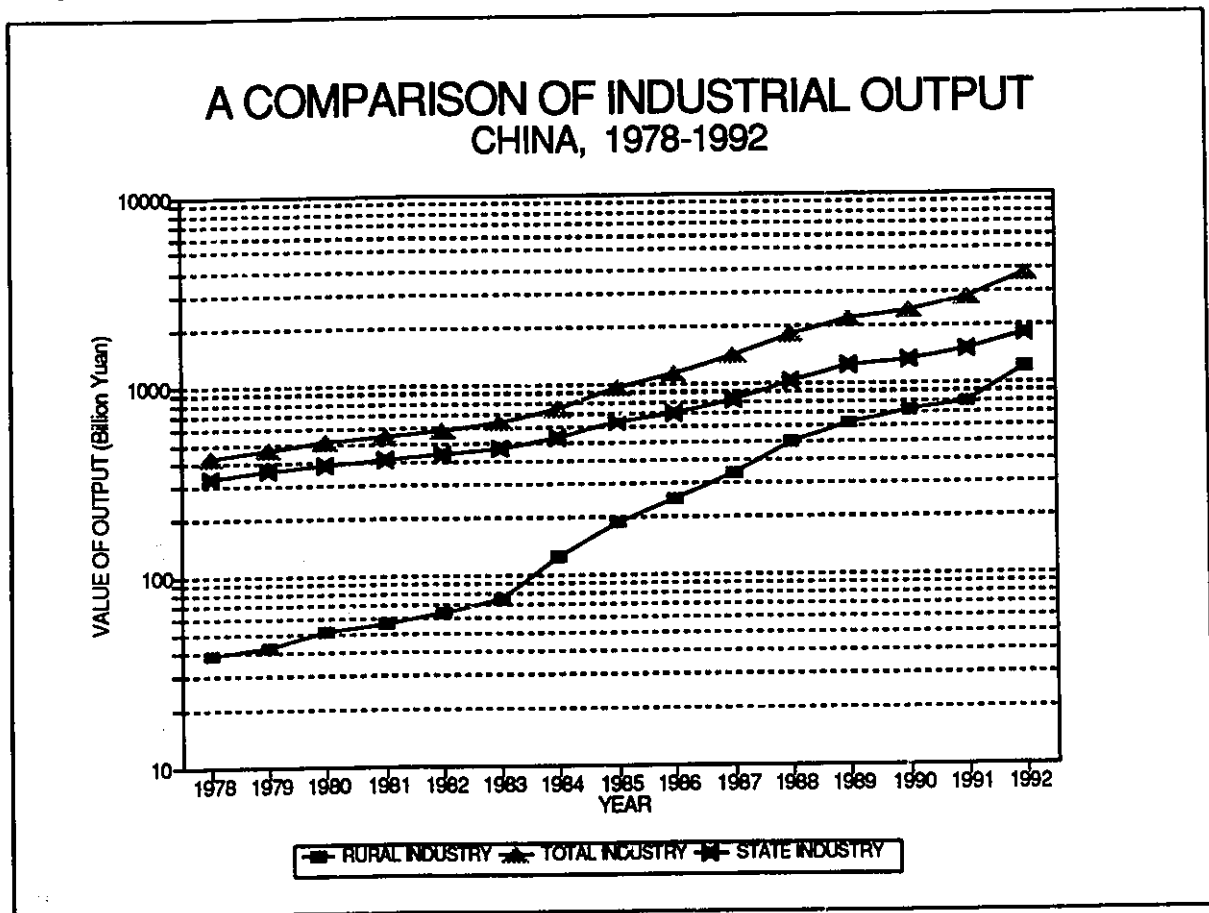
Rural industrial development, its relationship with modern industry, its spatial distribution, and its influence on the regional economy reflect the characteristics of market economic development in China. It has become an important economic phenomenon and has drawn much attention lately.

³ China's industry includes 40 sectors that can be classified to five categories:

1. Extraction of natural resources, including mining and lumbering.
2. processing of agricultural products.
3. Manufacture of industrial products.
4. Repair of capital goods.
5. Electricity generation and supply, water purification, and gas production.

Source: State Statistical Bureau of China (SSBC). 1989. China Urban Statistics 1988. New York: Praeger, p.xiii.

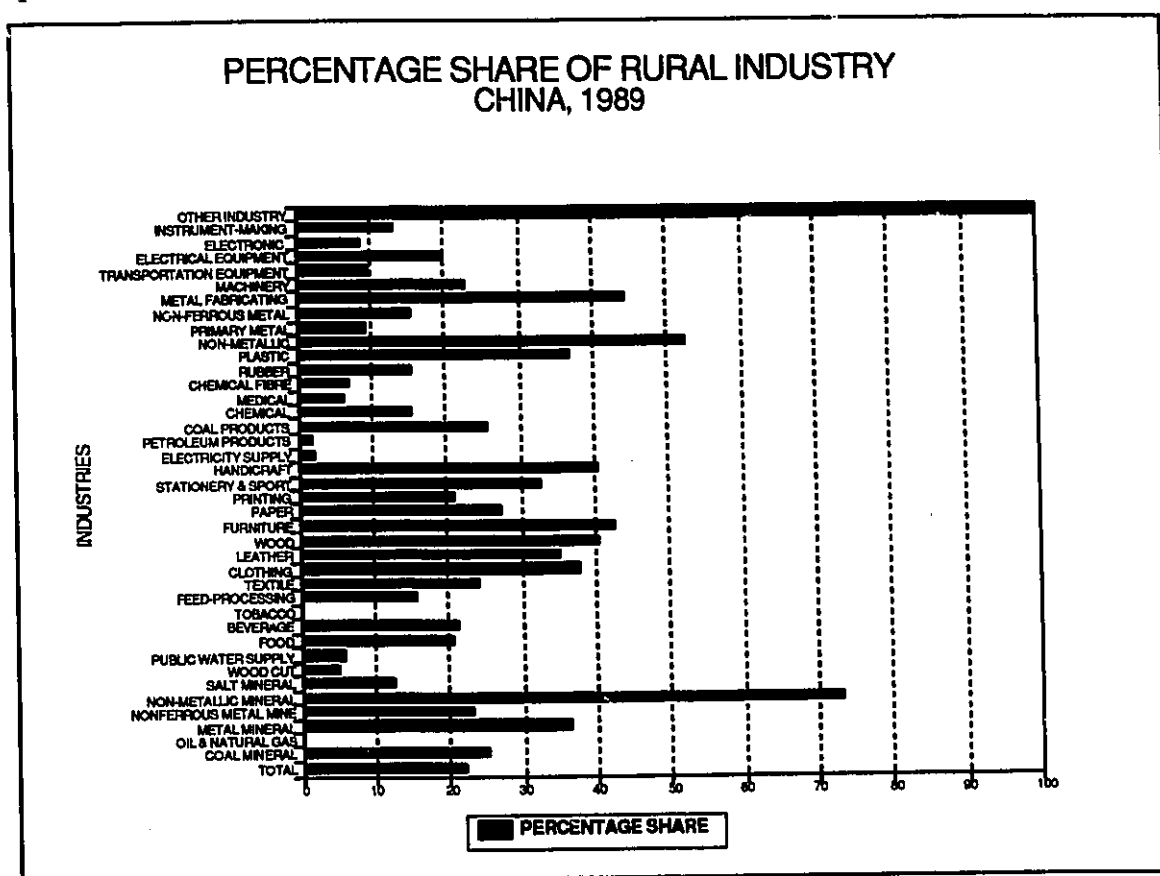
Graph I-1



Source: SSBC. 1993. China Statistical Yearbook 1993. Beijing:
China Statistical Publishing House, p.409.

Source: SSBC. 1990. China Statistical Yearbook 1990. Beijing:
China Statistical Publishing House, p.413.

Graph I-2



Source: SSBC. 1990. China Statistical Yearbook 1990. Beijing:
China Statistical Publishing House, pp.426-440.
DREMAC. 1990. China Rural Enterprise Yearbook 1990.
Beijing: Agricultural Press. pp.153-155.

3. Rural Industrial Development in Space

Since decentralization has been a deep concern, China's regional development and urbanization policies are distinctive in that there are strict controls on migration from backward regions to developed regions, from small cities to large cities, and from rural to urban areas. China's rural industrial location policy is further evidence of the concern. The policy only allows rural industry to be built within the community that the owner lives or in a market town near his community but not in the city proper. Rural workers and their dependents are only allowed to move into a market town with their grain ration for employment (State Council of China, 1984). The best expression of the policy is the government slogan "leave the land but not the countryside, enter the factory but not the city."

Although China's rural industry has much less spatial freedom than those in other countries, it faces similar types of market competition. Since 1949, rural industry is the first national scale industrialization to leave the decision to millions of individual entrepreneurs. The spatial distribution of rural industry not only reflects the characteristics of rural industry itself, but also the regional disparity, and the influence of different cores on their respective peripheral regions.

Although there has been a considerable volume of research on rural industry recently, only a few studies have dealt with the spatial distribution of rural industries and the relationship

between regional characteristics and rural industrial development. Among those studies, very few quantitative analyses have been realized at the provincial level due to the lack of data. Most studies dealt with the relationship between rural industry and regional characteristics and are based on examples. Obviously, there was more that can be done on the topic of regional characteristics and rural industrial development after the 1989 rural industrial data were published.

At the regional level, most studies on small town development and the rural economy have dealt with the rural industrial development issue, but none of them has done an in depth analysis on the distribution of rural industry and the relationship with regional characteristics. Much remains to be done.

4. Objectives and Hypotheses

There are three objectives of the research. The first objective is to reveal the spatial distribution pattern of rural industrial development in China at both the provincial and regional levels. The second objective is to identify and analyze the relationship between rural industrial development and regional characteristics. The third objective of this research is to compare rural industry with state-owned industry, and provide a better understanding of the core periphery relationship and the development of the market economy in a reforming socialist country.

Based on the assumption that rural industry is a market

economic sector in China, this research has tested two major hypotheses to reveal the similarity of market economic development in China and in other market economies.

First, according to behaviour theory, a large number individuals making random decisions at a certain point in time, the spatial distribution of the survivors should represent viable, or even optimum location patterns, even if the decision makers themselves do not know the location conditions of success or try to achieve them by changing locations (Alchian, 1950; de Souza, 1990). Since the development of China's rural industry is the result of a large number of individual decisions over the last 16 years, the spatial distribution should represent viable or even optimum location patterns at certain level.

Second, as a market economic sector, rural industrial development should be strongly influenced by market forces but not by government policies. There is a prior ground for expecting rural industrial activities to be developed more, in more economically developed areas. In this research, the developed region is assumed to have a higher agricultural productivity, more surplus labour and financial funding, a larger market, better industrial infrastructure, transportation facilities, and an educated labour force. These two hypotheses will be tested at both the provincial and regional levels.

5. Methodology Overview

The spatial analyses have been done using statistical methods and GIS (Geographical Information System) map overlay methods.

At the provincial level, this research uses a group of indicators to measure rural industrial development level. A factor analysis is applied to regroup the indicators in order to avoid the redundancy among those multiple indicators using the SAS⁴ system. The result shows the distribution of rural industry and the development stages of rural industry. The relationship between rural industry and regional characteristics is analyzed using a multiple regression method. The result identifies the regional indicators which have had significant influences on rural industrial development, and the relationship with rural industrial development. The hypotheses are tested by this analysis.

At the regional level, the Beijing Municipality is selected as a case study because of the variety that Beijing covers both on the rural industry and the regional characteristics, the highly centralized control of Beijing which may show the influence of government policies, and the availability of detailed data and base maps. This research uses a GIS map overlay methods from PC ARC/INFO⁵ combined with statistical analyses of the final output.

⁴ The SAS[®] system is an integrated system of software providing complete control over data management, analysis, and presentation (SAS Institute Inc. 1988. p.ii).

⁵ ARC/INFO and PC ARC/INFO are registered trademarks of Environment Systems Research Institute, Inc. Redlands, CA. USA (ESRI.1990). ARC/INFO is a geographic information system used to

The optimum region for rural industrial development can be selected according to the criteria established from the hypotheses. The relationship between Beijing's rural industrial development and regional characteristics is shown visually by the final map from the GIS map overlay and quantitatively by the two way frequency table from the statistical analyses.

6. Data and Base Maps

The data used in this research are mainly from published statistics and census data in 1989 and 1990. The secondary data source are the interviews during the field work in 1991. The major base maps are those maps published by China Cartographic Publishing House in 1990 for Beijing and 1989 for the whole country. The books, journal articles, documents, magazines, newspapers both in English and Chinese provide the bases and also the supplemental data and information for the research.

At the provincial level, the first statistical yearbook for rural industry, China Rural Enterprise Yearbook, 1990, made the quantitative analysis at this level possible⁶. This yearbook is

automate, manipulate, analyze and display geographic data in digital form (ESRI. 1990. p.1-1).

⁶ Rural industrial data in the previous statistical yearbook had different definitions and was disaggregated at the provincial but not at the industrial sector level. Before 1984, only the town and township level's rural manufacturing industry was defined and reported by industrial sector, while rural manufacturing below town and township level was aggregated with all of the other non-agricultural sectors such as transportation, construction, and services. From 1984 to 1988, rural industry was defined and

compiled by the Department of Rural Enterprise of the Agricultural Ministry of China and covers all of the rural industrial activities. The statistics in this yearbook are broken down into many categories at the provincial level. Another important statistical yearbook series is "China Statistical Yearbook" which is compiled by the State Statistical Bureau of China. The regional indicators for the provincial level analysis are mainly from this yearbook series. The third statistical source is the Major Figures of the Fourth National Population Census of China compiled by the National Office of Census Population Under the State Council of China. Other statistical publications consulted during the research, such as the China Urban Statistics series, the China Rural Economic Statistics: County Areas series, the China Industrial Statistical Yearbook series, the Census Manufacturing of China 1985. The precision and reliability of the statistics can vary among these statistical sources and have been checked and discussed in the chapters where the data are used. Generally speaking, the quantity and quality of published statistical data in China has improved considerably since the economic reform in 1978, and the quality of 1989's data used by this research are acceptable.

reported at the village and township level. It still left those below the village level, as well as the private, and jointly owned rural industries from the industrial statistics. Although the complete rural industrial data do exist internally, its confidential status prohibited any public use of the data. After 1989, did the Chinese government start to publish complete rural industrial data which include all of rural industrial activities, and broken down by industrial sector at the provincial level. It is this statistical series that made this research available.

At the regional level, Beijing's rural industrial output data at the township level, and the census of population data are the major statistical data sources. The reliability and precision of census data are very good according to the Census Office of Beijing. Compared to other available indicators, rural industrial output in Beijing is the best indicator of rural industrial development in terms of coverage and reliability. Although the data quality is not as good as state owned industry, it is better than rural industrial data at the regional level from most provinces, and therefore, has been used for this research. The base map used for Beijing's case study is a 1:600,000 topographic map compiled and published by China Cartographic Publishing House in March, 1990. Other maps such as the administrative map, geomorphology map, highway system map, and railway network map are supplemental maps for the research. China Cartographic Publishing House is the authorised map publisher in China, and the maps published by them are usually more precise and reliable than other map publishers in China. Fortunately, the cultural features plotted on the map date from March, 1989, which is the year that the rural industrial output data were available. During the field work in 1991, the author visited three levels' of government rural enterprise bureaus which are the provincial, county and township level. The author also visited rural industrial enterprises in Beijing, and obtained information from the Department of Rural Enterprise of the Ministry of Agriculture of China, research institutes, universities, and publishers. The information from the interviews and visits turned

out to be very important to the research. All of those data, information, and maps made this research possible.

7. Organization of the Dissertation

There are three major sections of the research: the general introduction and theories, provincial level analysis, and regional level analysis. The dissertation is organized into eight chapters.

The first chapter gives an introduction to the research, describing why and how the project is carried out, the main hypotheses, methodologies, and structure of the dissertation. The next chapter provides a general overview of the causes of the reforms in China, contents of the market-oriented reforms, and the effects of opening up to outside world. Chapter III describes the role of rural industry in China's growing dual economy, including the definition of China's rural industry, China's industrial administrative system, and the relationship between the state owned and rural industrial sectors. Chapter IV reviews Chinese regional development policies, rural industrial location policies using core periphery theory. The major literature is reviewed at both the provincial and the regional levels, and the hypotheses are introduced in the chapter.

The provincial level analysis is presented in chapter V and chapter VI. The unbalanced spatial distribution of rural industrial development is analyzed in chapter V using a factor analysis method on 12 rural industrial indicators. Three factors that represent

rural industrial development level are generated from the analysis. The typology of rural industrial development is also discussed in the chapter. Based on the result from chapter V, the relationship between rural industrial development and regional characteristics has been revealed using regression analysis among the three rural industrial factors and 19 regional indicators.

In chapter VII, Beijing's case is analyzed using a GIS map overlay method using PC ARC/INFO and combined with statistical analysis of the final output. At the end, chapter VIII summarizes the whole dissertation. In addition, there are five appendices attached to the dissertation: China's administrative hierarchy, definition of the city, list of statistics and maps, glossary of major indicators, and tables and figures.

II. China's Market Oriented Reform

China's economic reforms include two major components. Internally, market forces were introduced into the formerly centrally controlled economic system. This had an effect on the composition of industrial ownership, the relationship between state owned industries and other industrial sectors, and the spatial distribution of industries. Externally, an open door policy has been adopted and has changed China's position in the global system and the relationship with other countries. A brief review of China's economic reforms is given below.

1. The Causes of Chinese Reforms

The most significant differences between a centrally planned economy and a market economy is that a central plan replaces the dominance of the capitalist law of value, and public and collective ownership replaces private ownership. In a centrally planned economy, market competition is eliminated, and economic activity is administered directly by the government rather by individual entrepreneurs. Although it was thought that the capitalist inequality and waste could be eliminated and a high level of saving, investment, and growth could be achieved (Nolan, 1990), a centrally planned system did not produce those results in China or in any other centrally planned economy.

(1) Centrally Planned Economy and Shortages

Because perceived shortages are the major factor in a centrally planned economy, the adjustment always lags behind the perception, and therefore the lack of materials and products becomes a universal phenomenon. In addition, given the rigid planning system, strictly controlled markets, universally fixed prices, any merchandise in China became "the emperor's daughter who never had to worry about marriage". Hence, motivation was eliminated for most firms to improve their products, to maintain the goodwill of their customers, or to develop new markets.

(2) Public Ownership and Productivity

It was also thought that if one continuously 'upgraded' the relations of production (or ownership), productive forces would develop automatically to suit these newly formulated relations. But in China, public ownership actually disconnected people's income from productivity and profit, so nobody really took the responsibility if a financial loss was incurred in an enterprise. In rural areas, collective ownership and the work points system⁷ eliminated people's initiative, responsibility, and decision making.

⁷ Work points system: Peasants worked on collective owned farm. They earned work points, which is a unit indicating the labour performance in people's communes, from their daily work and received payment at the end of the year according to the points they had. The value of work point was counted at the end of a year and was the same in one community (brigade or production team) depending on agricultural output in the community.

In fact the system was unfair to those who made the greatest contributions (Rodzinski, 1988, p.103).

(3) Dominant Political Movement and Class Struggle

Since Mao always emphasized that the economy had to be subordinated to the class struggle, "a continued and artificial expansion of the class struggle occurred instead of a timely shift to economic construction after the socialist transformation in 1950s" (Lu, 1989, p.162). It reached its peak during the Cultural Revolution, where resources were squandered in struggles and conflicts, and people were driven away from economic construction. These events greatly aggravated the economic situation. The result was a significant lowering of productivity. The lack of quantity and quality of goods had reached such a level that per capita income in rural areas in 1978 was only Y74.7⁸, grain rations were 180 kg/year, person and more than 100 million rural people did not have enough food (Gao, 1991, p.86). In 1978, the shortages in urban areas was also serious. Many necessities were rationed such as grain, vegetable oil, cloth, cotton, meat, eggs, furniture, etc. In Hua Guofeng⁹'s words, the economy was 'on the brink of collapse'.

⁸ Y: RMB Yuan, Chinese currency unit. Please refer to Abbreviation and Terminology for exchange rate.

⁹ Hua Guofeng: The Chairman of the Communist Party of China and the Military Affair Commission in 1976.

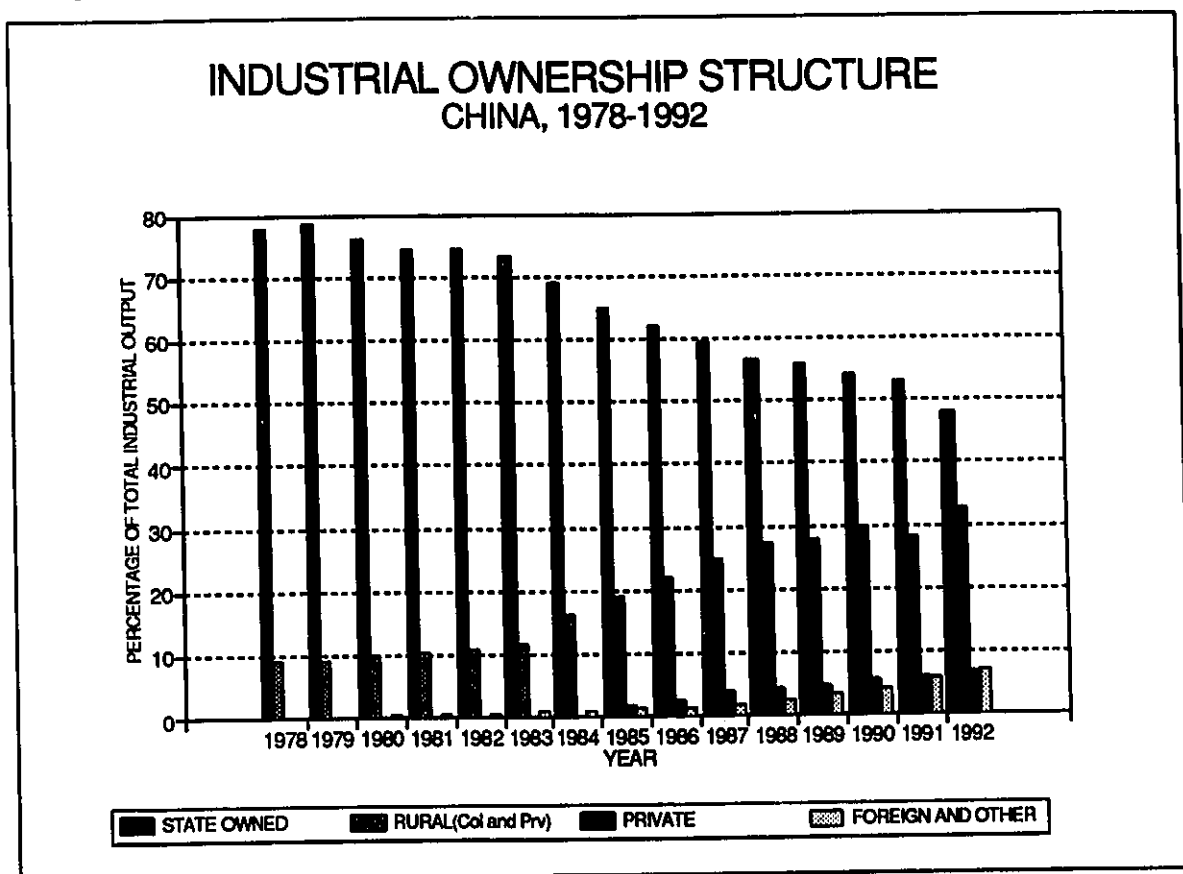
2. Market Oriented Reforms

Since the centrally planned model failed to meet the demands for goods and services, economic reforms became necessary in the middle of 1970s. After 1976, Mao's death provided the opportunity to make changes. China's economic reforms started in 1978. The Third Plenary Session of the 11th Central Committee of Chinese Communist Party was considered the corner stone. These reforms have since changed almost everything in China. Fundamental changes, such as ownership composition, and the reintroduction of market forces, were among the most influential.

(1) Reforming the Composition of Ownership

After 1978, China lifted the ban on private ownership and foreign investment, and rural household farming, which were forbidden from 1958-1978. As a result, in 16 years, China's economic structure has changed from an almost pure public and collective ownership, and centrally planned economy to one of multiple ownerships and a dual economy. The change of industrial structure is presented by Graph II-1. The percentage of state owned industrial output dropped from 77.6% in 1978 to 48% in 1992 (SSBC. 1993, p409), a very significant change.

Graph II-1



Source: SSBC. 1993. China Statistical Yearbook 1993. Beijing:
China Statistical Publishing House, p.409.
SSBC. 1990. China Statistical Yearbook 1990. Beijing:
China Statistical Publishing House, p.414.

Since 1992, China has encouraged the selling of shares in state owned industry. The "Experimental Regulation of a Stock Enterprise" was issued by central government in May 15, 1992 (RMRB. June 19, 1992). Up to October 1993, 3,800 formerly state owned enterprises have changed ownership, 124 enterprises have sold their stock on Shanghai and Shenzhen's stock market, and 9 enterprise' shares have been sold on the Hongkong's stock market (RMRB. October 25, 1993). When this policy is applied on most of state owned enterprises, the composition of ownership will be greatly changed.

(2) Decline of the Role of the Central Plan and Growth of Market Force

Before 1978, the production, allocation, and prices of all major industrial and agricultural products were controlled directly by the government hierarchy. Economic enterprises outside the scope of the plan could neither purchase materials controlled by the plan nor sell their products through centrally controlled commercial channels. The system was dominated by the government and was quite rigid.

The initial reforms first reduced the numbers and quantity of commodities from mandatory planning and created a better market environment for all producers. The number of industrial commodities controlled by mandatory planning was reduced from 120 in 1980 to 60 in 1988. The allocation of machines and equipment by the central government, was reduced from 256 categories in 1980 to 27

categories in 1988. The proportion of material supplied by the central government dropped from 70% in 1980 to 13.8% in 1992. (Gao, 1991, p.375, RMRB. December 21, 1992) Three channels for the circulation of commodities were established: a) mandatory planning (a shrinking proportion); b) guidance planning (the state encourages production through the various economic levers); 3) the marketplace (the state intervenes through indirect ways such as price). Economic reforms also modified the price system to give market forces a greater role in the determination of prices. Three categories of prices have been established: fixed price (for goods that are controlled by mandatory planning and sold to state owned industry); floating prices (government sets the range of the price but the exact price is determined by market or negotiation); market price (applied on many small consumer goods and agricultural goods, the price determined by market competition (Harding, 1987, pp.108-111). In the late 1980s, China also started to establish other markets such as a stock market, a labour market, a technology market, an estate market to push forward market-oriented reforms and to promote the market's role in China.

3. Opening to the Outside World

China, as the most populous country in the world, was relatively isolated as a result of the Sino-Soviet split in 1950's and the Cultural Revolution from 1966 to 1976. The introduction of market principles and the opening-up of the Chinese economy have

integrated China gradually into the international economy after 1978. The major changes in policy are the relaxation of central control on the import and the export of goods, allowing foreigners to invest in China, sending students to developed countries, and inviting specialists to work in China. As a result, China's role in today's global economic system is becoming more and more important.

Foreign trade after 1978 has increased rapidly in the last 16 years. The total value of imports and exports increased as much as eight times from US\$20.6 billion in 1978 to US\$165.6 billion in 1992. The largest trade partners in 1992 were Hong Kong (US\$50.85 billion), Japan (US\$25.38 billion), The United States (US\$17.49 billion), and Taiwan (US\$6.58 billion) (SSBC. 1993, pp633-640). These countries and regions counted for 60.6% of China's foreign trade value and are located in one of the world's most dynamic areas - the Pacific Rim. The growth of trade value between China and those countries and regions is making the Pacific Rim much more dynamic. Other countries such as Germany, South Korea, and Russia, had a trade value about US\$5 billion with China in 1992.

During the last 16 years, the composition of exports has changed to more manufactured goods than raw materials. China's manufactured export share accounted for 53% of the total exports in 1981, and increased to 80% in 1989. Except for the high export share of textile products (21% in 1981, 13.1% in 1989) which is in common with other low-income countries such as India, Pakistan, and Kenya, China's manufactured export share was similar to some upper-middle-income countries such as Brazil, Mexico, Chile. On the other

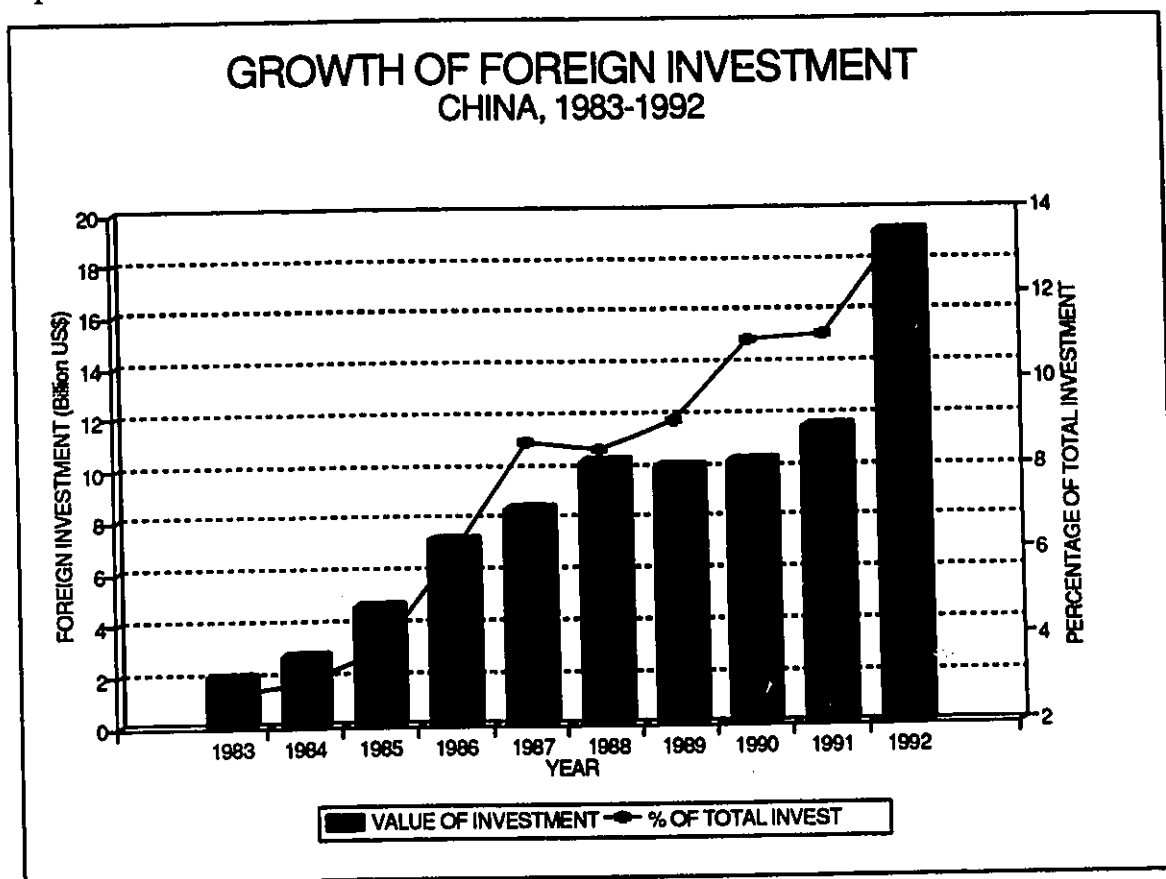
hand, the value of manufactured goods counted for 64% of China's total imports in 1981, and 83.5% in 1992 (SSBC.1993,p.634-635). These changes have stimulated manufacturing production in China, attracted new technology and equipment for the country, and have given China a more important position in the world's economic system.

After 1978, joint ventures and foreign owned enterprises have become one of the most active participants in China's economy. China has gradually relaxed the restrictions on the regions and the sectors in which foreigners can invest. Presently, 919 counties and cities and most of the industries are opened up to the outside world (RMRB. July 9, 1993). More and more multinationals are opening businesses in China. Northern Telecom of Canada has invested in eight provinces in China in 1993. When foreigners were allowed to invest in the retail industry, Hudson's Bay of Canada started building a chain of stores across China at the beginning of 1994. Graph II-2 shows the increase in foreign investment from 1983 to 1992. As a result, the value of output of foreign investment in industries in 1991 increased from 0 in 1979 to 122.1 billion RMB Yuan (5% of total industrial output) in 479 Chinese cities (SSBC, 1992, p.202). Although foreign investment is only a small portion of China's economy, this investment has brought about many changes such as new standards, and regulations. Laws were passed to create a compatible business environment for those enterprises. Government and industrial entrepreneurs are learning how to deal with those foreigners. And people are trained to work in the enterprises. The

experiences of those foreign owned or jointly owned enterprises open a window to both the Chinese and the outside world so that each knows each other better. It also serves to integrate China more into the world economy.

This chapter has reviewed briefly the causes of the market-oriented reforms within China, and the effects of opening up to outside world. Those fundamental reforms are changing China's role in the world economic system, and also the overall economic system within China.

Graph II-2



Foreign Investment 1983-1992

Year	Foreign Investment US\$ Billion	RMB Yuan* Billion	Total Investment Billion Y	Percentage of Foreign Investment
1983	1.98	4.02	143	2.8%
1984	2.71	5.49	183.3	3.0%
1985	4.65	9.53	254.3	3.7%
1986	7.26	18.15	301.9	6.0%
1987	8.45	31.36	364.1	8.6%
1988	10.23	37.94	449.7	8.4%
1989	10.06	37.72	413.8	9.1%
1990	10.29	49.08	445.1	11.0%
1991	11.55	61.35	550.9	11.1%
1992	19.2	105.61	785.5	13.4%

* Calculated according to each year's exchange rate.

Source: SSBC. 1993. China Statistical Yearbook 1993.

Beijing: China Statistical Publishing House, p.145,647.

III. Rural Industry in China's Growing Dual Economy

China's economic reforms have stimulated the growth of the market economic sector. The economic system has also been changed from a command economy to a more balanced dual economy. A dual economy is formed by two types of industrial sectors, core and periphery, modern and traditional. Researchers have defined a dual economy variably in different economic systems such as the Third World (Boeke, 1953; Lewis, 1958; Armstrong and McGee, 1985), and socialist countries. In China, the growth of the dual economy has reformed China's overall economic system greatly. As a representative of the peripheral or market sector, rural industry's characteristics and the relationships with the core or state owned industrial sector will be discussed in the chapter.

1. Concepts of a Dual Economy in Socialist Countries and China's Economic System

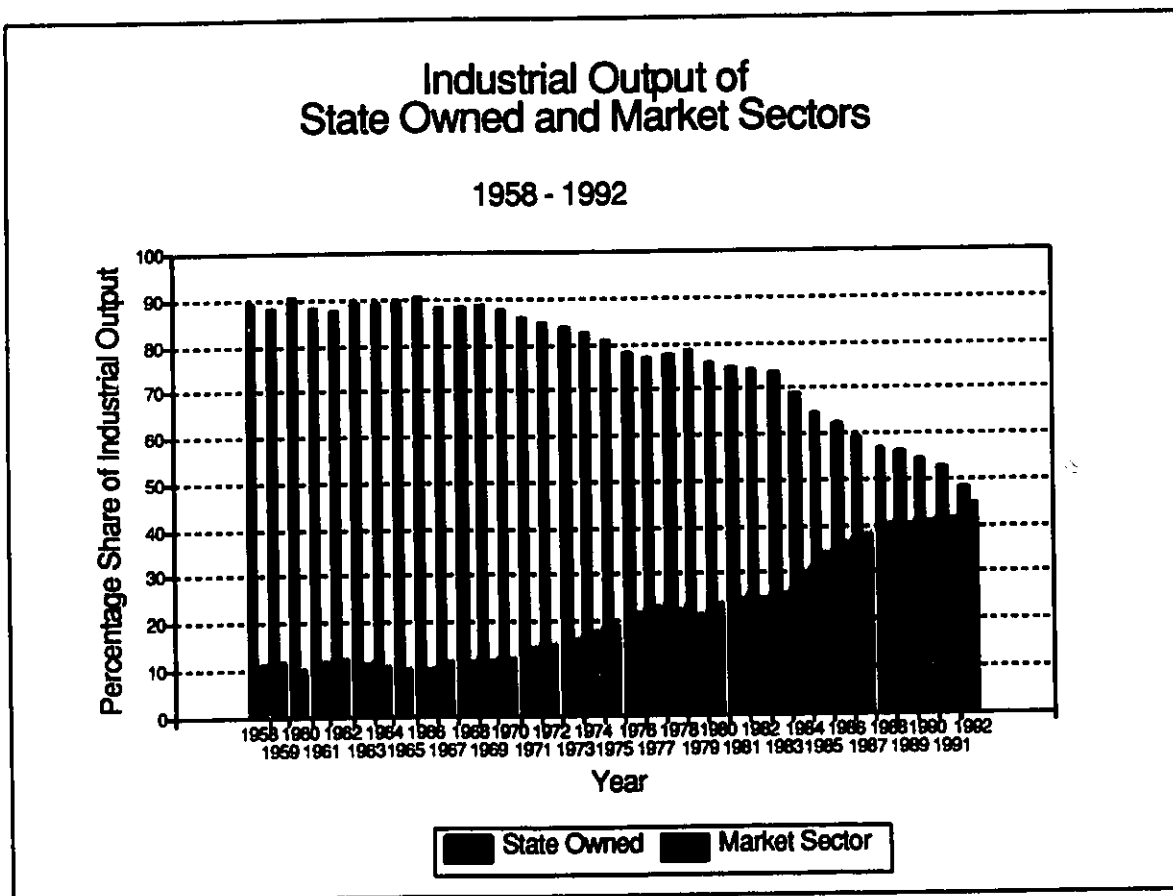
A dual economy exists in socialist countries. Los, in her book "The Second Economy in Marxist States" (1990, p.2), defined the second or market economy in socialist countries by the ideological criteria, which is ownership status of the economic activities. According to Marxist ideology, the public ownership should be the only ownership in a socialist country, any other ownership such as collective, joint, and private can be allowed to exist only during the transition period and should be upgraded to public ownership as

soon as possible. In other words, the second economy is a set of "economic activities that are inconsistent with Marxist ideology, and the activities that are formally legal but ideologically suspicious and therefore officially discriminated against and assigned a clearly inferior status" (Los, 1990, p.2).

Similar to other socialist countries, China had the same economic model for 30 years. China, however, had a much larger proportion of rural people who worked in a collectively owned commune than in other socialist countries. The central control of economic activities in rural area was not as tied as that in an urban area. In the industrial sector, state owned enterprises dominated the economy and got privileges from the central plan in a very broad way. On the other hand, the second or market economy, whose ownership is not public, was allowed to exist for providing goods and services that was insufficient at the local level. The discrimination and inferior status of those firms was clearly assigned with respect to access to raw material, equipment, market, and the employee income. Graph III-1 shows the proportion of industrial output produced by state owned firms (the core sector), and the market sector (which includes collective and private ownerships), from 1958¹⁰ to 1992. It is very clear that the state owned industries dominated more than 75% of the production capacity for 20 years from 1958 to 1978. After 1978, the second or market sector grew rapidly and produced as much as 45% industrial output in 1992. Since the modern sector is still dominated by state owned firms, the basic dual economy model has not been changed. The interaction between these two sectors is a major force which forms or reforms the economic system.

¹⁰ The socialist transformation of capitalist industry and commerce at ownership was finished in 1956. Before 1956, the percentage of industrial output from private and jointly owned firms was as high as 50%.

Graph III-1



Source: SSBC. 1993. China Statistical Yearbook 1993. Beijing:
Statistical Publishing House. p.414

2. China's Market Sector

(1) Sectors within the Market Sector

As discussed above, the market sector in China includes Chinese owned industrial activities in non state owned firms, such as collectively owned, privately owned, and jointly owned firms.

Collective ownership is officially accepted and has existed in a parallel fashion with the centrally planned economy for more than thirty years. Discrimination in this sector is obvious. Those firms normally can not get investment from government; can not gain access to centrally controlled resources; employee's income and benefits are lower than those in state owned firms. Private ownership, which was very strictly controlled after 1958, and completely forbidden during the Cultural Revolution, was reintroduced after 1978. Both of them are legal sectors and have been the most dynamic sectors in the market-oriented economic reform since 1978. Their emergence and development have helped to reduce shortages of goods and services and absorbed as well the surplus labour both in rural and urban areas. In 1992, 54.6 million people worked in these two sectors, and 44.8% of the industrial output was produced by the sector. Within the peripheral or market economy, Table III-1 defines the characteristics of those industries.

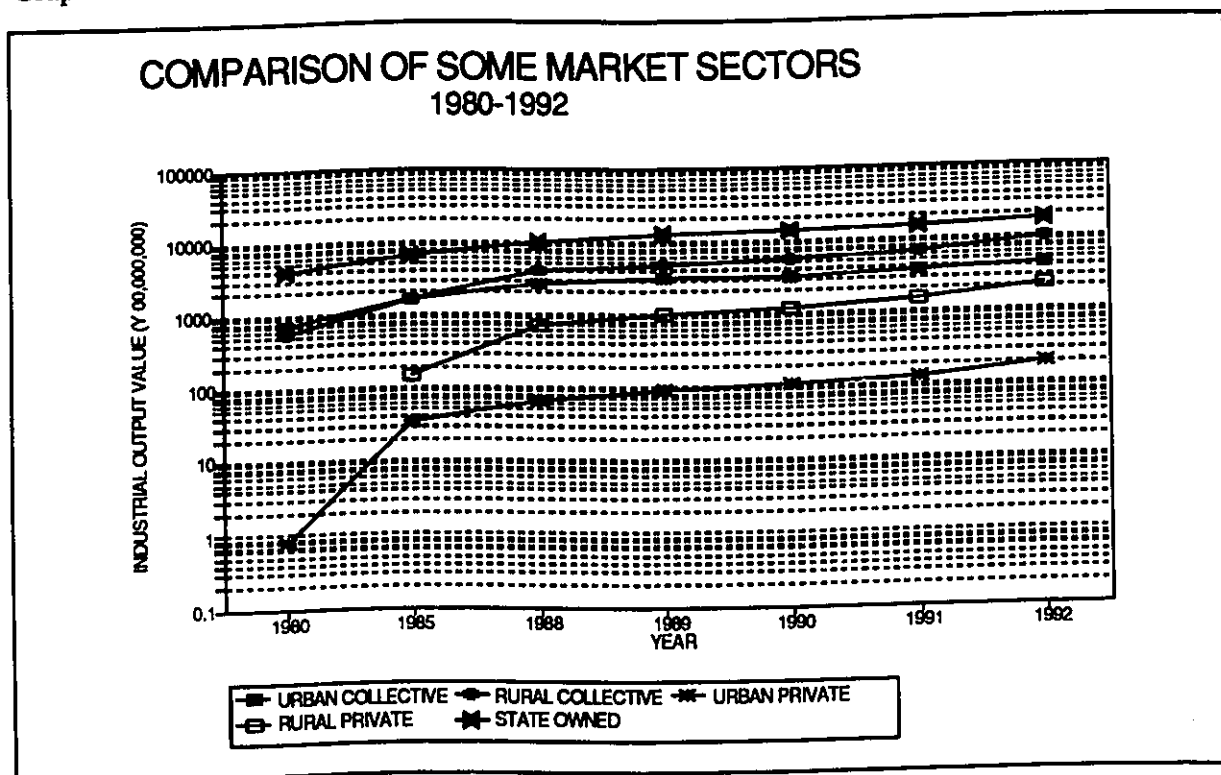
Table III-1 Comparison of Some Market Industrial Sectors in China

Ownership	Collective	Collective	Private	Private
Location	Urban	Rural	Rural	Urban
Relation with central plan	Some are within the central plan	Outside the scope of the central plan	Outside the scope of the central plan	Outside the scope of the central plan
Scale	Medium and small	Mainly medium and small, a few large	Small	Small
Stability	Stable	Relatively stable, township owned is better than village owned.	Not stable	Not stable
Autonomy	Controlled mainly by government hierarchy	Controlled by rural community's government or committee	Private	Private
Owners and Workers	Urban residents only	Rural residents	Rural residents	Urban residents
Wages and bonuses	follow the state wage system for collective industries	Can be decided by the collective owner, basically wage plus year end bonus	Decided by the owner and negotiable	Decided by the owner and negotiable
Benefit	Less than state owned industry	Largely non-existent	Non-existent	Non-existent
Statistics	Standard	Township industry is Standard, village industry is basically acceptable.	Available but not very reliable	Available but not reliable
Policies since reform	Similar to state owned industry	Many favourable policies but some restrictions also	A few favourable policies and more restrictions	A few favourable policies and more restrictions
Rate of development	Similar to state owned industry	Rapid	Rapid	Rapid

Source: The indicators and descriptions are generalized from:
 Armstrong, W. and T.G. McGee. 1990. Theatres of Accumulation. London: Methuen, 1985
 Los, Maria. Ed. The Second Economy in Marxist States. London: The Macmillan Press Ltd.
 Portes, A., M. Castells and L. A. Benton. 1989 The Informal Economy. Baltimore: The Johns Hopkins University Press.
 Byrd, William A. and Lin Qingsong. 1990. China's Rural Industry. World Bank: Oxford University Press.
 State Planning Commission. 1987. A Compilation of Important Economic Regulations 1979-1986. Beijing: Statistics Press.

The urban collective sector is more similar to a planned economy than to a market economy and the rapidity of growth is also similar to state owned industry. It is therefore not an interesting case. The private sector in the urban area could be an interesting sector. However since the sector is restricted to retailing, services and handicrafts, and only allowed to hire a maximum 5 employees for many years, it is not an important sector in the present economy. Rural industry, which includes both collectively and privately owned sectors in rural areas, is the largest and the most dynamic sector within the market sectors (Graph III-2). It has a special role both in industrial development and rural economic development. Rural industry is the most important component of the peripheral or market economy in today's China and this provides a focus of the research.

Graph III-2



OUTPUT VALUE OF SOME MARKET SECTORS IN CHINA Y 00,000,000

YEAR	COLLECTIVE		PRIVATE		STATE OWNED
	URBAN	RURAL	URBAN	RURAL	
1980	753.9	539	0.8		3915.6
1985	1542.1	1575	33.4	146.4	6302.12
1988	2637	3950	68.5	722	10351.28
1989	3100.3	4717.8	89.7	968	12342.91
1990	3202.83	5319.9	107.24	1183.06	13063.75
1991	3649.1	6435.65	129.28	1479.82	14954.58
1992	4376.18	9725.01	195.38	2311.42	17824.15

Source: SSBC. 1993. China Statistical Yearbook 1993. Beijing:
 Statistical Publishing House, p.409.

(2) Characteristics of Rural Industry

1) A Market Economic Sector

Although the major part of rural industry is collectively owned and has existed since the foundation of the People's Republic of China, it has been completely outside the central plan. Table III-2 situates rural industry in China's industrial system and government administrative hierarchy¹¹.

Table III-2 Industrial Organization in China

OWNERSHIP	PUBLIC	COLLECTIVE	PRIVATE AND JOINT*		FOREIGN	
LOCATION		URBAN	RURAL	URBAN	RURAL	
ADMINISTRATIVE LEVELS:						
STATE	A1					
PROVINCE	A2	B2				
PREFECTURE	A3	B3				
COUNTY	A4	B4				
TOWNSHIP			C5			
VILLAGE			C6			
BELOW THE VILLAGE LEVEL			C7			
PRIVATE				D8	E8	F8

Explanatory:

* Joint ownership includes:

- a. State and collectives,
- b. State and individuals,
- c. Collective and individuals,
- d. Chinese and foreigners. (SSBC. 1988)

PLANNING SYSTEM:

1. National plan controls A1 and part of A2 (national large and medium scale industries) by mandatory planning and guidance planning.
2. Provincial, prefectural and county plan control part of A2, A3, A4, B2, B3, B4 by guidance planning and mandatory planning.
3. All of C, D, E, F industries are outside of the scope of the planning system (Field Work).

¹¹ For further information about China's government and planned industrial system, please refer to Appendix 1.

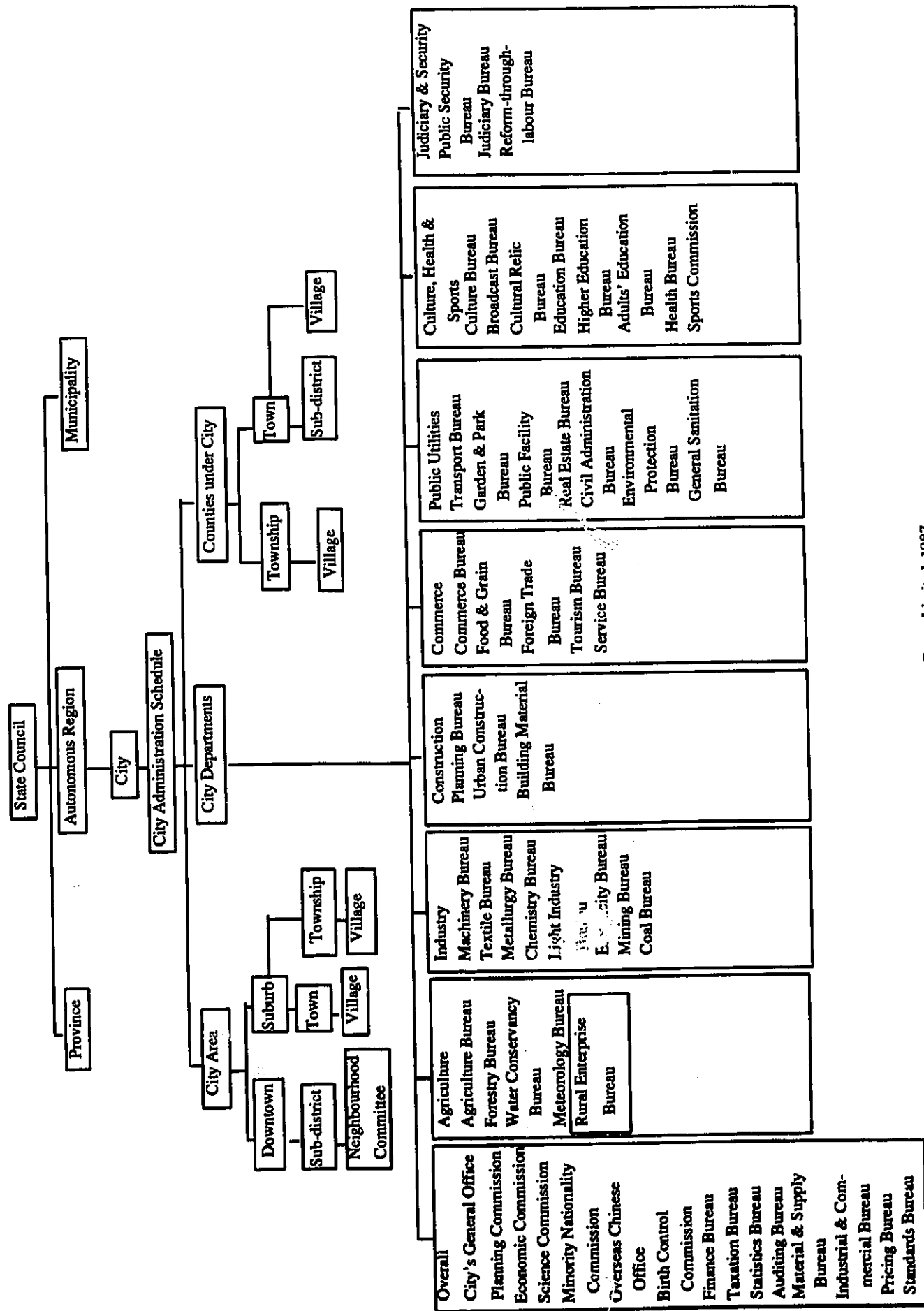
Rural industry includes township owned industry (C5), village owned industry (C6), other smaller communities owned industry (C7), private and jointly owned industries (E8) in rural areas. Although these different levels' rural industries have different relations with a local community government, they have common market economic characteristics which are:

A. Their production is adjusted by market condition and their survival depends on profit. They can make decisions for themselves on opening, closing, changing product, hiring, laying off, and deciding employee's salary and bonuses.

B. The relationship of the rural industry and government is different from urban industry both state owned and collectively owned. Fig III-1 shows China's urban administrative structure. Rural industry is administered by the Rural Enterprise Bureau under the Agricultural Department, but urban industries are controlled by the Industrial Departments by sector. This administrative structure shows the different position of rural industry in China's government administrative system. It is clear that rural industry is not officially considered as a formal industry.

China's Urban Administrative Structure

Fig. III-1



Source: State Statistic Bureau of China. China Urban Statistics, 1986. Hong Kong: Longman Group Limited, 1987

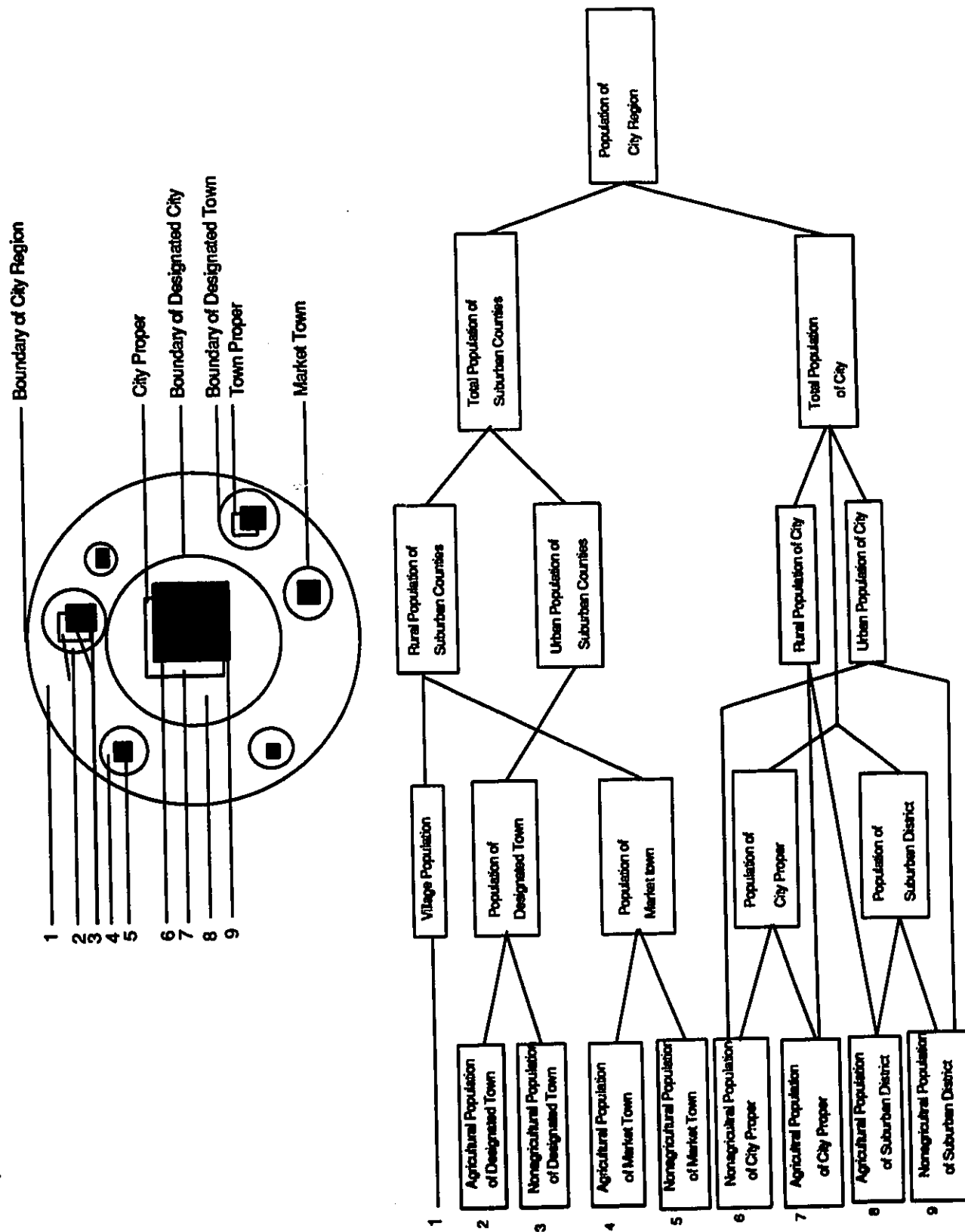
2) A Peasant Owned Industry

The situation described above is different from other Third World countries who define rural industry by location, scale, and industrial sectors (Astin, 1981; Storey, 1988). The official definition of rural industry in China is that the enterprises are owned by peasants or agricultural residents (SSBC, 1989). Obviously, the question is who is considered as an agricultural resident in China. The status of peasant or agricultural or rural resident is determined by China's household registration system. The distinction of residential status is described by the State Statistical Bureau (1988):

"The status of agricultural or non-agricultural residents is determined at birth according to household registration regulations. Generally, agricultural and non-agricultural residents live in rural or urban areas respectively, but this distinction may not reflect the nature of an individual's residential location or occupation. The status is largely related to access to state rations. Non-agricultural residents have certain privileges such as access to food coupons which allow them to purchase food at government subsidized prices. This privilege is retained when a non-agricultural resident moves to a rural area. Similarly, many agricultural residents may reside in a city but their status will remain agricultural. In recent years as cities have annexed increasing number of rural counties, the percentage of agricultural residents in the urban population has also increased."

The region where agricultural residents live is discussed by Laurence J.C. Ma and Gonghao Cui (1987). Fig III-2 shows the distribution of nonagricultural and agricultural population in a hypothetical city region. The categories of 1,2,4,7,8 are agricultural population and all unshadowed areas are the regions where an agricultural population lives. According to government regulations, rural industry can be built on the land that belongs to a peasant community outside the city or town as legally defined. (There are exceptions. see Byrd, 1990, p.57).

Fig. III-2 Spatial Relationships Between Population Types and Urban Settlements in a Hypothetical City Region



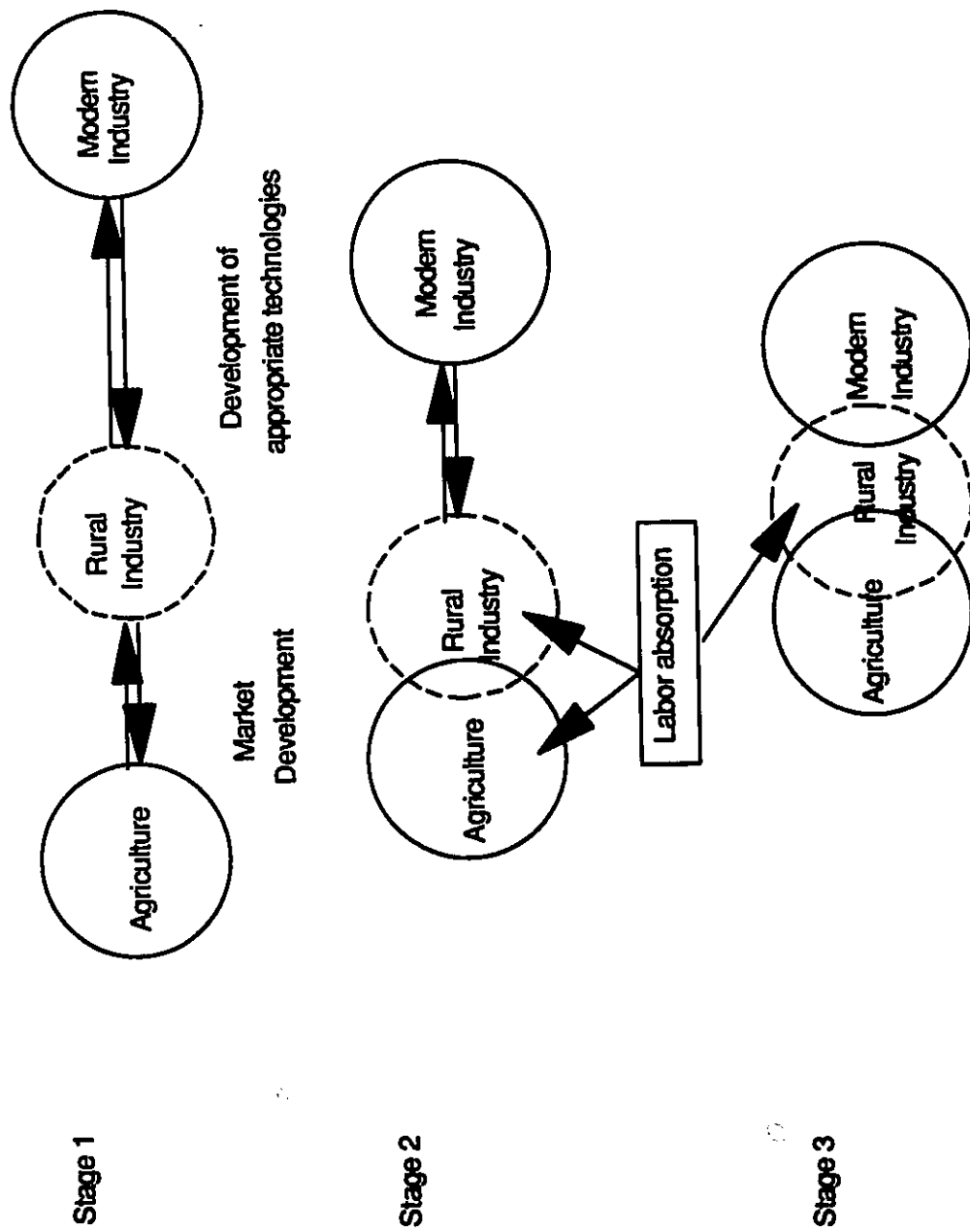
Sources: Ma, Laurence J.C. and Gonghao Qiu. 1987. "Administrative Changes and Urban Population in China." *Annals of the American Association of Geographers*, (77) p.391.

Since a change in residential status is difficult in China, the definition implies that China's rural industry can be located in suburban areas, be of any scale, and can employ full time employees who still keep their status of agricultural residents. As described above, it is clear that rural industry is a typical peripheral or market industrial sector in China's dual economy, and its tremendous expansion has recently been called "a new force suddenly coming to the fore".

3. Relationship Between the State Owned and Rural Industrial Sectors

Rural industry has existed since 1949 and has had some boom periods such as the Great Leap Forward and Rural Industrialization movements 1958-1960, and the movement of Accelerating Mechanization of Agriculture in the early of 1970s. Because the production was centrally planned before 1978, rural industry was not allowed to exploit centrally controlled resources, to produce certain kinds of products and sell them in centrally controlled commercial channels. At that time, rural industry was typically characterized as being small scale, depending on local resources, and serving local markets. There was little interaction between rural industry and state owned industry. The condition is described as the stage 1 or stage 2 in Fig III-3.

Fig. III-3 Development Stages of Rural Industry's Interaction With Agriculture and Modern Industry



Source: Sigurdson, Jon. 1977. Rural Industrialization in China. New York: Harvard University. p.19

After the economic reforms, central control was reduced, markets opened, and many favourable policies have been adopted since 1979. Among them, there are the relaxation of rules for enterprise registration, access to bank loans, and tax exemptions (Byrd 1990, pp.57-59; Gao, 1991). Furthermore, state owned industry is allowed to subcontract their standardized parts or mature products as well as sell equipment to rural industry. Interactions between the two sectors are indicated as the third stage in Fig III-3. They have become not only competitors but also collaborators in some types of production. Taking into consideration that over 37% of total national industrial output was produced by rural industry in 1993, the interaction, competitions and collaborations, can be found universally in modern China.

(1) Competitions

Two forms of competition, for goods in short supply and in a buyer's market, are identified by Byrd (1990). Firstly, for goods in short supply at low-government prices, rural industry may sell their goods at a higher cost, although at a somewhat lower quality. One example is aluminum products. Because of serious shortage of aluminum products, government controls production by a mandatory plan. The fixed price of aluminum in 1988 was Y4,000 - Y6,000 per ton and sales were allocated by government. Shortages raised the price to Y14,000 - Y16,000 in the black market. The possibility of super-profits motivated many new producers. Rural industry stepped

in to fill the demand since they were not constrained by sectoral or scale considerations such as those faced by private and foreign entrepreneurs.

In a buyer's market, rural industry also takes advantage of lower labour cost, diversified products and occasional use of substituted cheap materials. The clothing market is a good example. When one shops in any department store or supermarket, two types of clothing can be easily observed. On one side, the clothing produced by rural or private industry is in diverse styles, relatively fashionable and colourful, acceptable in price, but some of them are of poor quality. On the other side, the clothing produced by the state owned industry has fewer designs and colours, some of them are unfashionable, but most of them are of good quality and of acceptable price. In addition, other competitors for the consumer market include joint ventures, and foreign owned factories. Their products are available in well-decorated fashion houses or in a special corner of supermarkets. The clothing is both fashionable and of good quality but rarely affordable by the common salary earner.

(2) Cooperation

As collaborators, the two sectors interact mainly through subcontracting. As a result of subcontracting, state owned industries can take advantage of low-cost labour, available land, and avoid the strict pollution discharge regulations of big cities.

They also can transfer simple mature products and dump old equipment onto rural industry. They in turn can adopt new technology, update their old equipment, and produce new products. On the other hand, subcontracting makes it possible for rural communities to start a business and thus employ their surplus labour. They are also motivated by the need to gain access to certain technology, materials and markets that can not be easily developed by themselves. Rural industries in suburban areas or near a big city thus obtain more of these contracts than remote rural areas. The rural industrial sector in the Beijing region received 163 new subcontracts in 1990. In suburban area of Wuxi city, where rural industrial output per rural population was the highest in 1989, rural industrial output largely consisted of subcontracting and was 70% of total rural industrial output in 1978. (Byrd, 1990, p.97)

The diffusion of equipment and technology is also important. It is estimated that the value of equipment transferred to rural industry 1978-1988 is about 50 billion Yuan which is the equivalent to the whole country's industrial investment in 1986 (Guo, 1991, p.10). Since 1979, along with the industrial products and equipment, technology is also diffused to rural industry. Rural industry sometimes obtains the services of state industries, universities, research institutes, or pays a high wage to invite skilled workers, technicians, engineers to come and teach them. These skilled individuals are sometimes called "Sunday engineers". Approximately, 2 million engineers and technicians have worked for

rural industries since 1978. (Guo, 1991, p.11)

China's dual economic system and the peripheral status of rural industry in the system is described in this chapter. The analysis shows that rural industry is the largest and the most dynamic sector in the market or peripheral sector. The characteristics of rural industry have been described from the aspects of ownership and the position in China's economic system. This chapter also discussed the changes brought by rural industrial development in China's market sector and in the over all economic system. The fast growth of rural industry has changed the relationship between core or state owned and peripheral or market sectors greatly, the dominance of state owned industry is decreasing and the competition and cooperation between the two sectors is reforming China's economic system.

IV. Core Periphery Theory, China's Regional Policy, and Rural Industry

In the previous part, core-periphery relations and interactions were analyzed within the entire Chinese economic system. This chapter will focus on spatial characteristics and interactions in China as reflected by rural industrial development.

1. Core Periphery Theory

The spatial core-periphery model is "a conceptual model that divides the space economy into a dynamic, rapidly growing central region and its periphery." (Friedmann, 1966, p.xv) In the space economy, several different levels core and periphery can be observed. At the national level, there are core regions and peripheral regions, such as China's east coast region and the interior region. At the regional level, an urban centre surrounded by suburban and rural area, forms a core/periphery model. This core can be a regional capital, or a local service centre. In China, these centres can be provincial capitals, other lower level's cities, and towns.

The process of interaction between cores and their peripheries has been described by Friedmann's four-stage of spatial evolutionary model. The four stages are:

"1) A preindustrial phase, characterized by a number of small independent urban centres spread throughout a large region.

2) A period of incipient-industrialization, characterized by a primate city which dominates a large region and exploits the

natural resources of its periphery.

3) A transitional stage toward industrial maturation in which the primate city still dominates the large region, but not to the extent that it did previously.

4) A final stage consisting of a fully-fledged spatial organization based on the hierarchy principle and encompassing the entire national territory." (Cited from: de Souza, 1990, p.446)

This model relates to the process leading to the regional inequality stage of development. Friedmann suggested that the major city's continued urban-industrial expansion should have an effect on surrounding regions. The convergence and diffusion between centre and periphery in the final stage will fulfil internal spatial organization goals such as national integration, high degree of interregional balance, and maximum growth potential (de Souza, 1990. p.447).

The model above describes the spatial relation of core and periphery, and the development process of these two regions. Since the final stage suggested by the model shows a high degree of interregional balance and maximum growth potential, many policy makers wish to speed up the transition process by regional policies and reach the final stage as soon as possible. Many strategies have been applied in different regions and countries. Those strategies can be classified as "development from above" and "development from below" (Stohr, 1981). The Chinese government, with a high concern of regional equality and a not very successful 30 years' experience of redistributing revenue and skilled labours to interior regions, has changed regional policies since 1978. The new policies both on national and regional level bear witness to a mix of "top-down" and "bottom-up" strategies (Wu and Lo, 1981; Lo, 1989). A description

of those two strategies and Chinese policies follows.

2. Development Strategies and Chinese Regional Policies

(1) Development From Above

The theories known as "top-down" or "centre-down" offered by Myrdal (1957) and Hirschman's (1958) polarized development models and growth pole theory by Perroux (1950). These theories emphasize an initial heavy investment in capital-intensive industry at a specific point, then the centre generates an initial multiplier effect. As a result of the new local demands generated by the factory and its labour force, new factories are linked to both the initial industry and local demand is stimulated. A spiral of growth or polarized growth is formed. The polarization effects can be reduced eventually by spread effects and thus stimulate economic development in the periphery of a free market economy. (Darwent, 1969; Friedmann, 1972; de Souza, 1990)

In China, central-down policies can be evidenced from both national and regional levels. At the national level, the regional policy focuses on the relationship of east coast and interior regions. After 1978, economic reforms emphasized a decentralized, economic efficiency-oriented, or polarized development strategy. The key policy was "to encourage some areas, enterprises, and individuals to become prosperous first" (Chapter 49 of the Seventh Five-Year Plan. Cited from: Guo. 1988. p.42) . The decentralized

policies include transferring centrally controlled enterprises to local management, increasing regional authorities in revenue and expenditure, and encouraging interregional exchange and co-operation. The Seventh Five-Year Plan (1986) has designated different development strategies for three different developed regions:

"During the period of the Seventh Five-Year Plan and in the 1990s, we must speed up development in the east coast region, concentrate on building up the energy and raw and semi-finished materials industries in the central region, and make active preparations for further development in the western region (Section 3)." (Guo. 1988. p.41)

This statement delivered a clear message that China wanted to make the east coastal region a centre of national development and diffusion to bring about the national development. (Lo, 1989) The changes are very obvious, if comparing this with the First Five-Year Plan. The First Five-Year Plan (1953-1957) stated:

"... the unbalanced concentration of our industries in the east coast is very unreasonable in terms of economic efficiency as well as national defence. The regional distribution of industrial construction should be based on long-term national interest. Industry should be located rationally, close to the areas producing raw materials and fuel or the areas of highest consumption in the country, and for the benefit of the consolidation of national defence, so as gradually to improve this unreasonable situation and raise the economic level of those backward regions." (Guo, 1988, p30)

Clearly, the major concern of the First Five-Year Plan was balancing the regional economies between east coast and west regions, and also emphasized raising the economic level of backward regions. This policy was carried on by the centrally controlled economic system during the first 30 years after 1949. The policy

included investing more in the interior regions; giving more compensating appropriations to the western regions from the central government; allocating skilled labour force to backward regions mainly by planned migration of enterprises and assignment of university graduates; charging lower agricultural tax rate in interior provinces than in the east coast regions; and redistributing income by unified wage system in urban areas.

The higher growth rate was achieved in the interior regions from 1952 to 1983 at very high cost. Table IV-1 shows the average growth rate of industrial output 1952-1983 as 10.4% in the interior region, but it was only 8.92% in east coast region. As a result of the higher industrial investment and growth rate, the percentage share of industrial output in the interior regions increased from 30% in 1952 to 40% in 1983. Table IV-2 gives more detailed information on the pattern of provincial industrial growth. In Table IV-2, most provinces with higher level of per capita industrial output in 1957 had a lower rate of industrial growth 1957-1974. On the other hand, those provinces with a lower level of per capital industrial output in 1957 had a higher rate of industrial growth over the period 1957-1974. This does not seem logical that a more industrialized region has a lower industrial growth rate, but it is exactly reflected in China's regional policy, the level of central control, and the power of the central government during that period. Table IV-3 gives the information on regional profit ratios per unit capital. Obviously, the capital invested in the eastern region can create a much higher profit than

in the interior region, but according to statistics, Shanghai, as an example, turned over 288.3 billion yuan of fiscal revenue to the central government, while receiving only 20.7 billion in investment from 1949 to 1980. On average, the expenditures of the east coast provinces accounted for only 50% of the revenue that they collected during the period 1949-1980 (Guo. 1988. p.35). This imbalance interfered with the renewal of equipment, expanding infrastructure and urban construction in the east coast region, and affected economic growth. The overall result of the policies is that the efficiency of the national economy is reduced. This resulted in changes to the regional policies in the Seventh Five-Year Plan (1986-1990). The east coast region has benefited from the relaxation of central control and other favourable policies such as special economic zones, east coast open cities, and open districts since then. These changes of regional policies have also had a significant influences on rural industrial development.

Table IV-1 Proportion and Growth Rate of Gross Output Value by Regions (State-owned Industry)

REGION	1952		1983		1952-83 Growth Rate of Output
	Billion Yuan	Share %	Billion Yuan	Share %	
EAST COAST	23.81	69.4	366.75	59.5	8.92
INTERIOR	10.52	30.6	249.69	40.5	10.4
NATIONAL	34.33	100	616.44	100	9.45

SOURCE: State Statistics Bureau of China. 1985. The Development of Chinese Industry, 1952-1984. Beijing: China Statistical Publishing House.

Table IV-2 The Pattern of Provincial Industrial Growth (1957-1974)

LEVEL OF PER CAPITA INDUSTRIAL OUTPUT (1957)		
RATE OF INDUSTRIAL GROWTH 1957-1974	ABOVE MEDIAN	BELOW MEDIAN

ABOVE MEDIAN	BEIJING	SHANDONG
	JIANGSU	HEBEI
	GUANGDONG	SHAANXI
	NEIMONGGU	HUNAN
		QINHEI
		GANSU
		GUANGXI
		HENAN
		GUIZHOU
		NINGXIA
BELOW MEDIAN	SHANGHAI	JIANGXI
	TIANJIN	SICHUAN
	LIAONING	YUNNAN
	HEILONGJIANG	ANHUI
	JILIN	
	ZHEJIANG	
	SHANXI	
	HUBEI	
	FUJIAN	
	XINJIANG	

SOURCE: Nicholas R. Lardy. 1978. Economic Growth and Distribution in China. Cambridge. p156

Table IV-3 Industrial Economic Efficiency (State Owned), 1978

PROVINCE	REGION	GROSS OUTPUT RATIO OF FIXED ASSETS	PROFIT RATIO OF GROSS CAPITAL
BEIJING	EAST	131.49	35.80
TIANJIN	EAST	171.10	41.76
HEBEI	EAST	107.56	21.50
SHANXI	INTER	60.23	11.93
NEIMONGGU	INTER	46.66	5.88
LIAONING	EAST	93.38	26.31
JILIN	INTER	75.13	12.86
HEILONGJIANG	INTER	79.82	30.20
SHANGHAI	EAST	275.99	75.50
JIANGSU	EAST	192.59	33.99
ZHEJIANG	EAST	148.28	29.77
ANHUI	INTER	103.19	18.61
FUJIAN	EAST	111.47	23.69
JIANGXI	INTER	76.85	10.25
SHANDONG	EAST	125.01	32.52
HENAN	INTER	86.58	15.14
HUBEI	INTER	83.03	15.94
HUNAN	INTER	94.22	17.67
GUANGDONG	EAST	124.23	24.68
GUANGXI	EAST	92.47	17.31
SICHUAN	WEST	65.68	14.02
GUIZHOU	WEST	47.43	7.69
YUNNAN	WEST	58.61	11.59
SHAANXI	WEST	71.73	13.44
GANSU	WEST	61.55	16.90
QINHEI	WEST	49.93	10.28
NINGXIA	WEST	57.09	11.45
XINJIANG	WEST	52.76	17.61
NATIONAL	ALL	102.56	24.16

NOTE: EAST: East coast region; INTER: Interior region; WEST: West region.

SOURCE: State Statistics Bureau of China. 1985. The Development of Chinese Industry 1952-1984. Beijing: China Statistical Publishing House.

At the regional level, China used to include a few suburban districts into a city's boundary, but only a few very large cities such as Beijing, Tianjin have had some counties under a city's administration. After 1978, in order to take advantage of 'spread effects' from a core city, China adopted "core city policy". The policy designates some counties to be administered by an adjoining "core city" in the hope that the "core city" and the surrounding counties can have better access to each other's resources and facilities and more interaction. Thus the core city can bring about development of the periphery. In 1989, more than 300 cities of total of 450 cities have been designated counties under their administration (SSBC, 1989). Two provinces, Jiangsu and Liaoning, have designated all of the rural counties to cities in 1989. But before 1982, only 63 cities out of total 230 cities had counties under their administration (SSBC, 1981 and Li, 1991). This change is another evidence of decentralization policy after 1978. Lo (1989) indicated that "the Chinese government is clearly following some form of growth pole strategy in spatial development".

(2) Development From Below

An alternative strategy is known as "development from below" or "bottom-up and periphery inward development paradigm" (Friedmann and Douglas 1978, Lo and Salih 1981, Stohr 1981, Rondinelli 1985). According to the theory, a dispersed agropolitan development or the development from below could happen in a relatively small community

(50,000-150,000 people depending on population density (Friedmann and Douglas 1978)). Selective regional closure, as a policy, was emphasized to "inhibit transfers to and from regions which reduce their potential for self-reliant development" (Stohr 1981). The spatial units should be self-sufficient and self-reliant. Decision making and planning, and the emphasis on small-scale rural industry, depends mainly on local resources and technology, and serves local markets, in the hope of developing a rural economy. Other effects that are expected are the absorption of surplus agricultural labour, the control of rural to urban migration and the reduction of regional and rural-urban disparities.

Both at the national and regional levels, China's regional development and urbanization policies are distinctive in that there are strict controls on migration from the backward regions to the developed regions, from small cities to large cities, and from rural to urban areas. The basic urbanization policy in China is to "control the scale of large cities, develop medium-sized cities and actively expand small ones". These policies have been adopted to minimize the urban infrastructure investment and to narrow the differences between urban and rural areas. These policies have been implemented on since the 1950s by the household registration system. "A formal urban rationing system has also been in place since 1953. In its full implementation, it covered almost all foodstuffs and major consumer goods, such as cloth and bicycles. Ration coupons were handed out to urban residents registered with the household registration authorities at the place of household

registration (Government Administration Council 1953; State Council 1955)." (Cited from Chan.1989,p19). Not only the food ration but also the employment, housing, primary and high school education are all closely tied to the household registration system and are only offered to the people registered locally. For example, a person with urban residential status in Changping county of Beijing can not be employed by a state-owned factory located in Haidian district of Beijing (which is a near suburban district), unless another urban resident in Haidian district is willing to exchange his residential status with him. The household registration policy has been the most effective policy tool in controlling population immigration since 1953. Although urban enterprises are allowed to hire contract workers who do not have local urban residential status. Urban school education, government subsidised urban housing remain highly controlled by the household registration system, and even food coupons have been reintroduced in 1995 in many large cities after two years without it (RMRB. May 8, 1995). Given this situation, China's urbanization experiences are very different from other Third World countries where rural to urban immigration is a major factor in rising rates of urbanization.

China's rural industrial location policy is further evidence of a "bottom-up" strategy. After 1984, rural industry could be built within the community that the owner lived or in a market town near his community, but a rural entrepreneur was not allowed to build in the city proper. Rural workers and their dependents were only allowed to move into a market town (but not a designated town

or a city proper) with their grain ration for employment (PRC State Council, 1984). The best expression of the policy is the government slogan "leave the land but not the countryside, enter the factory but not the city (litu bu lixiang, jinchang bu jincheng)". Since both labour and industry are constrained within the relative closure of a rural region, accumulation from the region will be reinvested mostly in the region. This is quite similar to the "agropolitan model".

3. China's Rural Industry

Although promoting decentralization is a deep concern and a strict control system is adopted by Chinese government, rural industry is not equally distributed throughout the regions. As Friedmann (1966, pp.207-208) pointed out:

"the search for decentralized activity locations, however, does not occur at random. Investors will seek out locations which, among other things, will have the following characteristics:

- a. good accessibility to regional, national, and/or international markets;
- b. a wide range of diversified, specialized services and the possibility of establishing functional linkages to already existing firms in the locality;
- c. organized industrial estates including basic utility and transport facilities;
- d. a high level of urban service facilities, including schools, research centres, hospitals, recreation facilities, housing, and public administration."

China's rural industry has much less spatial freedom than Venezuela, but faces similar market competition. The location criteria indicated by Friedmann influences the distribution of China's rural industry as well. According to behaviour theory, a

large number individuals making random decisions at a certain time, the spatial distribution of the survivor firms over time should represent viable or even optimum location pattern, even if the decision makers themselves do not know the location conditions of success or try to achieve them by changing locations. (Alchian, 1950; Souza, 1990) The development of China's rural industry is the result of a large number of individual decisions over the last 16 years. Moreover, it is the first national scale industrialization that left the decision to millions of individual entrepreneurs after the foundation of the People's Republic of China in 1949. The spatial distribution of rural industry not only reflects the characteristics of rural industry itself, but also tests the regional disparity, city hierarchy, and the influences of regional characteristics on peripheral regions.

4. Provincial Rural Industrial Development: Some Past Work

Although there has been a considerable volume of research on rural industry recently, only a few studies have dealt with spatial distribution of rural industries and the relationship between regional characteristics and rural industrial development.

Lu (1990) has generally described regional differences of rural industrial development in the east coastal, interior and west regions using several indicators singly such as rural industrial output, average size of rural enterprises, and fixed capital per rural industrial employee. He also developed a rural industrial

density indicator that is the rural industrial output divided by number of townships to analyze the spatial distribution of rural industry. The map displays the differences of the rural industrial density at a provincial level, but unfortunately the precision is reduced due to the variables used in the indicator. It is assumed in Lu's research that there is a standard size of population in each town or township, therefore the number of town and townships can reflect rural population as well as township density. But the fact is the national standard for population in towns and townships can vary greatly. According to the fourth census of population in 1990, the population of Baihepu Xiang was 1,700, but Tongzhou Zhen was 119,685 which is over 50 times more population than in Baihepu Xiang, although both of them are in the Beijing municipality. Since this analysis is based on data with such a wide range, the result can not be very precise. Probably because of the limitation of the data, no further analysis was done on the subject. The book also described briefly the relationship of rural industrial development with urban industry, rural economic development, and market potential mostly at national level and some at three big regions level (east, interior, and west). But there is no quantitative analysis attempted in the book on the relationship between rural industrial development and regional characteristics at provincial level.

Wang has developed a good set of provincial indicators to define the regional imbalance of rural industry (Wang. 1990. pp.255-274). Those indicators were valuable in 1985, since there

was no officially published statistics for rural industry at that time. The article divides China into three regions by the national averages of the indicators. Since several indicators were used separately to rank the rural industrial development level, the rank of the provinces was different from one indicator to another. Although the final rank of the rural industrial development is only classified to three levels, there are still some provinces with inconsistent ranks in different indicators. Wang did not describe the method of the final classification in the article and did not mention the possible intercorrelation among those indicators (Wang. 1990. pp.260-270). The result could be improved, if those two issues had been taken into consideration.

Pang has pointed out the links between the spatial disparity of rural industrial location and the regional characteristics of economic development and industrial structure (Pang. 1991). Since her research focuses on rural industrial distribution, the links that she presented are only described by examples.

Other research has appeared as part of broader work on rural development in China at the provincial level, such as Walker (1990), Leeming (1985), Lee (1988), and Tan (1990), but these researchers concentrate on the relationship of rural industry and rural economic or small town development. For instance, Walker (1990) has analyzed the relationship between per capita Rural Social Value of Output (RSVO) and the share of rural industry in RSVO, and the relationship between rural industry's contribution to RSVO and to rural employment using provincial data. Obviously,

there is more that can be done on the topic of regional characteristics and rural industrial development even at the aggregated level of the province.

At the provincial level, this research will develop a group of indicators to measure rural industrial development level using the first officially published rural industrial statistics in 1989. In order to avoid the redundancy among multiple indicators, a factor analysis will be used to regroup the indicators. The result will show the distribution of rural industry and the development stages of rural industry. Another analysis will be done at provincial level so as to reveal the relationship between rural industrial development and regional characteristics. The rural industrial development indicators from the above analysis and regional statistical data will be used and a multiple regression method will be applied. The result will display the influences of regional development on rural industry, and also the nature of rural industry.

5. Regional Rural Industrial Development: Some Past Work

There are some contributions to the literature on regional differences in rural industry or rural economy at the regional level, either within a province or a smaller region. The World Bank has supported a project dealing with China's rural industry. The bank has done a comparison of rural industrialization of four counties selected from four provinces (Byrd, 1990). The research

includes a detailed comparison on ownership, performance, labour, and the role of community governments. The conclusions are based on the analysis of the data from the four counties. The distribution of rural industry at the local level, however, was not discussed. Other recent publications such as Lo's (1989) "analysis of the spatial restructuring of rural region in Zhujiang Delta", Veeck's (1989) "rural economic restructuring and farm household income in Jiangsu province" dealt with spatial issues of rural economic reform. Rural industrial development has been discussed in those articles as one of the rural economic activities, but the issue was not the focus of the research.

The distribution of rural industry in local areas has been mentioned by some researchers, such as Pang (1991), Lui (1990), but no in depth analysis has been done on this issue. Some other works on small town development have partially included or mentioned this issue (Tan, 1990; Lui, 1990; Lo, 1989). Despite the volume of research on rural industrial sectors, little if any depth and comprehensive work had been done on the relationship of rural industrial development with the characteristics of core regions at township level. There is much that remains to be done.

This research will display the distribution of rural industry and analyze the spatial relationship between rural industry and regional characteristics at the township level using Beijing as a case study. The geographic information system (GIS) map overlay method will be used for the analysis. The working hypothesis is that a large number individuals making independent and random

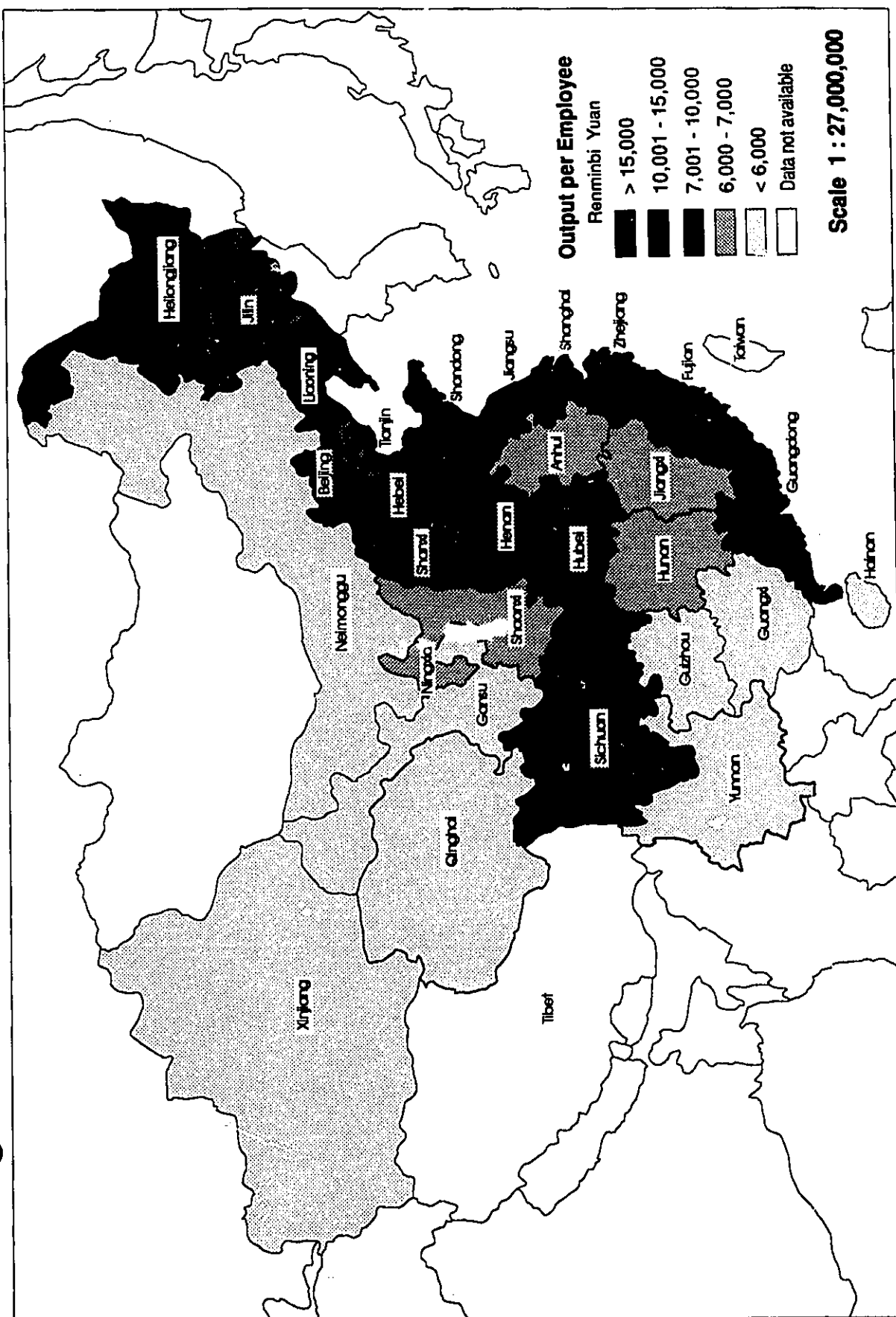
decisions in 12 years should represent viable or even optimum location pattern. The analysis therefore tests the hypothesis and attempts to reveal the determinants of rural industrial location.

V. The Empirical Analysis of Levels of Rural Industrial Development at the Provincial Level

China is the third largest country in the world after the former USSR and Canada. It covers a total area of approximately 9.6 million km². It is the world's most populous country with 77.8% of its population in rural area in 1992 (SSBC.1993,p.81,329). Its economic and environmental conditions vary considerably over this great landmass. Moreover, the regional differences in natural resources, human resources, and economic history have created a very unbalanced base for current rural industrial development.

China's rural industry is characterized by great regional imbalances. Generally speaking, it is concentrated in the east coast region and the development level decreases from the east to the west. Fig V-1 displays the distribution of rural industrial output per employee in 1989. Most provinces along the east coast had Y12,000-Y22,000 of output per employee, such as Beijing, Tianjin, Liaoning, Shanghai, Jiangsu, Zhejiang, Shandong, and Guangdong. The differences are very obvious between east coast and interior regions, most interior provinces had only about Y5,000 output per employee. This chapter surveys the unbalanced distribution of rural industry and classifies the levels of rural industrial development by the indicators from published statistics of rural industry in 1989.

Fig V-1 Rural Industrial Output per Employee, 1989



1. Indicators of Rural Industrial Development

At the provincial level, the research area includes 22 provinces, 5 autonomous regions, and 3 municipalities, for a total of 30 provincial level administrative regions¹².

In this research, rural industrial indicators are selected from "China Rural Enterprise Yearbook, 1990" compiled by the Department of Rural Enterprise of Ministry of Agriculture of China. The statistics in the 1990 Yearbook was reported at the end of 1989, and was the first year that Chinese government published rural industrial data. This series of yearbooks is the most important data source at the provincial level for rural industrial analysis, because:

a) It covers all of the rural industrial activities from township owned, village owned, below village level's community owned (former production teams), jointly owned, to private owned enterprises. Usually, those rural industrial data are included in the overall industrial data or aggregated with rural economic data in statistical publications such as China Statistical Yearbook, so that complete rural industrial data can not be obtained from those publications.

b) It reports the rural enterprise data by agriculture, industry, construction, transportation, and services sectors. This makes rural industrial (manufacture) analysis possible. Instead of

¹² Please refer to Fig I-1 in Chapter I. Data for Taiwan, Hong Kong, and Macao are not available, therefore, only 30 provincial level administrative regions are included in the research.

analyzing a mixed data set of all rural non-agricultural activities as most people did before 1990 (Byrd, 1990; Lu, 1990, Wang, 1990).

c) This source provides many more rural industrial statistics that are broken down to the provincial level, such as fixed asset, total tax and profit, export value, and raw material consumption, etc. Those data are not available from other publications.

d) According to the Yearbook, the statistics were provided by the Department of Rural Enterprise of Ministry of Agriculture of China and the Rural Enterprise Bureau of each province, autonomous region, and municipality. Also the data have been verified before publishing (DREMAC. 1990, p.i). Although there is no further description of the validity of the statistics, the consistency of the data should be better than those collected from various other sources or from non-official sources.

The precision and reliability of the data were not discussed in the Yearbook. However, the procedure of collecting statistics in China, and a comparison of the data published by different government departments can give some clarification about it. The statistical data are recorded first by the enterprise's accountants and statisticians. Then at the end of each month, quarter, and year, those data are reported to the higher authorities of the enterprise, such as the village enterprise office, and township enterprise bureau. Those government agencies classify and aggregate the data collected from the subordinate enterprises, and report the aggregated data to the higher authorities, such as the county level. This process is repeated at the county level, provincial

level, and finally the data are reported to the competent authorities in the central government - the Department of Rural Enterprise of Ministry of Agriculture of China. The data reported to different levels' government agencies as not only uses for statistical purpose but also for administering and evaluating their subordinate units. Since the higher authorities always have some power on the subordinate units, those data should have a certain level's reliability. A comparison of rural industrial data published by the different government agencies shows that the data published in the Rural Enterprise Yearbook 1990¹³ are exactly the same as it in the China Statistical Yearbook 1990¹⁴ for 'total rural industrial employee', 'total number of rural industrial enterprises', and 'total rural industrial output' (SSBC. 1990, p.399-401; DREMAC. 1990, p.135-136). This indicates that the data published in the Rural Enterprise Yearbook come from the mandated statistical source and was proofread before printing. Although many questions still can be asked about the data quality, the improvement of the quantity and quality of the statistical data has been lauded by many researchers (Lee. 1988; Lo. 1989; Linge. 1990; Walker. 1989; Lin. 1993; Guo. 1988).

Twelve indicators of rural industrial development in each

¹³ Compiled by Rural Enterprise Bureau of Agricultural Ministry of China and published by Agricultural Press.

¹⁴ Compiled by State Statistical Bureau and published by China Statistical Publishing House.

province¹⁵ in 1989 are selected from the Rural Enterprise Yearbook and listed in Table V-1. The selection of those indicators is based on the considerations: a) availability of the data; b) they reflect best the rural industrial activities; c) are the most meaningful indicators.

Those twelve indicators portray rural industrial activities from various aspects. The percentage of the rural industrial labour force in the total rural labour force gives the information on the proportion of actual rural labourers involved in industrial activities. This indicator reflects the level of rural industrialization of a region. The average size of an enterprise indicates the stability of the enterprises and the stage of rural industrial development in a region. The larger the average size, the more the rural industry is developed in the region. Shanghai, Beijing, and Tianjin achieved the highest average size of rural industrial development, and most east coast provinces have a higher average size than those in the interior regions. Since most rural industry is at the beginning stage and the analysis is aggregated at the provincial level, the differences of industrial composition should not influence the average size of enterprise too much.

Total rural industrial labour force and total output give the information about the overall scale of rural industry in a region. Although the large provinces can have high values for both indicators, this is not always the case. Jiangsu's total output and

¹⁵For simplicity, the term "province" covers all provincial level administrative regions, including three municipalities and five autonomous regions.

labour force are the highest and even one quarter more than the province in second place. Its rural population is only two thirds of the largest province. On the other hand, Neimonggu has a rural population which is 5 times that of Beijing, but its rural industrial output is less than 20% of Beijing's output. Total labour force and total output may be correlated to each other, but the orders of the two variables are not the same, therefore, they both are included in the research.

Output per employee and tax and profit per employee are the indicators of efficiency. The difference between those two indicators is that the value of output includes the value of intermediate goods but the value of tax and profit is the value after all production costs. Theoretically, tax and profit per employee is the best indicator for efficiency, and output per employee is not necessary. In fact, the value of tax and profit is influenced by regional tax policy and only counted by current price that is always different among regions. On the other side, output is "list price multiplied by the quantity produced" (SSBC. (3), 1988, p.xiii), and the list price can be a constant price which ensures comparability between the different areas and different periods. As described above, in order to give more complete information about the rural industrial efficiency, both variables are selected.

Fixed assets¹⁶ per employee of rural industry indicates industrial types, labour intensive or capital intensive, in a

¹⁶ Original value of fixed assets is used.

region. It also implies industrial composition, such as heavy industry or light industry. For rural industry, the highest values of fixed assets per employee are observed for Beijing, Tianjin, and Shanghai municipalities, an indication that the rural industries are more mechanized and more capital intensive in those regions.

Export value is the value of goods exported to countries or regions out of China. Export value per rural industrial employee gives information on market and quality of products. Usually, the more stable products with better quality can have larger market. Therefore, the higher export value per employee shows the more established rural industry and better quality products in a region. Before economic reform, few products produced by rural industry could have overseas' market; but in 1989, every province exported some rural industrial products. Rural industrial export value reached 25% of the national export value of industrial finished products in 1989. In Shanghai, 17% of rural industrial output was earned from export in 1989. Export values of interior provinces were much lower than Shanghai, Tianjin, and Beijing, most of them exported less than 5% of their rural industrial output.

Four raw material consumption indicators are used in the research: coal, electricity, wood, and cement consumption of rural industrial output. Electricity and coal are the major energy sources of China's industry. Coal provided 76% of the primary energy consumption of China, and over 73% the coal was consumed by industry. Since energy consumption is an important indicator of industrial efficiency and manufacturing structure, these two

indicators are included in the analysis. For raw material consumption, quite a few materials were reported by the Yearbook, but unfortunately some of them had missing data, such as iron, and steel, therefore, only wood and cement consumption were used in the research.

Table V-1 Indicators of Rural Industrial Development¹⁷

1. EMPRL: Percentage of rural industrial labour force in total rural labour force (%)
2. ASIZEFTY: Average size of rural industrial enterprise (employees/enterprise)
3. TOTEMP: Total rural industrial labour force (employees)
4. TOTOUT: Total rural industrial output value (Yuan)
5. OUTPEMP: Rural industrial output per employee (Yuan)
6. TAXPRFPE: Tax and profit per rural industrial employee (Yuan)
7. FIXASTPE: Fixed assets per rural industrial employee (Yuan)
8. EXPORPE: Export value per rural industrial employee (Yuan)
9. COALOUT: Coal consumption of rural industrial output (Ton/1,000 Yuan)
10. ELECOUT: Electricity consumption of rural industrial output (kwh/1,000 Yuan)
11. WOODOUT: Log consumption of rural industrial output (m³/10,000,000 Yuan)
12. CMNTOUT: Cement consumption of rural industrial output (Ton/1,000 Yuan)

2. Methodology

Although all of indicators listed above are carefully selected, two questions should be asked before any further analysis is done on the data: A) Are those data intercorrelated? B) Can a

¹⁷ For a detailed description of the indicators, please refer to Appendix 4 Glossary of Major Indicators.

classification of rural industrial development level be easily obtained from those raw data? For question A, the answer will be given after correlation analysis; and for question B, the answer is no, because Wang's (1990) work already shows the difficulties of classifying rural industrial development levels using multiple indicators. Therefore, a multivariate statistical analysis is necessary for the classification of rural industrial development in China. In addition, the hypothesis on some factors underlying the set of variables seems to exist from observing the variable definitions and correlation coefficients in Table V-3. Therefore, factor analysis is used for the orthogonal transformation of the rural industrial variables.

Since most statistical analysis is based on the assumption of normally distributed data, skewness in the data has been tested for both original data set and the log transformed data. Table V-2 shows that the logarithmic transformation reduced the skewness, and the data could then be assumed to be normal for most of the variables listed in Table V-1. As a result, logarithmic data are used for the further analysis.

The intercorrelation of the logarithmic data has been tested and the result is listed in Table V-3. It is noted that there are some very high intercorrelations in table V-3 in shaded cells, such as LASIZEFT (Log average size of rural industrial enterprise) and LEMPPRL (Log percentage of rural industrial labour force in total rural labour force), LOUTPEMP (Log rural industrial output per employee) and LEMPPRL (Log percentage of rural industrial labour

force in total rural labour force), LTOTOUT (Log total rural industrial output) and LTOTEMP (Log total rural industrial labour force). The scatter graph among the indicators provides the same evidence (Graph V-1 and Graph V-2). Since many of the twelve indicators may be intercorrelated, a factor analysis was performed to produce a smaller set of theoretically coherent variables.

Factor analysis performs an orthogonalization procedure on an intercorrelated data set, and produces a set of factors that are uncorrelated with each other. "Factor analysis, as Lawley and Maxwell (1963) emphasize, usually implies some hypothesis as to the number of common factors underlying the set of variables in the research problem" (Cited from King, 1969, p.185). As discussed above, some of the rural industrial development indicators are intercorrelated, and extracting a smaller number of basic dimensions from the observed indicators is important for the classification of rural industrial development level.

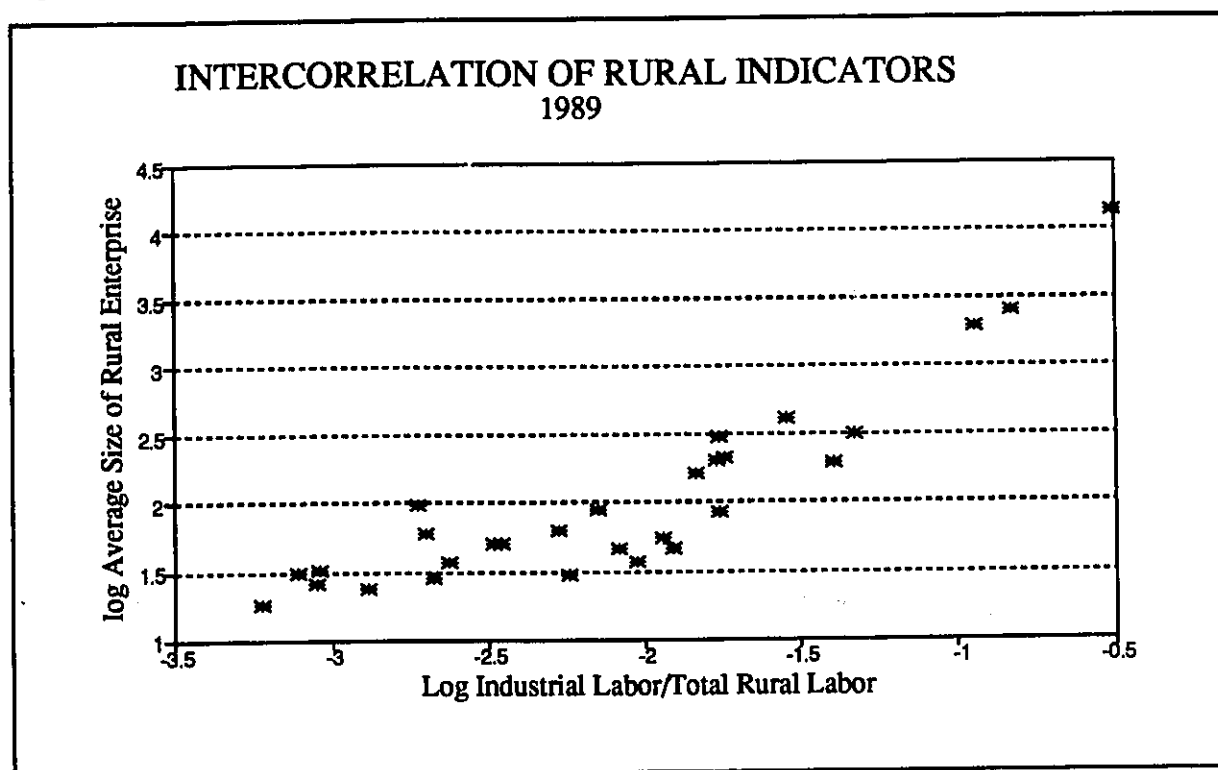
Table V-2 Comparison of Skewness Between Original Data and Log Transformed Data

ORIGINAL DATA	EMPPRL	ASIZEFTY	TOTEMP	TOTOUT	OUTEMP	TAXPRPE	FIXASTPE	EXPORPE	COALOUT	ELECOUT	WOODOUT	CMNTOUT
SKWNESS	2.09	3.56	1.31	2.19	1.17	1.63	0.84	2.24	3.54	2.67	1.09	3.41
LOG TRANSFORM	LEMPRL	LASIZEFT	LTOTEMP	LTOTOUT	LOUTEMP	LTAXPRFP	LFIXASTP	LEXPORPE	LCOALOUT	LELECOUT	LWOODOUT	LCMNTOUT
SKWNESS	0.39	1.59	-0.80	-0.66	0.46	0.83	0.11	0.47	0.20	1.07	-0.26	0.92

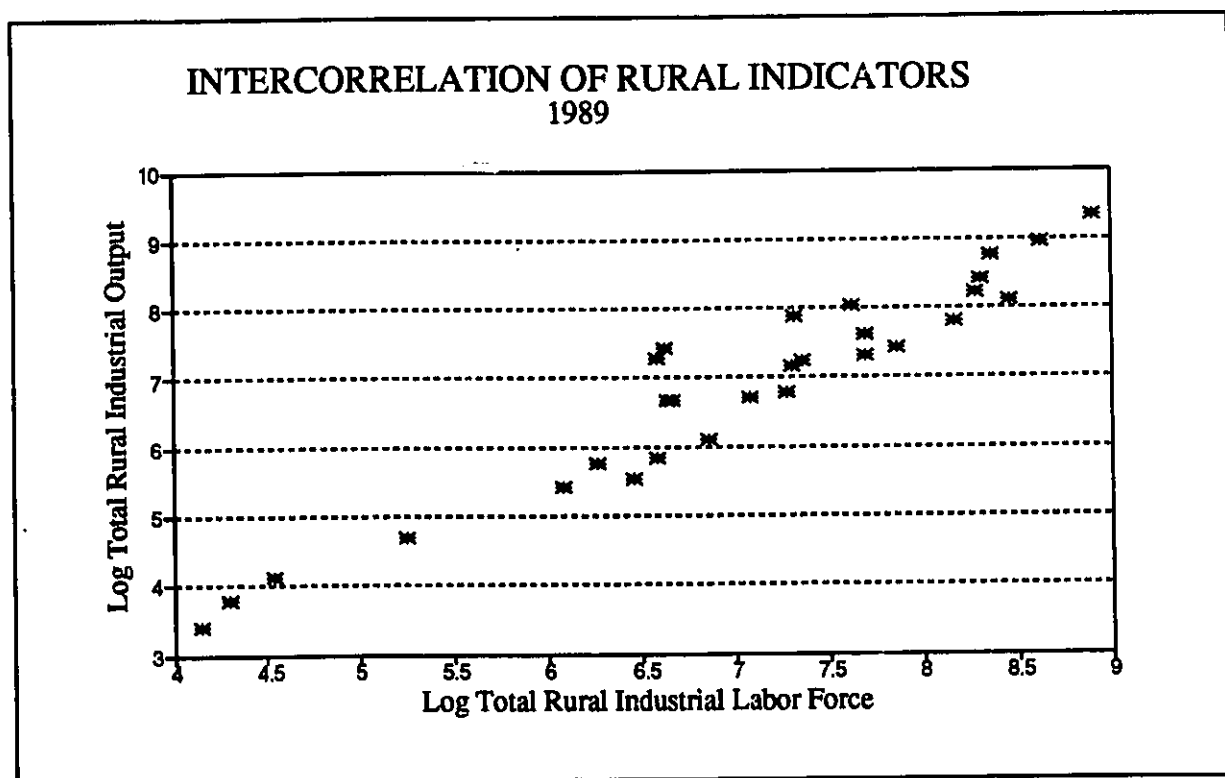
Table V-3 Matrix of Intercorrelations

NAME	LEMPRL	LASIZEFT	LTOTEMP	LTOTOUT	LOUTEMP	LTAXPRFP	LFIXASTP	LEXPORPE	LCOALOUT	LELECOUT	LWOODOUT	LCMNTOUT
LEMPRL	1.000											
LASIZEFT	0.830	1.000										
LTOTEMP	0.518	0.315	1.000									
LTOTOUT	0.712	0.513	0.961	1.000								
LOUTEMP	0.930	0.826	0.456	0.683	1.000							
LTAXPRFP	0.887	0.845	0.251	0.480	0.887	1.000						
LFIXASTP	0.552	0.662	-0.177	0.070	0.698	0.708	1.000					
LEXPORPE	0.766	0.785	0.299	0.487	0.783	0.699	0.624	1.000				
LCOALOUT	-0.434	-0.474	-0.158	-0.293	-0.530	-0.369	-0.469	-0.573	1.000			
LELECOUT	-0.468	-0.340	-0.453	-0.519	-0.478	-0.395	-0.179	-0.201	0.533	1.000		
LWOODOUT	-0.533	-0.639	-0.182	-0.340	-0.617	-0.519	-0.581	-0.558	0.440	0.225	1.000	
LCMNTOUT	-0.493	-0.467	-0.259	-0.366	-0.494	-0.434	-0.311	-0.617	0.358	0.059	0.333	1.000

Graph V-1



Graph V-2



Source: DREMAC. 1990. China Rural Enterprise Yearbook 1990.
Beijing: Agricultural Press. p.149,168.

The factor analysis is conducted using the SAS[®] factor procedure. The factor procedure in SAS[®] performs a variety of principal component and common factor analyses with rotations and outputs component scores or estimates of common factor scores. Factor and principal component methods are multivariate statistical techniques which result in the "collapsing of a set of intercorrelated variables onto a smaller number of basic dimensions or composite variables" (King, 1969, p.165). Although both methods have much in common, factor analysis is different from component analysis since a component is an observable linear combination, "A common factor is an unobservable, hypothetical variable that contributes to the variance of at least two of the observed variables" (SAS[®]. 1988, p.450). Principal component and common factor analysis are often followed by rotation of the components or factors. Rotation is the application of a non-singular linear transformation to components or common factors to aid interpretation (SAS[®]. 1988, p.35). Usually a rotated pattern matrix in which all the coefficients are close to 0 or 1 is easier to interpret than a pattern with many intermediate elements, but it is not always the case. This research has attempted factor analysis with varimax, and orthomax rotation methods on the logarithmic data¹⁸ of the twelve rural industrial indicators. The final result which will be discussed in the next section is from a factor analysis with no rotation. The selection of the final result is

¹⁸ Since Procedure Factor of SAS[®] Version 6.06 transforms data set to standard score matrix before factor analysis, a raw data set with different measurement scale or unit can be used.

based on the considerations of a) the smallest number of factors with highest cumulative value, b) the most meaningful component loadings for interpretation.

3. A Factor Analysis of Rural Industrial Development Level

Many statistical results have been produced by procedure FACTOR. The outputs listed in this section include the eigenvalue, prior and final communality estimates, the unrotated factor pattern, the variance explained by each factor, and scoring coefficients. Then the SCORE Procedure of SAS® is used to multiply values from factor-scoring coefficients and the raw data. The result of this multiplication is the factor score matrix containing linear combinations of the coefficients and the raw data values. Those factor scores are plotted on three maps, and the interpretation of the typology and spatial distribution of the rural industrial development follows.

The eigenvalue and percentage of total variance is given in Table V-4. Since the eigenvalue dropped below 1 after factor4 (0.82), no further analysis was performed. The first three factors account for more than 80% of cumulative value, and are retained for the analysis. Strong groupings of variables on the three components can be observed by Table V-5. The final communality estimates for total is 9.68, and for each variable the lowest communality is 0.53, so the result of the three factors is acceptable.

Table V-4 Eigenvalues of the Correlation Matrix

Initial Factor Method: Principal Components						
Prior Communality Estimates: ONE						
Eigenvalues of the Correlation Matrix: Total=12 Average=1						
	1	2	3	4	5	6
Eigenvalue	6.7408	1.9024	1.0397	0.8197	0.5798	0.3469
Difference	4.8384	0.8627	0.2200	0.2399	0.2329	0.1071
Proportion	0.5617	0.1585	0.0866	0.0683	0.0483	0.0289
Cumulative	0.5617	0.7203	0.8069	0.8752	0.9235	0.9524
	7	8	9	10	11	12
Eigenvalue	0.2398	0.1335	0.1159	0.0610	0.0205	0
Difference	0.1062	0.0176	0.0549	0.0405	0.0205	
Proportion	0.0200	0.0111	0.0097	0.0051	0.0017	0
Cumulative	0.9724	0.9835	0.9932	0.9983	1	1

Table V-5 Matrix of Component Loadings
Principal Components Method

*VARIABLE	FACTOR1	FACTOR2	FACTOR3
LEMPRL	0.9415	0.0875	0.0931
LASIZEFT	0.9006	-0.1634	0.0746
LTOTEMP	0.4952	0.8343	0.1435
LTOTOUT	0.7032	0.6806	0.1170
LOUTPEMP	0.9605	-0.0126	-0.0024
LTAXPRFP	0.8735	-0.1757	0.0404
LFIXASTP	0.6713	-0.6260	-0.1395
LEXPORPE	0.8525	-0.1931	0.1986
LCOALOUT	-0.6155	0.1158	0.5004
LELECOUT	-0.5132	-0.4072	0.6742
LWOODOUT	-0.6789	0.2530	0.0546
LCMNTOUT	-0.5811	0.0731	-0.4720
Variance explained by each factor			
	FACTOR1	FACTOR2	FACTOR3
	6.740812	1.902374	1.039705
Final Communality Estimates: Total = 9.6829			
LEMPRL	0.9026	LFIXASTP	0.9619
LASIZEFT	0.8433	LEXPORPE	0.8035
LTOTEMP	0.9619	LCOALOUT	0.6426
LTOTOUT	0.9714	LELECOUT	0.8836
LOUTPEMP	0.9227	LWOODOUT	0.5279
LTAXPRFP	0.7955	LCMNTOUT	0.5658

* For the meaning of the variables, please refer to Table V-1.

Study of Table V-5 reveals a quite clear classification of the original rural industrial development indicators. Three industrial development dimensions emerged. A meaningful interpretation can be given to index the development dimensions:

- 1) FACTOR1 - productivity of rural industry
- 2) FACTOR2 - employment of rural industry
- 3) FACTOR3 - energy consumption of rural industry.

Factor scores for the 29¹⁹ provinces on each of these three factors were obtained. The scores are listed in Table A5-1²⁰ and mapped in Fig V-2, Fig V-3, Fig V-4 which will be shown after interpretations. The spatial distribution of rural industrial development level in 1989 can be observed from the figures.

(1) Productivity of Rural Industry (Factor1)

In general terms, productivity is a measurement of production, or output, in terms of the inputs required to operate the productive process (Johnston. 1991. p.372). A comprehensive multi-factor productivity index would take into account all resources that are used as inputs to the production process and the effectiveness with which they are combined and organized for production. However, as the information needed for the precise measure of all these inputs is not generally available and in some cases not quantifiable, it is not possible to derive a completely satisfying measure of productivity (Roberge, 1993). The indicators used in the analysis, the output of labour, capital, and raw materials, have the advantage of being widely used in traditional accounting terms as the measurement of productivity.

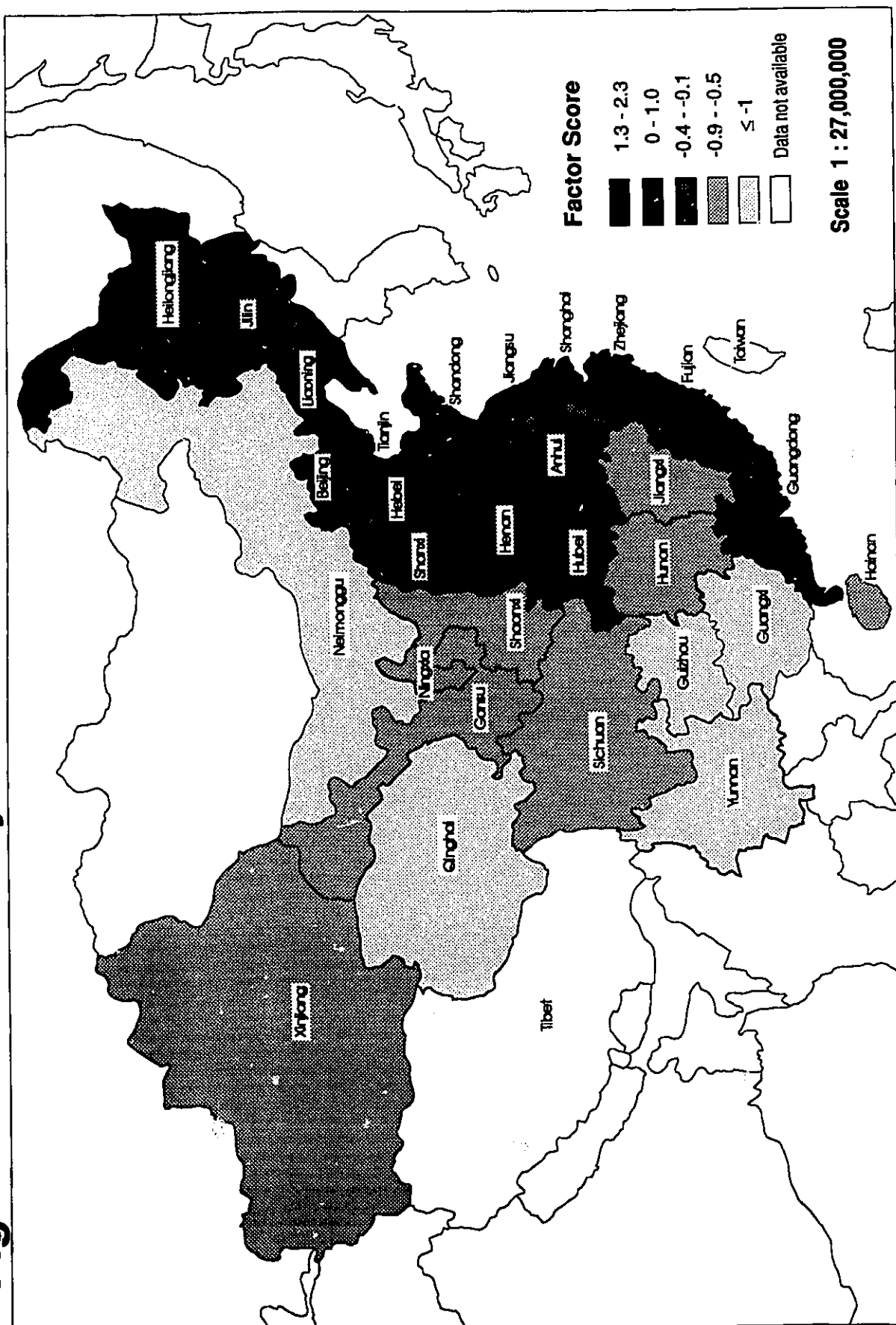
¹⁹ Data for Tibet are not available.

²⁰ Please refer to Appendix 5 Tables and Figures.

This dimension is defined by the high component loadings of labour productivity variables, such as tax and profit per employee (LTAXPRFP) and output per employee (LOUTPEMP), relatively high component loading of fixed assets per employee (LFIXASTP), and high negative loadings of all of the raw material consumption variables (LCOALOUT, LELECOUT, LWOODOUT, LCMNTOUT). As described above, since the indicators that measure productivity have significant component loadings (Table V-5) in this dimension, it is defined as the productivity of rural industry.

It is also noted that the percentage of rural industrial labour force in the total rural labour force (LEMPRL), size of enterprises (LASIZEFT), and total output (LTOTOUT) have high component loadings in this dimension. This shows that its higher rural industrial productivity occurs in the place where higher proportion of rural labour force involved in industrial activities and large rural industrial enterprises. In other words, the more industrialized regions have rural industries that are more productive. The high component loading of export per employee (LEXPORPE) indicates that the more productive rural industries produce better quality and more competitive products for the international market. In summary, FACTOR1 has the largest variance (56%) of the original data set, and it shows the productivity of rural industry. Therefore, FACTOR1 is the most important variable for a classification and regionalization of China's rural industry.

Fig V-2 Productivity of Rural Industry (Factor1), 1989



The productivity map (Fig V-2) clearly display the differences in rural industrial development of China. Three municipalities' (Beijing, Tianjin and Shanghai), Jiangsu and Zhejiang provinces achieve the highest productivity in 1989. Obviously, the productivity level is higher in the east coast region, and a clear high score corridor emerges from Liaoning to Guangdong. Generally speaking, the level of development of high productivity industries decreases from east to west. Nevertheless, some provinces in the interior region have relatively good performance on productivity, such as Shaanxi, Ningxia, Gansu, and Xinjiang while the lowest productivity levels can be observed in Neimonggu, Qinghai, Guizhou and Guangxi.

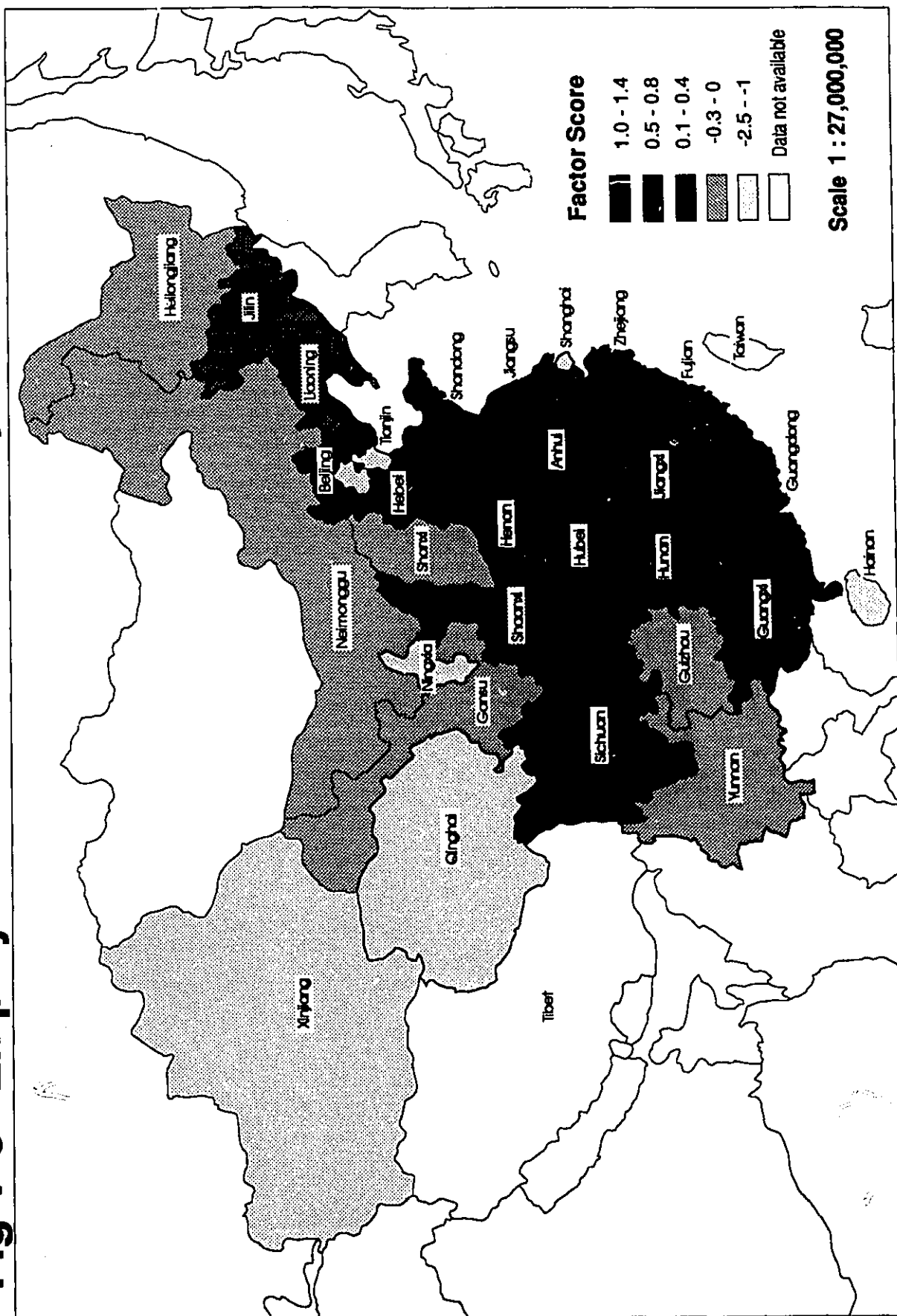
(2) Employment of Rural Industry (Factor2)

This variable retains 15.8% of the variance, and is the second most important variable derived from the analysis. The high component loading of total employees (LTOTEMP) characterizes this component. The loadings in Table V-5 show that the total industrial output (LTOTOUT) is associated with total employees, but not with the labour productivity variables, such as tax and profit per employee (LTAXPRFP) or output per employee (LOUTPEMP) whose component loadings are very close to 0. The emergence of this dimension suggests that the regions with large rural industrial employment are not the regions that have high industrial productivity. In addition, the large negative loading for fixed

assets per employee (LFIXASTP) and the relatively significant negative loading of electricity consumption of rural industry (LELECOUT) represent the basic nature of this labour intensive group of rural industries in China.

The employment map (Fig V-3) presents the spatial distribution of labour intensive rural industries. The highest factor scores are concentrated mostly in the provinces adjoining the east coast region, such as Henan, Hebei, Jiangxi, and Anhui. Another large centre is Sichuan province with the largest population in China. Conversely the lowest factor scores on this component can be observed in Beijing, Tianjin, Shanghai, Ningxia, Qinghai, Hainan, and Xinjiang. The three municipalities have very high proportion of rural labour force involved in industrial activities, but because of small rural population in those municipalities, they got lower scores on this component. Ningxia, Qinghai, Xinjiang, and Hainan are provinces with a small population and a small proportion of rural people working in rural industrial enterprises, therefore, they have the lowest scores in this total employment component.

Fig V-3 Employment of Rural Industry (Factor2), 1989

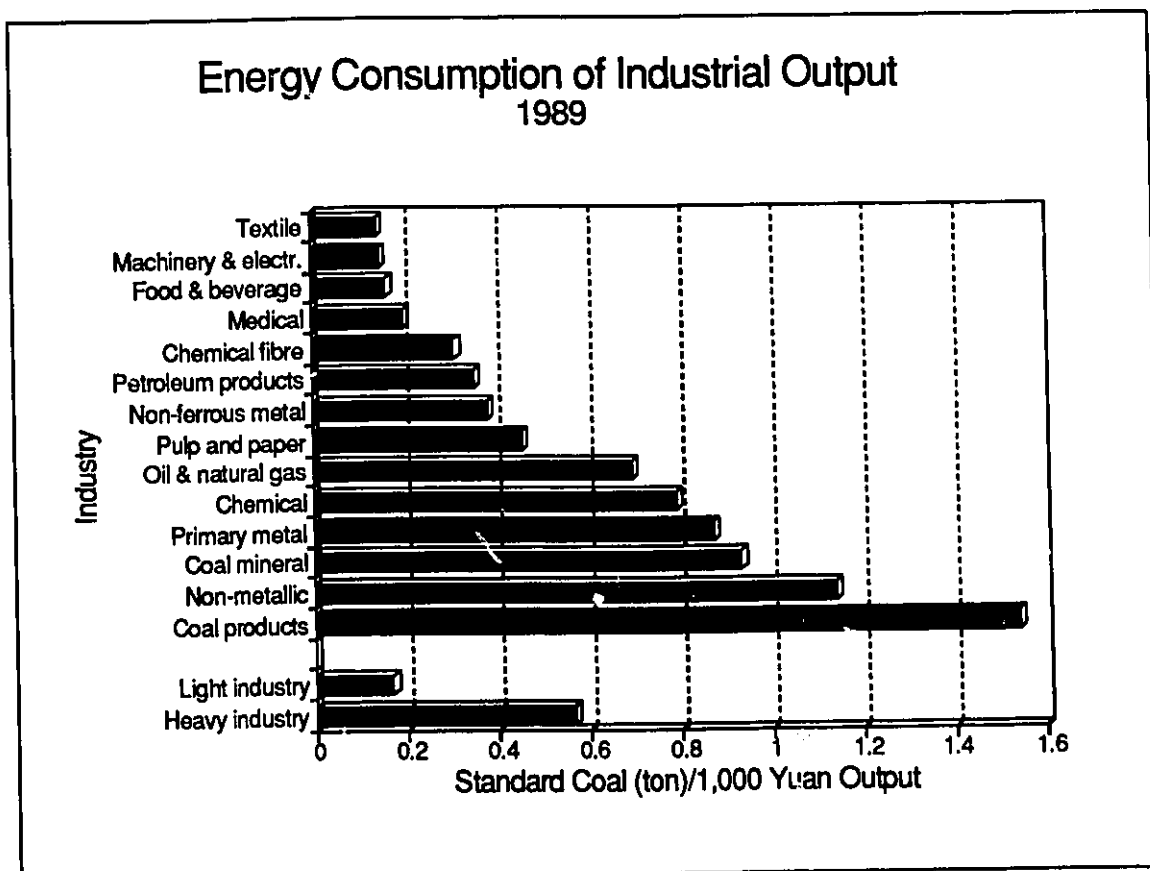


(3) Energy Consumption of Rural Industry (Factor3)

Two variables, coal and electricity consumption of rural industrial output (LCOALOUT and LELECOUT), are significant on this component, although the value of the component loadings (Table V-5) is not very high. Because electricity and coal are the major energy sources for industries in China, this component represents the energy intensive industries. Graph V-3 shows the energy consumption per 1,000 Yuan industrial output produced by major industrial sectors²¹ in China. Generally speaking, heavy industry consumes more energy than light industry to produce a unit value of output. In 1989, the energy consumption per 1,000 Yuan industrial output in light industry was only 0.15 standard coal, but three times higher in heavy industry, the coal products industry, the non-metallic industry, coal mineral industry, and the primary metal industry are the large energy consumers. Every 1,000 Yuan of industrial output produced by coal products industry consumes ten times more than that in textile industry. Therefore, the distribution of the factor scores reflects regional rural industrial composition in China.

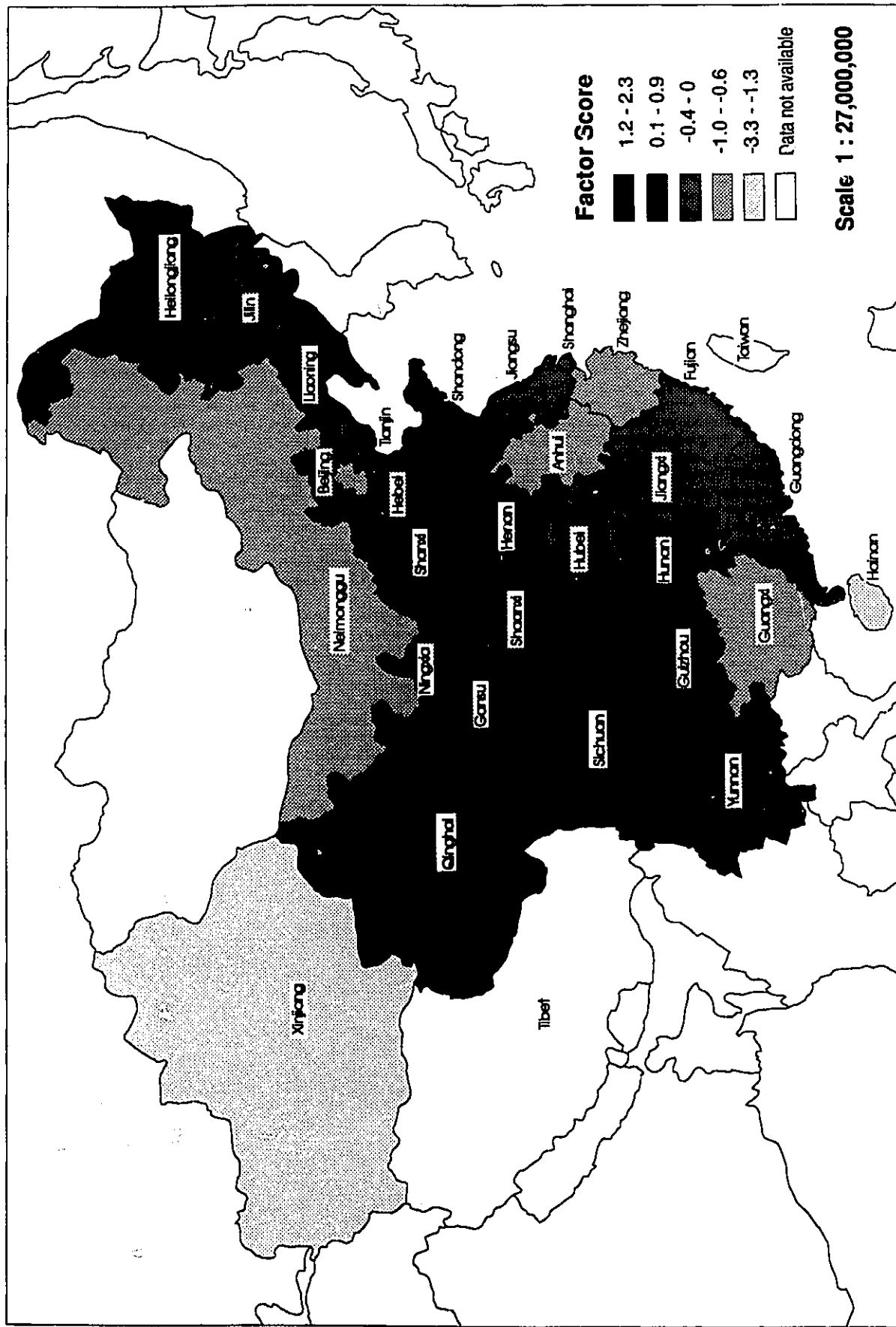
²¹ Include all of state owned, collective owned, jointly owned, private owned, and rural industries in China.

Graph V-3



Source: SSBC. 1991. China Statistical Yearbook 1991. Beijing:
China Statistical Publishing House, p.474
SSBC. 1990. China Statistical Yearbook 1990. Beijing:
China Statistical Publishing House, p.419

Fig V-4 Energy Consumption of Rural Industry (Factor3), 1989



The highest factor scores on the energy consumption map (Fig V-4) are achieved by the provinces with large coal production such as Shanxi, Ningxia and Henan. Shanxi province, the largest coal producer in China, has the highest factor score in the energy consumption component. The high score is a reflection of the industrial composition in Shanxi province. Coal mineral, non-metallic, and primary metal industries are the largest rural industrial sectors and account for two third of total rural industrial output in Shanxi. Since those three industrial sectors are the top three energy consumption industries in China, the highest energy consumption score occurs in Shanxi. In both Ningxia and Henan provinces, non-metallic industry is the largest rural industrial sector and it has been the largest sector in both provinces since 1984 (Wang. 1990. p.263). Qinghai province has three leading rural industries: non-metallic, primary metal, and coal mineral industry. Those high energy consumption industries resulted in the high scores in the provinces. Some provinces, such as Xinjiang, Hainan, and Zhejiang have large proportions of rural industrial output in the textile, rubber, and food industries. As a result, their factor scores are low on the component.

4. A Typology of Industrial Development

Study of the factor scores and the three maps, not only identifies the distribution of rural industrial development but also the development stages of rural industry in China. Four

development stages are defined:

i) Highly developed stage

The regions in this category identify areas where capital intensive enterprises are emerging; almost all rural surplus labour is involved in non-agricultural activities. In some cases they even face labour shortages as in the case of the three metropolitan regions. On the other hand, even in these regions, there are still many small scale, seasonal, labour intensive enterprises. The average size of rural industrial enterprises in Beijing is only 27 employees in 1989 and shows that the words "highly developed" can be meaningful only when it is compared with the other regions.

ii) Semi-developed stage

These regions, classified as semi-developed, have reached the level of relatively stable products and market share. Most of the surplus rural labour is working or looking for jobs in rural industry. On the maps, they have the first or second level's productivity scores on the Fig V-2, and the second or third level scores on the employment map (Fig V-3), since they have passed the primary high labour intensive stage. Provinces such as Jiangsu, Zhejiang, Shandong, Liaoning, Guangdong, are in this category.

iii) Emerging stage

Massive rural industrialization has started in those regions and more and more people are involved in rural industrial activities, but the enterprises are still very small, unstable, and the productivity is low. On the maps, these regions are classified in the third or fourth productivity level on Fig V-2 (scores are

below zero), but in the highest employment level on Fig V-3. The provinces such as Henan, Hebei, Anhui, Jiangxi, Sichuan, Shanxi, Hubei, Hunan, Jilin, Heilongjiang provinces and Guangxi autonomous region can be included into this category.

iv) The pre-industrial stage

These regions' rural industries are mostly resource based and the enterprises were previously owned by communes or villages. Entrepreneurs have not yet mobilized rural labourers or started enterprises. On the maps, these regions have low productivity scores, low rural industrial employment, and a high energy consumption, Qinghai, Ningxia, Gansu, Guizhou, Yunnan fall in this category.

As described above, China's rural industry is distributed throughout China but at clearly different levels of development. The three factors derived from the factor analysis are the important indicators for rural industrial development, and will be used for further analysis. The relationship between rural industrial development and regional characteristics is the subject of the analysis found in the next chapter.

VI. The Relationship Between Regional Characteristics and Rural Industrial Development at the Provincial Level

The spatial distribution and the typology of rural industrial development have been analyzed. This chapter will reveal the regional characteristics that cause unbalanced distribution of rural industry at the provincial level. The hypothesis to be tested in this chapter is that rural industry, as a market economy in China, and its development and distribution are strongly influenced by market forces but not by government policies. In addition, the relationship among rural industrial indicators and regional characteristics will be analyzed.

1. Indicators of Regional Characteristics

As described in previous chapters, rural industries have to be developed in the locations that are viable, although rural industrial location policy should have certain control on it. Being a market economy, there is a prior ground for expecting rural industrial activities to be developed in more economically developed areas. In this research, the developed region is assumed to have a higher agricultural productivity, more surplus labour and financial funding, a larger market, better industrial infrastructure, transportation facilities, and an educated labour force. Based on the findings already provided, and the availability of data, 19 indicators are used to represent regional

characteristics.

These indicators are obtained from the China Statistical Yearbook, 1990 compiled by State Statistical Bureau and published by China Statistical Publishing House. The statistical data in the book were reported at the end of 1989, the same time as rural industrial statistical data used in the research.

This yearbook series is the most complete official statistical series at the national level. The data source in the yearbook is described by the editor: "For the Chinese statistics, most data in this statistical yearbook are from the year end statistical reports collected and compiled by State Statistical Bureau of China, other data are from social survey done by investigation teams of State Statistical Bureau of China (SSBC. 1990, p.i)." The statistical data collecting procedure in China has been discussed in chapter V for rural industrial data. The national level's statistics are collected by the same procedure. In addition, the State Statistical Bureau is the authorized statistical agency in China, and has many sub-bureaus at the provincial and county level to collect data, and also to ensure quality of data. The precision of national level's data published by State Statistical Bureau is usually better than other publications because of the authorized data source, professional editor and publisher, and longer publishing history. This research uses the regional data entirely from the China Statistical Yearbook not only because it is available and more reliable than the other publications, but also because the focus of the research is on the comparison among provinces. The data from

the same publication will minimize the problem of data inconsistency and incompatibility.

Another question often discussed about Chinese statistical data is that "in the past, the data published were for propaganda rather than economic management (Travers, 1982. pp480-485. Cited from Li, 1988. p.12)". It is difficult to prove that this situation has totally changed, but some facts have indicated the changes after introduction of the economic reforms. For instance, the enormous amount of data are published and used for economic analysis and management, more and more international organizations are using Chinese statistics as their primary data source, etc.

In order to minimize the affect of non-accurate data (if any), some efforts have been made. First, the regional characteristic indicators are selected carefully by using major and often used indicators in the statistical yearbook. Second, multi-variables are used to represent one key factor group such as market, industry. Thus, some of the bias caused by a single indicator may be reduced or cancelled by another. Third, instead of using 1989 data as a single database, other information drawn 2 years before and 2 years after the 1989's statistics for all of selected indicators are used to see if there is any severe discontinuities in the data series. The result of the examination is that the 19 indicators listed in Table VI-1 are statistically acceptable.

Table VI-1 Indicators of Regional Characteristics, 1989²²

1) Agriculture

AOUTPRLB: Agricultural output per rural worker (Yuan)
 LANDPPOP: Arable land per rural population (mu²³)
 GRAINPRL: Grain output per rural worker (kg)

2) Market

POPPKM2: Population density (person/km²)
 HOUSEXP: Household expenditure per capita (Yuan/person)
 INVESTPP: Investment per capita (Yuan)
 COMEMPP: Commercial employees per capita

3) Industry

UOUTPEMP²⁴: Urban industrial output per employee (Yuan)
 FIXASTSE: Fixed assets per employee of state owned industry (Yuan)
 TAXPROFE: Tax and profit per employee of state owned industry (Yuan)
 INDUINVE²⁵: Total industrial investment (Yuan)

4) Transportation facilities

RAILWAYD: Railway network density (km/km²)
 HIGHWAYD: Highway network density (km/km²)
 FREIGHTR: Railway freight transport (Ton)
 FREIGHTH: Highway goods transport (Ton)

5) Communication

TOTBUSNI: Total value of communication services (Yuan)
 PHONPE: Telephones per thousand people

6) Labour force

UNIVTY: Persons with college or above education per 100,000 people
 JUNIORAB: Persons with junior middle school education
 or above per 100,000 people

These 19 indicators reflect major regional characteristics which could influence rural industrial development, such as market,

²² For a description of indicators, please refer to Appendix 4.

²³ 1 hectare = 15 mu

²⁴ Urban industrial output: Total industrial output minus rural industrial output.

²⁵ Total industrial investment: Rural industrial investment is included, because of aggregated data.

agriculture, industrial infrastructure, transportation facilities, communication facilities, and labour force. A brief description on the 19 indicators follows.

Rural industry is developed in rural areas. Theoretically, agriculture should be an important factor that influence rural industrial development. Three indicators are selected to represent regional agricultural characteristics. They are agricultural output per rural worker, arable land per rural population, and grain output per rural worker. Agricultural output is the output of agricultural products in terms of money (listed price multiplies quantity produced). Agricultural output per rural worker shows rural people's gross income from agricultural production. It should be expected that a region with higher agricultural output per rural worker has more rural industries developed. Grain output is another important material measurement for rural production. As a tradition and also because of the large population, grain self-sufficiency is always a very important economic indicator in China. Even today, grain products are still the most important agricultural products in rural areas, especially at the provincial level. At the provincial level, arable land per rural population implies the availability of surplus rural labour in a region. The smaller arable land area per rural population in a region may indicate more surplus labour in the region for rural industries.

In a market economy, "the importance of access to the market as a factor affecting industrial location has been recognized for a long time (Smith. 1981, p.54)." Since China's rural industry is

a market economic sector, it is assumed that the access to market can affect its development. The importance of the regional market characteristics to rural industrial development in China is tested. Four indicators are used to represent market situation in a region. First, population density shows potential customers and labour force for rural industry in a region. Second, household expenditure is the total of expenditures of personal consumption excluding bank savings. It reflects living standards and purchasing power in a region, which is one of the most important indicator of a market situation. Third, investment contains the capital construction and technical reforms of state owned establishments, the investment in fixed assets by collective enterprises, and the investment in housing and production fixed assets²⁶ by individual person (SSBC. (1), 1985. p.174; SSBC. (15), 1990. p.568). The three indicators above represent the overall market demand in a region, the greater demand provides a better chance for rural industrial development. The last indicator in this group is commercial employees per capita, which includes the employees in retail, catering, and service industries (SSBC. (15) 1990. p.602). This indicator reflects the availability of commercial services in a region. A region with more commercial employees per capita indicates better commercial networks for rural industry.

Urban industrial activities create an industrial environment for rural industrial development. Rural industries may benefit from

²⁶ The fixed assets are the assets which can be used for more than two years and unit value is over 50 RMB Yuan (SSBC. (1) 1985, p.174).

existing urban industry for agglomeration, and linkages economies. Since this analysis is at the provincial level, agglomeration and linkage effects can only be analyzed at a general level. For instance, the larger and more developed urban industries in a province may provide a better trained industrial labour force, better infrastructure, and more opportunities for rural industrial development. On the other side, rural industry may get negative influences from urban industrial activities, such as overloaded transportation and infrastructure, occupied resources, higher price of local labour, etc. Nevertheless, rural industry is closely related and influenced by existing urban industry in the same region. According to data availability, 4 indicators are included. First two indicators, urban industrial output per employee and tax and profit per employee of state owned industry, give the information on urban industrial productivity in a region. At the provincial level, more productive urban industry may provide better opportunity for rural industry. The third indicator, fixed capital per employee of state owned industry shows the type of urban industry in a region, such as capital intensive or labour intensive. This may influence rural industrial type in the same region. The last indicator, total industrial investment reflects the total growth of manufacturing in a province. It would have been better if rural industrial investment were excluded. Even though, this is still an important indicator for industrial characteristics.

Transportation is often considered to be the most important

determinant of plant location, although it is less true than it has been historically (Smith. 1981, p.57). In a geographically large country such as China, transportation plays an important role for industries. It is even more important for China's rural industries, since they are spread over a huge territory unlike urban industry. Railways and highways are the most important transportation systems in China, while waterway indicators are not included because of missing data. For railway and highway networks, only length and density data are available at the provincial level. Since density reflects accessibility to transportation facilities better than length which is influenced by area of a province, both railway and highway density indicators are selected. Another important indicator used in the analysis is freight transport. It shows the usage and capacity of transportation facilities. Both railway and highway freight transport data are available and included in the analysis.

Communication facilities and services include telephone, telegraph, and post services. In today's world, information and communication are becoming more and more important to any type of business, and rural industry is no exception. Two indicators in this group are a) total revenue of communication services, and b) telephones installed per thousand people. The revenue from communication services reflects the regional information exchange level and services availability. Telephone quantity per thousand people shows not only regional communication capacity, but also implies the living standards of a region because telephone

installation is very expensive in China.

Any industrial enterprise needs labour to operate, therefore, labour is an important factor for rural industry. The local advantages with respect to cost, quantity, and quality are major aspects of the labour factor. Due to the data availability, the labour indicators in this research can only focus on labour quality or educational level. It is assumed that rural industry will develop more in a area that has a better educated labour force. Two indicators are used, a) persons with university education or above per 100,000 persons, and b) persons with junior middle school education or above out of 100,000 people. These two indicators present two educational levels which reflect workers and technical and management personnel. Both are important to rural industry.

As described above, the 19 indicators are related to rural industrial development in some way. The purpose of the following analysis is to test the hypotheses, and answer the questions: a) Is there a relationship between rural industrial development and regional characteristics and how good is the relationship? b) Which regional indicators influence or correlate with rural industry significantly and why? c) How good can those indicators predict rural industrial development level by regions?

2. Methodology

The major method used in this chapter is multiple regression²⁷. The relationship between rural industrial development and regional characteristics can be identified by the regression analysis.

Before any regression analysis, the raw data of 19 regional indicators were tested to get a better understanding of the data. Univariate and correlation procedures were used for the data base testing. Due to the skewness observed from univariate analysis on most indicators, a logarithmic transformation was used for the 19 independent variables. The skewness of the 19 logarithmic transformed indicators was clearly reduced from the original ones²⁸. Therefore, the logarithmic transformed indicators will be used in the entire regression analysis (The letter "L" at the beginning of each variable indicates a log transformation).

Results of correlation analysis show some high correlations ($CORR > 0.85$) among household expenditure, investment per person, and communication indicators. Also some relatively high correlation can be observed among household expenditure and labour education indicators. This test brings in a question: should the regional indicators be regrouped by factor analysis before running multiple regression analysis? First, factor analysis was tried on 19 logarithmic transformed indicators, but it was eliminated from the

²⁷ The regression analysis is done using SAS® version 6.06.

²⁸ Please refer to Table A5-2, Appendix 5.

analysis due to the difficulties of proper theoretical interpretation, an indication that the factor method was not suitable in the case. Secondly, one of the purposes of the provincial level analysis is to find those regional characteristics that have high correlations with rural industrial indicators. This not only will provide a better understanding of the relationships at the provincial level, but also, an example for selecting indicators for the regional level analysis. From this point of view, the original indicators are better than the factors. Finally, this analysis will use the stepwise method to select indicators, the number of indicators and inter-correlation among some variables should not be a problem.

As described above, the dependent variables are the three factors (productivity, employment, and energy consumption of rural industry) from previous analysis in chapter V. The independent variables are the 19 logarithmic transformed regional indicators in Table VI-1.

The first part of the analysis is a preliminary multiple regression analysis between dependent variables and regional indicator groups. The relationship between rural industry and regional groups can be shown by the general results. A comparison of R^2 values from each regression analysis can give the degree of association between rural industry and regional indicator groups. Interpretations will be given based on the result. This analysis was a pretest of the hypothesis, if the result supports the hypothesis in general, further analysis was attempted.

The second part was a more detailed analysis among rural industrial indicators and all of 19 regional characteristic indicators. The two types of analysis were: 1) stepwise analysis, 2) multiple regression analysis on those variables selected by the stepwise method. The correlation between every rural industrial indicator and 19 regional indicators was analyzed using those two steps.

The stepwise method selects regional indicators which are the most highly correlated with rural industrial variables. It also gives each variable's partial R^2 , and therefore shows the contribution of the individual variable to the overall correlation. This analysis will allow us to identify those indicators that influence rural industrial development significantly. The minimum number of independent variables which represent the maximum model R^2 can be selected by the partial R^2 and model R^2 for further analysis.

Multiple regressions will be run between the dependent variables and the independent variables selected by the stepwise method. This analysis should highlight the relationship between rural industrial indicators and those important regional indicators. The estimated parameter obtained from the analysis provides more information about the relationship. The spatial distribution of the residual scores indicates those areas that are over predicted or under predicted by the model. Interpretation of the result will show whether the hypothesis is supported, partly supported, or not supported. A better understanding for the spatial

relationship between rural industrial development and regional characteristics will be provided.

3. Regression Analysis between Rural Industrial Development and the Regional Characteristic Groups

The purpose of this preliminary regression analysis is to identify the relationship between rural industrial development and regional characteristics in general. The hypothesis to be tested is the relationship between rural industry and regional characteristics. Eighteen regressions have been performed between each rural industrial development variable (productivity, employment, and energy consumption) and every regional indicator group (6 groups) in Table VI-1. The R square of those regressions are listed in Table VI-2.

Table VI-2 R Square of Multiple Regression Analysis

Regional Characteristics Category	Productivity (Factor1)		Employment (Factor2)		Energy consumption (Factor3)	
	R ²	*ADJ R ²	R ²	ADJ R ²	R ²	ADJ R ²
Agriculture	0.3989	0.3267	0.4186	0.3489	0.3224	0.2410
Market	0.9053	0.8895	0.6740	0.6196	0.2529	0.1284
Industry	0.5393	0.4625	0.6805	0.6272	0.0937	-0.0574
Transportation	0.6326	0.5714	0.3319	0.2205	0.1889	0.0538
Communication	0.5668	0.5335	0.2428	0.1845	0.1148	0.0467
Labour Force	0.4893	0.4500	0.4122	0.3669	0.0186	-0.0569

*ADJ R²: adjusted R²

The high correlations between dependent variable productivity of rural industry and market and transportation facilities show the market orientation of rural industry in China clearly. It also has a good correlation with the communications, and industry groups, which indicates that most regional characteristics have influences on rural industrial productivity. It is very interesting to see that rural industrial productivity has a weak correlation with regional agricultural indicators. Although this is a very general test, the result shows that rural industrial development is influenced by local market opportunity more than the possibility of processing agricultural products.

Another dependent variable, employment of rural industry, has high correlation with industry, and market groups. This result indicates that more than one rural industrial indicator has a high correlation with regional characteristic indicators. Although the correlation between agriculture and employment of rural industry is somewhat higher than the R^2 value in the result with the productivity indicator, it is still low if compared to other groups. It seems to indicate that regional agricultural development level has no significant influence on rural industrial development in 1989.

The energy consumption indicator is not correlated with any individual group in this pretest. This indicates that the energy consumption indicator measures resource orientation of primary industries, therefore it has weaker correlation with regional indicators.

This preliminary analysis gives a general idea of the relationship between rural industrial development and basic regional characteristics. The result supports the hypothesis that rural industrial development is correlated and influenced by certain regional economic characteristics. Furthermore, this result already clearly shows the market oriented characteristics of rural industry, although a detailed interpretation can not be given at this time.

4. Regression Analysis between Rural Industrial Development and Selected Regional Indicators

The existence of correlations between rural industrial development and regional characteristics has been supported by the preliminary analysis. A further analysis continued to identify the contribution of each independent variable. A stepwise analysis is used to identify minimum number of independent variables (19 logarithmic transformed regional indicators) which can explain the maximum variation of dependent variables (Productivity, employment, energy consumption). A multiple regression analysis was conducted between rural industrial development indicators and the regional indicators selected by stepwise method. The results of those analyses were listed and interpreted.

(1) Rural Industrial Productivity and Regional Indicators

Rural industrial productivity is the most important indicator of rural industrial development, because it counted 56% of variance of the original rural industrial data set. The provinces with the highest scores are in the east coast region. their strong correlation with market indicators and some other regional characteristic groups have been demonstrated in the previous analysis. A stepwise analysis and a multiple regression analysis among rural industrial productivity and selected regional indicators was conducted in this section. Those analyses tested the hypothesis at a more detailed level and provide a better understanding of the relationships.

The summary of the stepwise procedure for the dependent variable rural industrial productivity appears in Table VI-3. The statistical result listed in the Table VI-3 are the step, the independent variables, the partial R square, and the model R square. This analysis has been done using stepwise option of SAS® v.6.06 regression procedure. The variables left in the model are significant at the 0.1500 level which is the default value of the procedure. According to the criteria, six variables are left in the model for the productivity indicator. The model R^2 is as high as 0.94.

Table VI-3 Summary of Stepwise Procedure for Dependent Variable Productivity

STEP	VARIABLE		PARTIAL R ²	MODEL R ²
	ENTERED	REMOVED		
1	LHOUSEXP		0.6375	0.6375
2	LPOPKM2		0.2500	0.8876
3	LINDUINV		0.0265	0.9141
4	LINVESTP		0.0115	0.9256
5	LJUNIORA		0.0077	0.9333
6	LPHONPE		0.0079	0.9412

Note:

LHOUSEXP log household expenditure
 LPOPKM2 log population density
 LINDUINV log total industrial investment
 LINVESTP log investment per population
 LJUNIORA log population with junior middle school education
 or above per 100,000 people
 LPHONPE log telephones per thousand people

Among the independent variables, one single variable, household expenditure (LHOUSEXP), contributes 0.6375 to the partial R² in the first step. Other variables left in the model are in three categories, market, investment, and labour force. It is noted that the model R² reached 0.887 after the second variable entered the model, the last four variables in the model explained very little variation (0.05) of the dependent variable. Therefore, those 4 insignificant variables were eliminated, only the first two variables will remain for the further multiple regression analysis.

Table VI-4 Results of Multiple Regression for Dependent Variable Productivity

 Dependent Variable: Productivity

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	2	24.85185	12.42593	102.624	0.0001
Error	26	3.14814	0.12108		
C Total	28	27.99999			
Root MSE	0.34797	R-square	0.8876		
Dep Mean	0.00000	Adj R-sq	0.8789		
C.V.	33636984.148				

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-14.412706	1.28235476	-11.239	0.0001
LHOUSEXP	1	1.896670	0.20738132	9.146	0.0001
LPOPKM2	1	0.411229	0.05408255	7.604	0.0001

Table VI-4 displays the results of multiple regression analysis among the dependent variable Productivity and two independent variables, household expenditure (LHOUSEXP) and population density (LPOPKM2), selected by stepwise analysis above. The R² value is 0.8876 and adjusted R² value is 0.8789, both of them are very high. The results of the model are:

$$\text{Productivity} = -14.41 + 1.897 \cdot \text{LHOUSEXP} + 0.411 \cdot \text{LPOPKM2} + \varepsilon$$

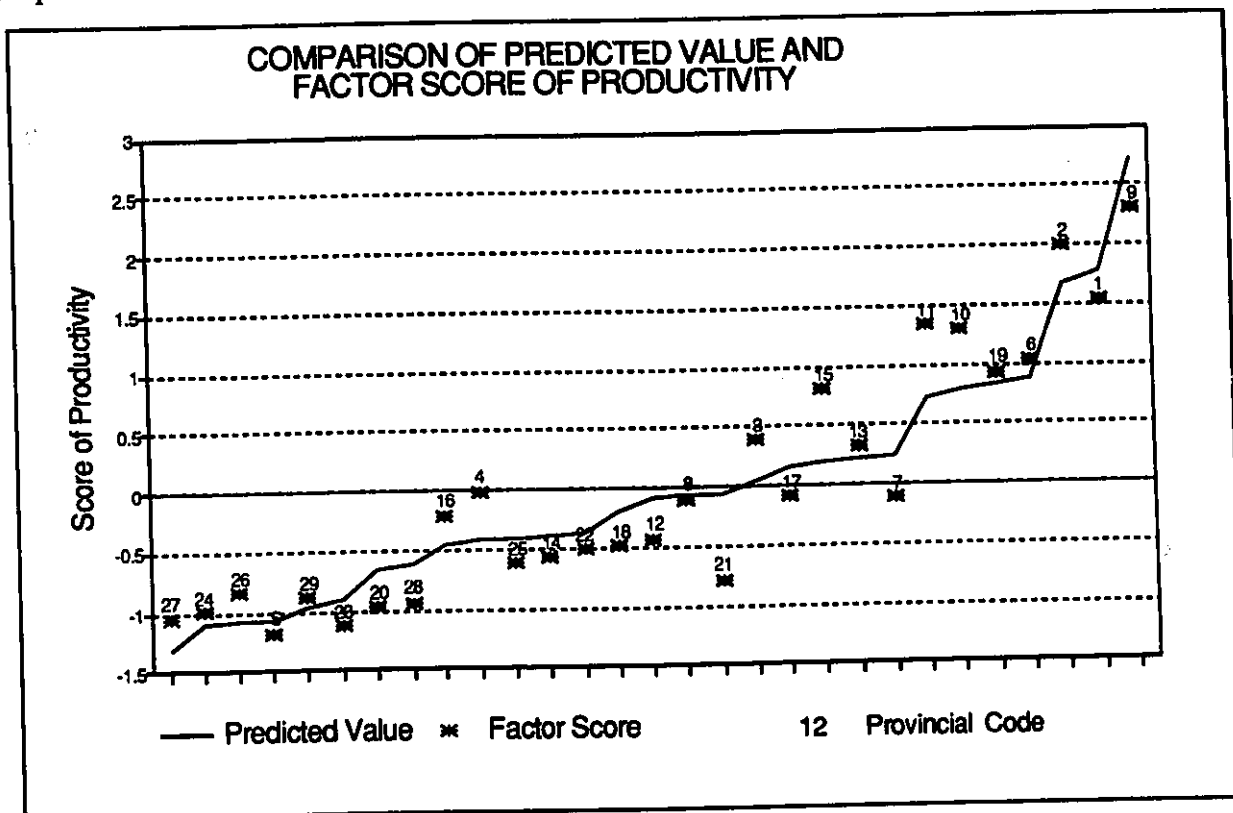
in the equation:

ε residual
 LHOUSEXP log household expenditure
 LPOPKM2 log population density

Both of the independent variables have a positive influence on the dependent variable, the productivity of rural industry.

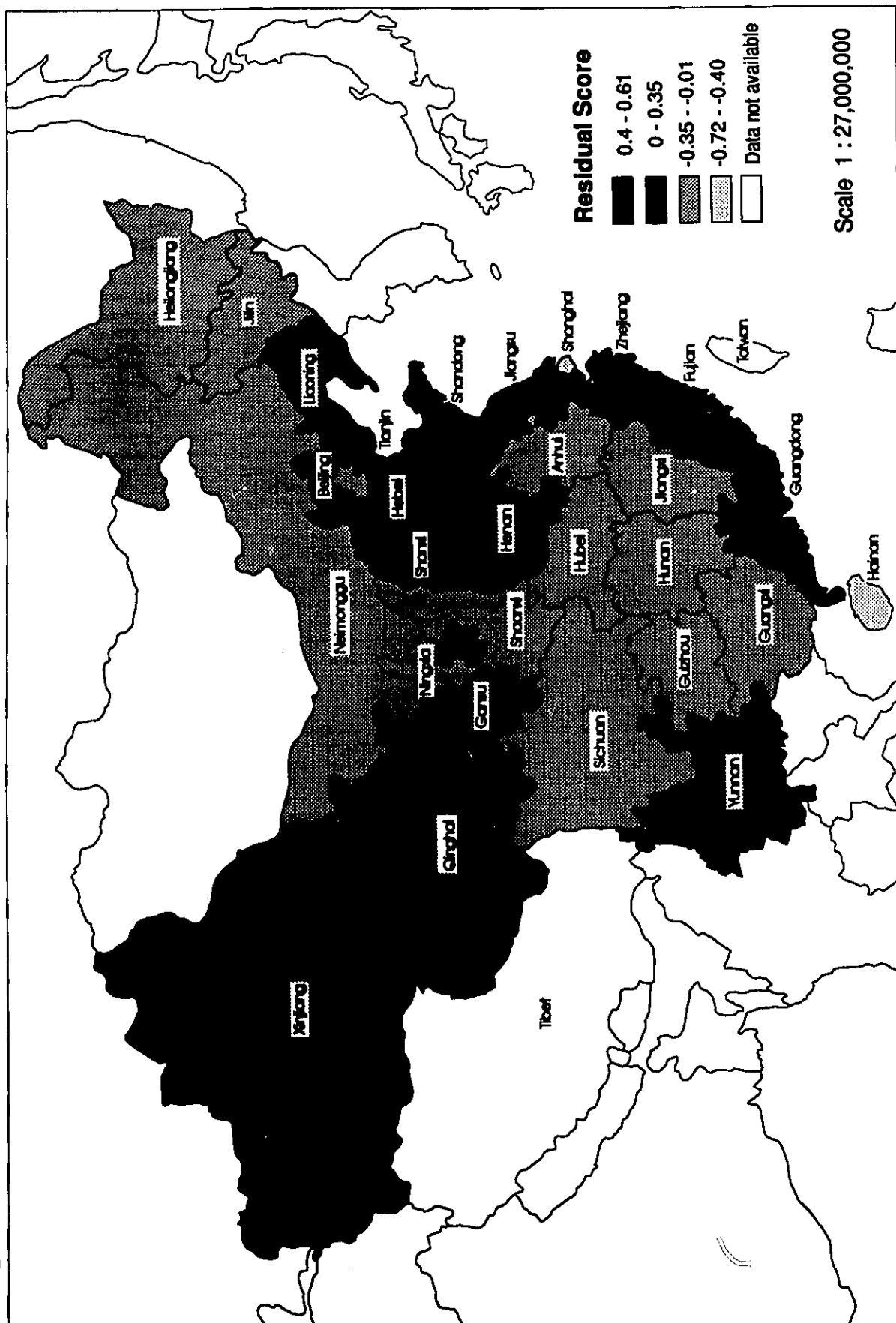
Household expenditure is the most important indicator of a market situation. The high positive correlation between rural industrial productivity and household expenditure shows the strong market bias of rural industry in China. It is very clear that the high productive rural industries developed in rich regions. The equation also shows that the high industrial productivity achieved by the rural industries located in the regions where population density (LPOPKM2) is high. Since higher rural industrial productivity occurs in more densely populated and economically developed region, this result strongly supports the hypothesis that rural industry develops more in highly developed economic regions but not in the remote rural areas that the government's policies were designed to achieve.

Graph VI-1



- | | | |
|----------------|--------------|-------------|
| 1 BEIJING | 11 ZHEJIANG | 21 HAINAN |
| 2 TIANJIN | 12 ANHUI | 22 SICHUAN |
| 3 HEBEI | 13 FUJIAN | 23 GUIZHOU |
| 4 SHANXI | 14 JIANGXI | 24 YUNNAN |
| 5 NEIMONGGU | 15 SHANDONG | 25 SHAANXI |
| 6 LIAONING | 16 HENAN | 26 GANSU |
| 7 JILIN | 17 HUBEI | 27 QINGHAI |
| 8 HEILONGJIANG | 18 HUNAN | 28 NINGXIA |
| 9 SHANGHAI | 19 GUANGDONG | 29 XINJIANG |
| 10 JIANGSU | 20 GUANGXI | |

Fig VI-1 Residual Map of Rural Industrial Productivity, 1989



The predicted value and real factor score are displayed in Graph VI-1. The line represents predicted scores and the asterisk symbol shows the real factor score of rural industrial productivity. The numbers above each asterisk is the provincial code, and the provincial name is listed under the graph. The asterisk symbols above the predicted line indicate the provinces which had positive residuals, and the asterisk symbols under the line show an opposite situation where the residuals were negative. The spatial distribution of the residual scores²⁹ is mapped in Fig VI-1. The darker areas represents the regions whose residual scores are positive, in other words, their productivity scores are under predicted by the model. The lighter one represents the regions whose residual scores are negative or they are over predicted by the model.

Generally speaking, the factor scores of rural industrial productivity are very well predicted by the model. The highest positive residual scores, (or under-predicted provinces) can be observed from Shandong, Zhejiang, and Jiangsu provinces. Two provinces with the largest negative residuals are Shanghai and Hainan.

The three provinces with positive residuals, Shandong, Zhejiang, and Jiangsu, have a high level of rural industrial productivity. It is very clear that the boom of rural industries in those provinces can not be well predicted by living standards, and reflected in the result is the positive residuals in those

²⁹ The scores are listed in Table A5-3 in Appendix 5.

provinces. In addition, both Shandong and Zhejiang provinces have quite large areas covered by mountain and hilly land, and this reduces the population density of those provinces and also affects the predicted value.

The greatest negative residual score, or the most over predicted value, is observed in Hainan. Hainan is in a very special situation. Hainan's rural industrial development was at a very low level in 1989, and its rural industrial productivity score is far below the national average as its performance in urban industrial activity. This has been caused mainly by the lack of industrial infrastructure, such as power supply, and the long term military concern about this frontier island. In addition, Hainan is the only tropical products producer in China, and those products such as rubber, coffee, pepper brings in a good income for the local people. As a result, Hainan province gains the greatest negative residual, or the most over predicted value.

Shanghai is the second over predicted region. Shanghai is the largest industrial and commercial centre in China. Shanghai has the highest population density, and the highest household expenditure in China. Although Shanghai also has the highest rural industrial productivity, it does not correlate with its population density that is almost three times higher than the second most densely populated city Tianjin. Since the predicted value in the model is based on population density and household expenditure, its large population density and high household expenditure contributed to the over prediction. Except for those five provinces, residual

scores of other provinces are close to 0 (-0.35 to 0.40). Two middle level grey shades in Fig VI-1 represent them.

(2) Rural Industrial Employment and Regional Indicators

Rural industrial employment is the indicator that represents labour intensive rural industries. The provinces that have higher scores are in the emerging stage of rural industrial development. The preliminary analysis has shown the high correlation among employment indicators, industry, and market indicator groups. The stepwise analyses at this step will further identify individual regional indicators that have highest correlation with employment indicator. The multiple regression among the employment indicators and selected regional indicators will test the hypothesis again and give information of a more detailed interpretation. Table VI-5 lists the result of stepwise procedure for dependent variable rural industrial employment. The variables left in the model were significant at the 0.1500 level which is the default value of the SAS® regression procedure. Five independent variables are left in the model.

Table VI-5 Summary of Stepwise Procedure for Dependent Variable Employment

STEP	VARIABLE		PARTIAL R ²	MODEL R ²
	ENTERED	REMOVED		
1	LFIXASTS		0.4963	0.4963
2	LINDUINV		0.1625	0.6588
3	LINVESTP		0.2061	0.8649
4	LUOUTPEM		0.0176	0.8825
5	LCOMEMPP		0.0258	0.9083

Note:

LFIXASTS log fixed assets per employee of state owned industry
 LINDUINV log total industrial investment
 LINVESTP log investment per capita
 LUOUTPEM log urban industrial output per employee
 LCOMEMPP log commercial employees per capita

Fixed assets and investment variables have higher correlation with rural industrial employment than other variables. After the first three independent variables entered the model, the model R² reached 0.86. The last two variables are not important in accounting the variation of dependent variable, only 0.04 variation is explained by the variables. Therefore those two variables (LUOUTPEM, LCOMEMPP) are eliminated from further analysis. The multiple regression analysis has been applied for the first three independent variables (LFIXASTS, LINDUINV, LINVESTP), and the results are displayed in Table VI-6.

Table VI-6 Results of Multiple Regression for Dependent Variable Employment

 Dependent Variable: Employment

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	3	24.21817	8.07272	53.365	0.0001
Error	25	3.78185	0.15127		
C Total	28	28.00002			
Root MSE	0.38894	R-square	0.8649		
Dep Mean	0.00000	Adj R-sq	0.8487		
C.V.	1.2699311E18				

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	21.611769	4.16856727	5.184	0.0001
LFIXASTS	1	-2.311705	0.41744613	-5.538	0.0001
LINDUINV	1	0.860121	0.11550099	7.447	0.0001
LINVESTP	1	-0.837865	0.13565813	-6.176	0.0001

The results of the model for dependent variable Employment shows 0.8649 R² and 0.8487 adjusted R² values with three independent variables. The equation is as follow:

$$\text{Employment} = 21.6118 - 2.3117 \cdot \text{LFIXASTS} + 0.8601 \cdot \text{LINDUINV} - 0.8379 \cdot \text{LINVESTP} + \epsilon$$

in the equation:

ϵ residual
 LFIXASTS log fixed assets per employee of state owned industry
 LINDUINV log total industrial investment
 LINVESTP log investment per capita

It can be observed from the model that the rural industrial employment has negative correlation with the variable fixed assets per employee of state owned industry. This means that the labour

intensive rural industries are developed in the regions where fixed assets per employee of state owned industry (LFIXASTS) are low. This result shows that the manufacturing structure of rural industry is mirrored in the structure of state owned industries, and indicates that when certain types of state owned industries are operating in a region, rural industry in the same region has a better opportunity to get subcontracts, raw materials, and expertise in that type of industry. In addition, if state owned industry in a region is categorised as a labour intensive industry, it implies that the region is not an economically developed region. Rural industry in the same region usually can not surpass in production of state owned industry in such a short time. Therefore, the similarity of industrial type between state owned and rural industry is understandable.

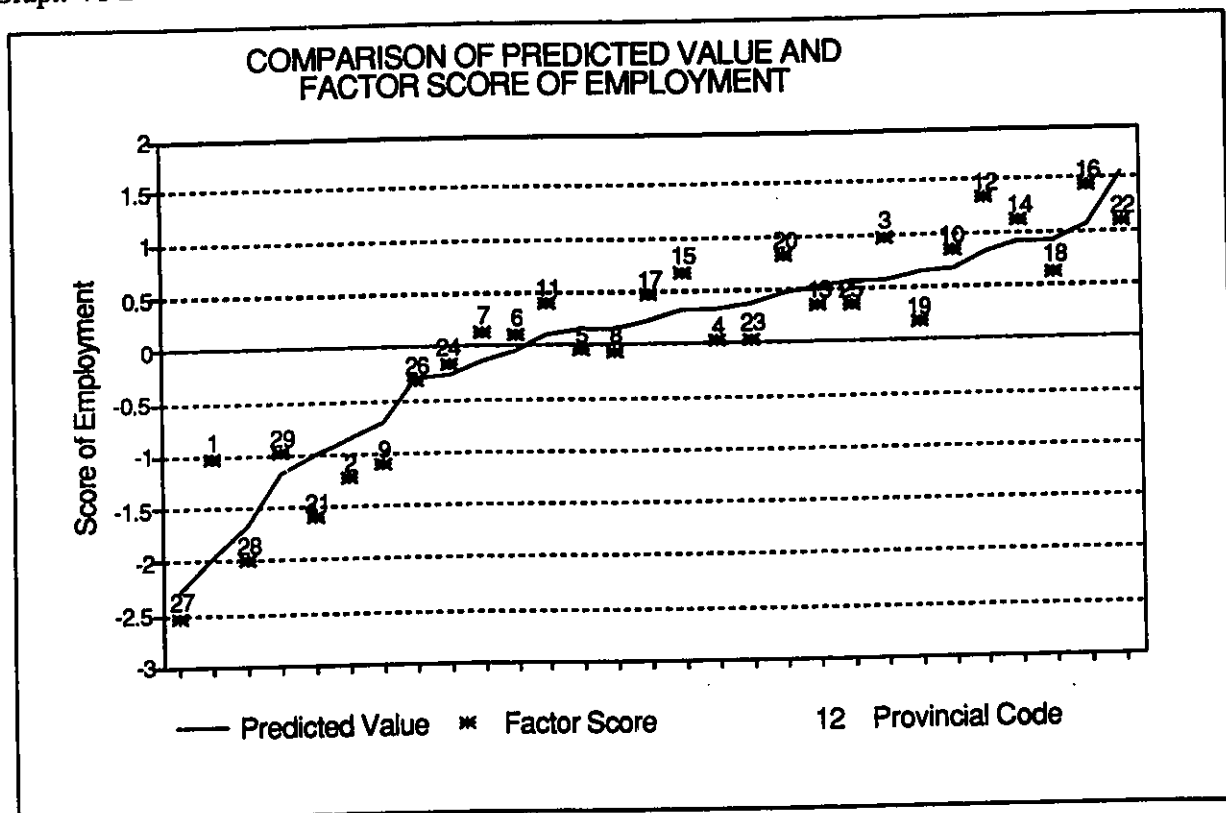
It is very interesting to see that the rural industrial employment factor has a positive correlation with total industrial investment but negative correlation with investment per capita. This result suggests that high rural industrial employment occurs in large provinces where the total industrial investment is high due to the large size. On the other hand, the negative correlation between employment indicators and investment per capita shows that the labour intensive rural industry is developed in the provinces where the economy is not highly developed because the investment per person is low. In addition, with lower industrial investment per capita, the labour intensive industry is more appropriate than capital intensity industries. This result fits the reality very

well. For instance, Henan, Anhui, Hebei, and Sichuan provinces have large population but economically are not very developed provinces, therefore, their rural industrial employment is high, and their total industrial investment is also high, but not the investment per person.

The comparison of predicted value and factor score of employment is displayed in Graph VI-2. The asterisks above the predicted line are those under predicted provinces (positive residual scores), and those under the line are the over predicted provinces (negative residual scores). Map VI-2 shows the spatial distribution of residual scores³⁰. Since the model R^2 is high, the residual scores are very close to 0. Most provinces are very well predicted except Beijing, Anhui, and Hainan provinces.

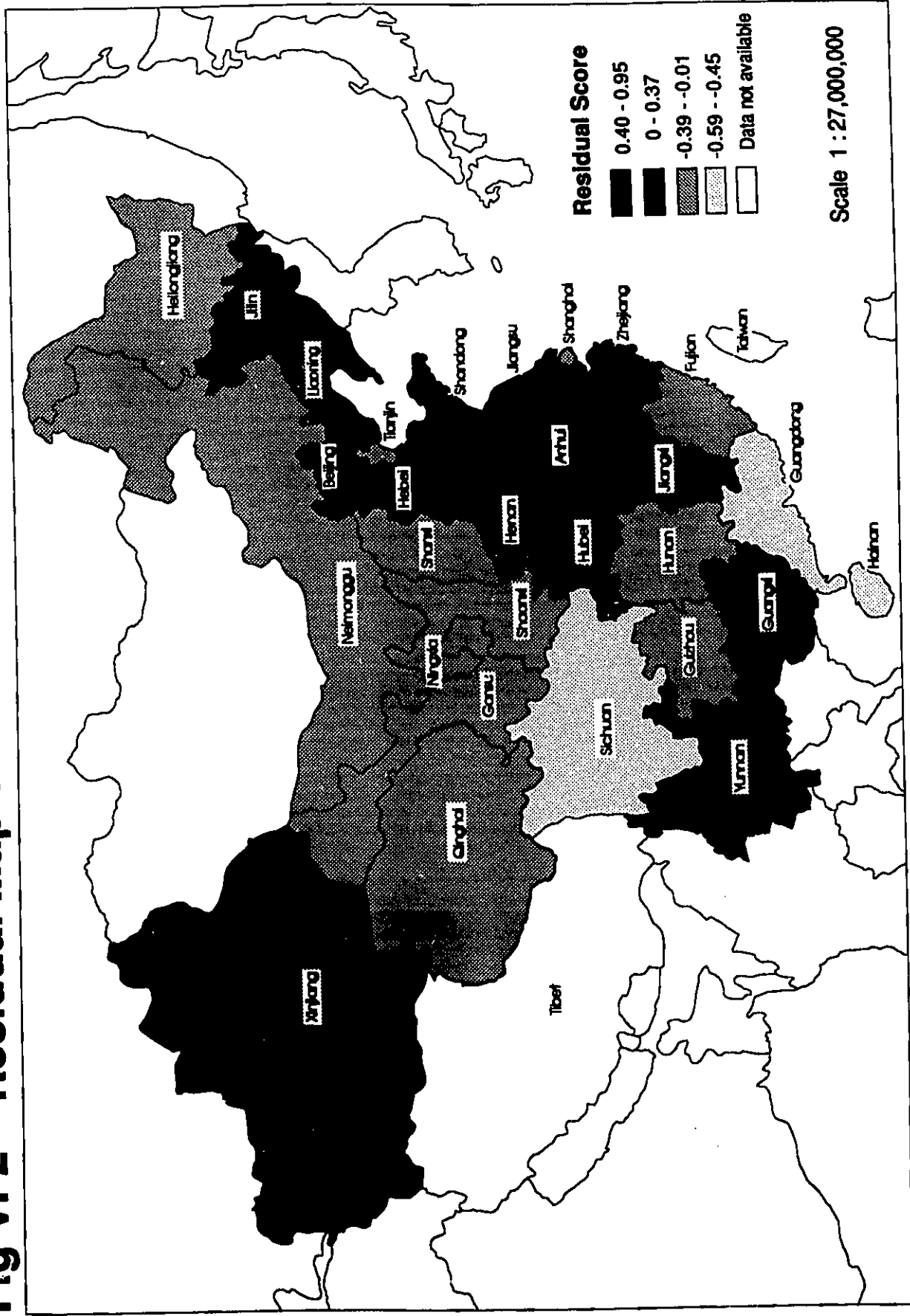
³⁰ The residual scores are listed in Table A5-4 of Appendix 5.

Graph VI-2



- | | | |
|----------------|--------------|-------------|
| 1 BEIJING | 11 ZHEJIANG | 21 HAINAN |
| 2 TIANJIN | 12 ANHUI | 22 SICHUAN |
| 3 HEBEI | 13 FUJIAN | 23 GUIZHOU |
| 4 SHANXI | 14 JIANGXI | 24 YUNNAN |
| 5 NEIMONGGU | 15 SHANDONG | 25 SHAANXI |
| 6 LIAONING | 16 HENAN | 26 GANSU |
| 7 JILIN | 17 HUBEI | 27 QINGHAI |
| 8 HEILONGJIANG | 18 HUNAN | 28 NINGXIA |
| 9 SHANGHAI | 19 GUANGDONG | 29 XINJIANG |
| 10 JIANGSU | 20 GUANGXI | |

Fig VI-2 Residual Map of Rural Industrial Employment, 1989



Beijing municipality has the highest positive residual score. The reasons for that are the high value of fixed assets per employee and investment per capita in Beijing (both are negatively correlated with the employment factor), and very low industrial investment (which has positive correlation with the employment factor). Those three indicators reflect Beijing's situation. Beijing has invested in heavy industry and high tech industry for many years, and its high fixed assets figure is the result of those investments. Most recently, Beijing is restricted from developing heavy industry due to its national capital status, this made Beijing's total industrial investment 1989 figure very low. Instead of investing in industries, Beijing has received large investments in infrastructure, transportation, commercial centres, residential housing. This is reflected by the high value of investment per capita. As a result, it is the positive residual (or under prediction) of Beijing's rural industrial employment. Anhui is another under predicted province (with a positive residual), but the positive residual is mostly related to its lower total industrial investment.

On the other hand, the highest negative residual score (over predicted) can be observed for Hainan province. As for the productivity model, and the energy consumption model, Hainan is the exception which always has the highest level of over prediction (greatest negative residuals). Generally speaking, the situation is that Hainan has relatively high economic development level, but very low rural industrial development scores. Hainan's high

economic development level is mostly due to its tropical products, tourist industry, and its special economic province status³¹. On the other side, due to the lack of industrial infrastructure, the shortage of electricity supply, and its military frontier location, Hainan's industry is not developed. In 1989, the percentage of industrial workers in Hainan's total labour force was only 6.7%, far below the national average of 17.3%, and was the second lowest province after Tibet. Hainan's rural industry is at the same level as its state owned industry, therefore it is always over-predicted by regional indicators in the three models.

Similar to the residual map of rural industrial productivity, the majority of provinces are in two categories, closely above 0 and below 0. Since those scores are very well predicted by the independent variables, no further analysis is needed.

(3) Rural Industrial Energy Consumption and Regional Indicators

The analysis in this section uses the same method as the previous two components. The energy consumption indicator has no good correlation with any regional indicator groups, but it does not necessarily mean this indicator has no relationship with regional characteristics. The analysis in this section shows that energy consumption factor is correlated with regional indicators, although the R^2 value is not as high as the other two models. The

³¹ Hainan has benefited from very special policies and privileges since April 1988 (Guangming Daily, Dec.1, 1993).

summary of the stepwise procedure for rural industrial energy consumption is shown in Table VI-7. The model R^2 for dependent variable energy consumption is not very high, but it reaches a significant level (0.6288). The same as the other two models, those variables left in the model are significant at the 0.1500 level that is the default value of SAS[®] procedure.

Table VI-7 Summary of Stepwise Procedure for Dependent Variable Energy Consumption

STEP	VARIABLE		PARTIAL R^2	MODEL R^2
	ENTERED	REMOVED		
1	LAOUTPRL		0.2603	0.2603
2	LFREIGHR		0.2491	0.5093
3	LFIXASTS		0.0735	0.5828
4	LINDUINV		0.0461	0.6288

Note:

LAOUTPRL log agricultural output per rural worker
 LFREIGHR log railway freight transport
 LFIXASTS log fixed assets per employee of state owned industry
 LINDUINV log total industrial investment

Four variables left in the model are agriculture, transportation and industrial development variables. Those variables explain most of the variation in the dependent variable. Although the last two variables, LFIXASTS and LINDUINV, did not contribute much to explain the model variation, they remained in the analysis due to the low R^2 of the model. A multiple regression analysis is applied on the independent variable, rural industrial

employment, and four regional indicators selected by the stepwise method. Table VI-8 displays the result.

Table VI-8 Results of Multiple Regression for Dependent Variable Energy Consumption

Dependent Variable: Energy Consumption

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	4	17.60743	4.40186	10.165	0.0001
Error	24	10.39260	0.43302		
C Total	28	28.00002			
Root MSE		0.65805	R-square	0.6288	
Dep Mean		-0.00000	Adj R-sq	0.5670	
C.V.		-95416698.46			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > T
INTERCEP	1	-5.542792	7.22368085	-0.767	0.4504
LAOUTPRL	1	-1.851965	0.32986688	-5.614	0.0001
LFREIGHR	1	0.545228	0.18405620	2.962	0.0068
LFIXASTS	1	1.674177	0.69739734	2.401	0.0245
LINDUINV	1	0.316483	0.18336950	1.726	0.0972

The result of this model is not as good as the other two models. The R^2 value is 0.629 and adjusted R^2 is 0.567, the equation is as follows:

$$\begin{aligned} \text{Energy consumption} = & -5.5428 - 1.8520 \cdot \text{LAOUTPRL} \\ & + 0.5452 \cdot \text{LFREIGHR} + 1.6742 \cdot \text{LFIXASTS} \\ & + 0.3165 \cdot \text{LINDUINV} + \varepsilon \end{aligned}$$

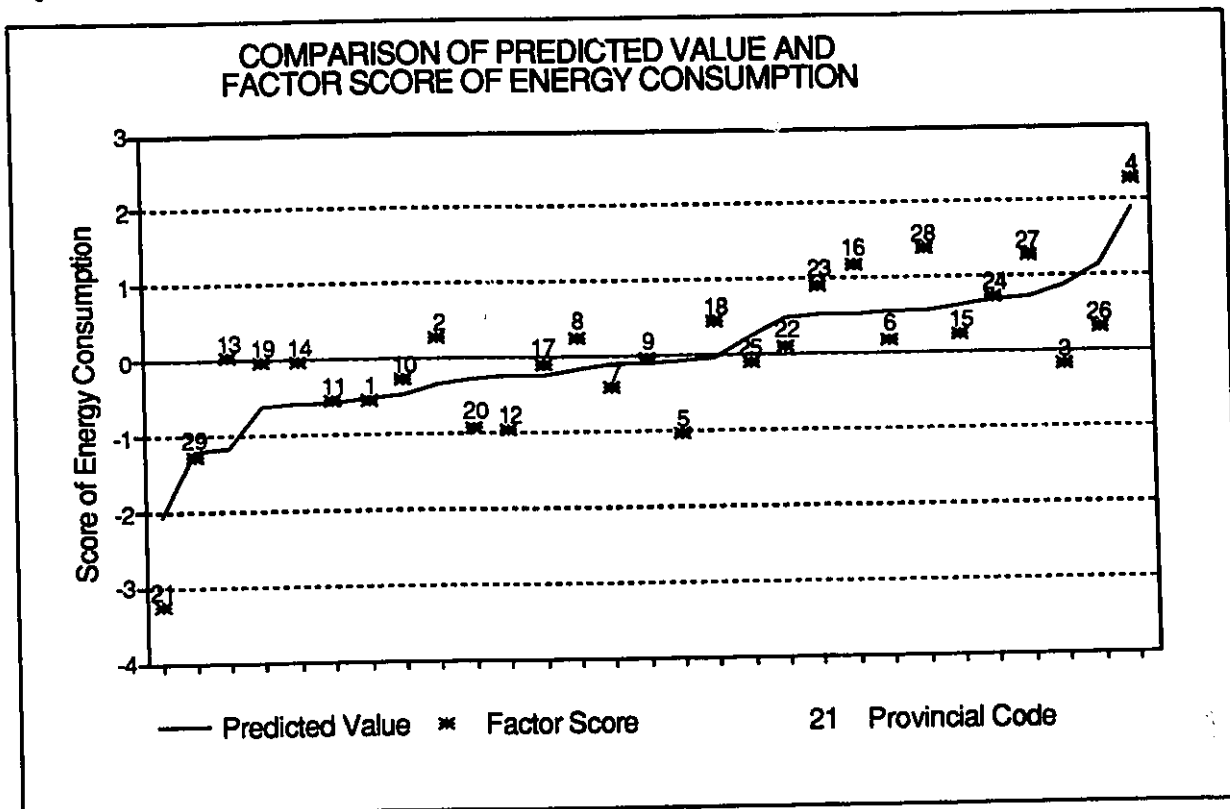
in the equation:

ε residual
LAOUTPRL log agricultural output per rural worker
LFREIGHR log railway freight transport

LFIXASTS log fixed assets per employee of state owned
industry
LINDUINV log total industrial investment

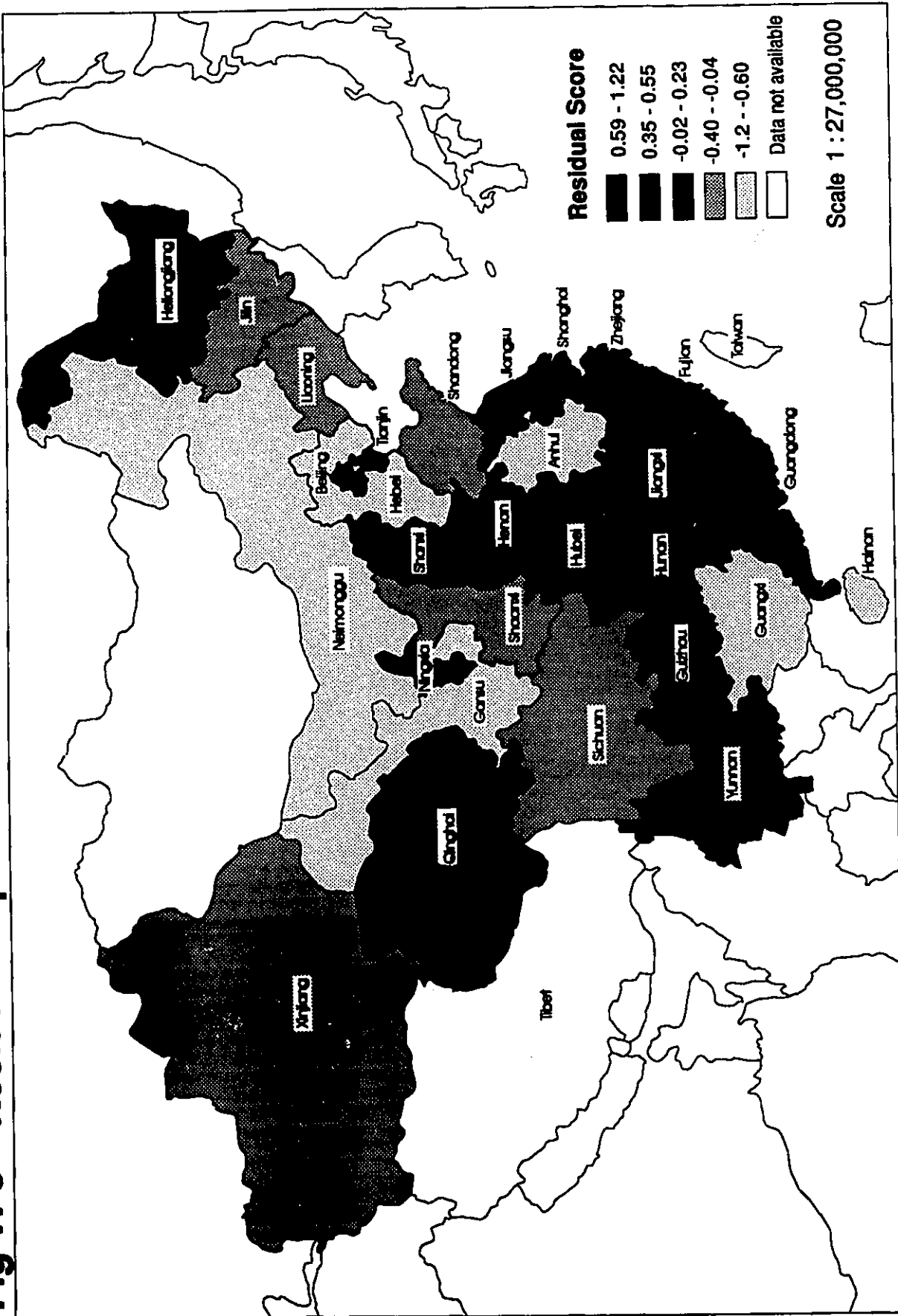
It is clear that the high energy consumption regions are the bases for heavy industrial production. This can be observed from the positive correlation between rural industrial energy consumption and railway freight transport (LFREIGHR), fixed assets per state owned industrial employee (LFIXASTS), and total industrial investment (LINDUINV). Although the previous analysis has shown a weak correlation between agricultural indicator group and rural industry, the negative correlation between rural industrial energy consumption and agricultural output per rural labour is still a little surprising. This result indicates that the high energy consumption rural industries are developed in the low agricultural production regions. It signifies that rural industrial development in China, especially resource industries, do not depend on agricultural development at all.

Graph VI-3



- | | | |
|----------------|--------------|-------------|
| 1 BEIJING | 11 ZHEJIANG | 21 HAINAN |
| 2 TIANJIN | 12 ANHUI | 22 SICHUAN |
| 3 HEBEI | 13 FUJIAN | 23 GUIZHOU |
| 4 SHANXI | 14 JIANGXI | 24 YUNNAN |
| 5 NEIMONGGU | 15 SHANDONG | 25 SHAANXI |
| 6 LIAONING | 16 HENAN | 26 GANSU |
| 7 JILIN | 17 HUBEI | 27 QINGHAI |
| 8 HEILONGJIANG | 18 HUNAN | 28 NINGXIA |
| 9 SHANGHAI | 19 GUANGDONG | 29 XINJIANG |
| 10 JIANGSU | 20 GUANGXI | |

Fig VI-3 Residual Map of Rural Industrial Energy Consumption, 1989



The comparison of the predicted value and factor score of energy consumption is shown in Graph VI-3. Those asterisks above the prediction line are the provinces whose residuals are positive. The asterisks under the line are the provinces with negative residuals. The spatial distribution of the residuals³² is displayed in Fig VI-3. The residual scores are higher in this model than the other two models, because of the lower R^2 of the model.

Fujian province has the highest residual score (1.217), it is caused by Fujian's special position among the independent variables in the model. Fujian is the province whose location is closest to Taiwan. It has been considered after 1949 as the military frontier for more than 25 years. Daily bombardments between the islands belonging to Taiwan and Fujian province occurred for years. Given this situation, Fujian got little investment for industrial development, the railway system, and civil construction. But its highway system is built at the highest level in terms of density and quality due to military needs. As a medium-sized province, Fujian's highway density is only a little lower than Beijing, Tianjin, Shanghai, the three provincial level municipalities, and Hainan province which is a frontier island much smaller than Fujian province. This is an indication of Fujian's special position. Its low fixed assets, low freight railway transport are a result of this situation. On the other hand, after the reforms and changing relationship between China and Taiwan, Fujian's rural industry has grown rapidly, especially non-metallic and electricity supply

³² The residual scores are listed in Appendix 5, Table A5-5.

industries. Using the low freight railway transport, and low fixed assets per employee to predict Fujian's booming rural industry, the result is the under prediction, and high positive residual score.

Ningxia and Henan provinces are the coal producers of China. Their rural industrial energy consumption is both at the highest level. On the other hand, as a small province, Ningxia's industrial investment is very low. Henan's fixed assets and freight railway transport scores are also low. Those indicators under-predicted those two provinces' coal and related industries.

Hainan has the highest negative residual in the model. Since Hainan's case has been discussed in the previous two models, no further interpretation is needed. Hebei is the second over predicted province (with second largest negative residual). It has high scores on freight railway transport, fixed assets, and industrial investment, and it also has low agricultural output. All of those four indicators over-predicted Hebei's rural industrial energy consumption. Neimonggu's high freight railway transport and Gansu's high fixed assets industry such as petroleum and chemical industries over-predicted their rural industrial energy consumption level. Other provinces with residual scores close to 0 are well predicted by the independent variables in the model. They are displayed by Fig VI-3 in three categories, around 0, above 0, and below 0.

5. Summary

The provincial level's analyses have revealed the relationship between rural industrial development and various regional economic characteristics. The results of the regression analysis by regional characteristic groups demonstrate that market forces influence China's rural industrial development the most. The influences of government policies on rural industrial location have no obvious representation in the results. The stepwise procedure and regression analysis further identified the regional indicators that have influenced rural industrial development. The results support the hypotheses that rural industries develop in the areas that have large markets, better transportation facilities and industrial infrastructure, and more surplus labour and financial funding. One exception identified by the regression analysis is that rural industry is not developed in agriculturally developed areas as it was assumed. This exception shows that rural industry's market economic characteristic and market bias in China are much more stronger than its rural orientation.

The result also displays the core-periphery relation in China at the provincial level. The provinces along the east coast have provided the best market and infrastructures for rural industry and achieved the highest rural industrial development level. Those peripheral provinces in the west where the regional economy are not developed have a lower level's industrial development. Rural industry, as a peripheral industry and a market economy, have

actually developed the most in the national core region. Although policy makers wish to avoid this condition, the polarized development which most market economies experienced, is also occurring in China's rural industrial development.

In summary, the overall hypothesis, "that rural industry in China, as in most market economies, is strongly influenced by market forces but not government policies", is well supported by the analyses in this chapter. The extent to which that relationship is apparent at the sub provincial scale is the theme of the next chapter.

VII. A GIS Analysis of Rural Industrial Development at Regional Level: Beijing's Case

As described above, China's rural industry is distributed throughout China but at clearly different levels of development. The provincial level analysis also showed that rural industry developed more in the region which has larger markets, more surplus labour, financial funding, better industrial infra structure, and transportation facilities. In other words, the regional characteristics, not the government policies, have strong influences on rural industrial development at the provincial level.

Although provincial level analyses have produced a result which supports the hypothesis well, it is too general and too aggregated for the purposes of industrial location analysis. The effects of government policies on rural industrial location at local level, may be or may not be the same as at the provincial level, so a regional level analysis is necessary. At the regional level, the performance of rural industry at individual town or township can be observed, and the relationship between rural industry and regional characteristics can be shown more clearly than at the provincial level.

1. Hypothesis and Study Area

The hypothesis to be tested at the regional level is that the distribution of rural industries, as a market economic sector and

a large number individuals making random decisions, represents viable or even optimum location pattern. The criteria of viable or optimum locations are based on those regional indicators selected by provincial level analysis. They are a larger market, better capital resources, better transportation facilities, and already developed urban industries. Agricultural output will be included in regional level analysis to test if it has more influence on rural industry at the local level. The regional analysis is done using Beijing as a case study. The selection of Beijing is discussed below.

In order to be a good representative for the regional level's analysis, a study area should be able to cover major varieties of rural industry and regional characteristics that exist in the whole country. Beijing is selected because first it is a large metropolitan region which covers 16,809 square kilometres area and has a varied topography. The mountainous regions in Beijing covers 62% of the area, and 38% of Beijing's area is an alluvial plain. Beijing is the only city region which has a large mountain area in the three provincial level's municipalities in China, and it represents the situation of the whole country³³ better than other municipalities.

Second, Beijing has 4 urban districts, 6 suburban districts,

³³ "China is a mountainous country, with mountains, hills, and plateaus occupying 65 per cent of the total land." (Zhao, 1986, p.9)

and 8 rural counties. there are 77 towns³⁴ and 209 townships³⁵ in Beijing. Beijing has 10.8 million population and 30% is rural. As a study area, Beijing covers a larger area and has more variety than Shanghai and Tianjin, but is not too large, or too complex.

Third, compared to other provinces, Beijing's rural industry is highly developed but spatially unbalanced. The difference in rural industrial output between the developed towns and townships and the backward towns and townships is greater than 10 times. At present, Beijing represents the nationwide reality better than Shanghai and Tianjin whose rural industries are more equally distributed.

Fourth, Beijing is the national capital. The central control in Beijing is much stronger than that in other provinces and municipalities. As mentioned in Chapter 4, the central government policy for rural industry is: a rural entrepreneur is not allowed to build in the city proper and rural workers and their dependents are only allowed to move into a market town (but not a designated town or a city proper) with their grain ration for employment (PRC State Council, 1984). In addition, Beijing municipal government has

³⁴ "The designated towns normally administered a well-defined and fairly densely populated town area but had no formally demarcated suburban regions." (Ma, 1987, p.383) "However, the 1984 circular of the State Council (PRC. State Council 1984b) changed their status. The circular promoted the policies of "abolishing townships and establishing towns" and "town administering village", whereby townships were abolished and their territories and population were placed under the jurisdiction of towns." (cited from: Ma, 1987, p.385)

³⁵ For more information about a town and a township, please refer to Appendix 1.

its own policy to decentralize rural industries: horizontal economic cooperation. The policy asks state owned factories to help remote rural areas to initialize or develop rural industries in their community. The policy also offers preferential conditions for those horizontal cooperated enterprises. The policy mobilized about 10,000 engineers and expertise to help rural industry in 1987 (Huang, 1987, p.9). Under this situation, the rural industrial location in Beijing municipality should be much more constrained in the rural area than in other municipalities and provinces. If the location pattern of Beijing's rural industry reflects the characteristics of a market economy, the situation of rural industry in the whole country may be understood more clearly.

Fifth, the rural industrial development in Beijing has been well predicted by the regression models at the provincial level analysis. The independent variables, regional characteristics, selected by those models can be considered as the basic criteria in local level analysis.

Sixth, at the local level, Beijing has a clear spatial core periphery hierarchy pattern, which is formed by a highly developed core (urban districts), local level's cores (county town and town) and their peripheries (townships).

Last but not the least, the rural industrial data are available at the township level in Beijing, and it is the most detailed and complete data the author could obtain. Beijing is also the area where the field work was undertaken and as a result, statistical relationships could be verified in the field.

2. Methodology

In order to test the hypothesis that the distribution of rural industry reflects viable locations, two major aspects, rural industrial distribution and regional characteristics, must be included and the relationship between these two major aspects will be analyzed. It might be good for a comparison later on, if the same statistical method could be used for both provincial and regional level analysis. Although Beijing's rural industrial output data and census of population data are available at the township level (286 units), other regional data are only broken down to county level (18 units only), and therefore a statistical analytical method can not be used. Fortunately, good base maps of Beijing solved the problem. The information plotted on the major base map, such as transportation system, and political boundary, was dated March, 1989, which matches the date of other data sets. Other maps such as a Beijing administrative map, a Beijing elevation map, a Beijing-Tianjin railway network map, provide additional information. The combination of data sets and base maps makes a GIS analysis possible. GIS is a very suitable tool for this research, since it is more adapted to identify the relationships among regional characteristics which have different spatial unit and boundaries. When GIS is used jointly with a statistical analysis, a better result of the analysis can be achieved. A GIS map overlay method on the PC ARC/INFO combined with a statistical analysis will be used to analyze the relationship between Beijing's

rural industrial development and the regional characteristics.

The first step is to choose an indicator for rural industry at local level. The major criteria for choosing the indicator is that the data should be reliable, complete, and compatible with other variables in terms of date, level of detail (county level or township level). This selected indicator will be classified and displayed on a map. Rural industrial location and distribution will also be shown on the map.

The second step is to select the map layers, which represent the regional characteristics that influence rural industrial development significantly using the results of provincial level's analysis presented in the previous analysis.

The third step is to classify the variables, such as the three level's of highways, four level's of physiographic features, and establish the general criteria for the regional characteristics.

The fourth step is to prepare base maps and create a data base by digitizing base maps, creating topology, editing, adding attributes, and transforming to real-world coordinates. Since more than one base map is used in the research, a lot of technical work had to be done at this step to ensure that digital maps are created precisely, all map layers are registered correctly, with no distortion, or offset.

The fifth step is to identify areas accessible from the highway, and railway network using the buffer function of the PC ARC/INFO. The distance accessible to transportation network will use empirical values from field work.

The sixth step is to establish the detailed criteria for the selection of optimum locations for rural industrial development, i.e. how many levels' optimum locations will be selected, and what the population density should be.

The seventh step is to perform spatial and tabular analyses. Those operations include overlaying regional characteristic map layers, selecting optimum locations according to the criteria, identifying the correlation between optimum location selected by the criteria and the actual distribution of rural industrial output level, displaying the results, and producing the final map.

The last step is to export the result from PC ARC/INFO system, evaluate, and interpret the results of the analysis using various statistical methods to confirm the relationships. The analysis is described step by step in the following section.

3. Data and Base Maps Availability and Quality³⁶

(1) Data Availability and Quality

The basic data used in the regional level's research are the output data for rural industry, state owned industry, and agriculture, and the census of population data. Output data are statistical data that are collected and published yearly by different level's government statistical department. Although the

³⁶ For a complete list of statistics and base maps, please refer to Appendix 3.

precision of the statistics is not discussed in the statistical books, the interviews during the field work however gave some information about the data. According to managers of enterprises, leaders of township industrial offices, and the officers of county and city industrial department, the output data are usually more precise than other data such as cost and profit. Because many small rural enterprises do not have professional accountants, some financial data are not very carefully recorded, but the output of production can usually be reported close to the real value. In some rural industrial cases, the output data are even more precise than employment data because of the use of part time workers and seasonal production. As discussed above, the production output data are acceptable, and can reflect the general achievement and overall scale of industrial production within a certain period.

Another database used in the research is the Census of Population. China held its fourth³⁷ population census on July 1, 1990. The results were published after 1991. The census was taken by enumerators on the census day, and a census quality re-examination was performed using samples ten days after the census day. 591 census blocks were selected according to the sampling method, the overall error was 0.6% for total population (NOCPUSCC, 1993, Vol.4, pp.521-530). The quality of the census was very good especially for the total population which is the data used in the analysis. Beijing's census report did not give the actual value for

³⁷ The first population census: July 1, 1953
The second population census: July 1, 1964
The third population census: July 1, 1982

the error, but it reported that the error of Beijing's census was smaller than the national standard. Since the census data are the only detailed and reliable population data available for 1989 - 1990, and the six month difference³⁸ of the two databases is not very long, the census of population data were used for the analysis.

(2) Base Maps

The major base map used in the research is a 1:600,000 topographic map published by China Cartographic Publishing House in March, 1990. The information plotted on the map was dated March, 1989, which is the year that the rural industrial output data was available. Other map layers for the analysis such as highway system, railway network, and townships, are from this map. Other maps such as a 1:800,000 administrative map, a 1:800,000 geomorphology map, a 1:800,000 highway system map, and a 1:800,000 railway network map supplement the analysis.

4. GIS Analysis of Rural Industrial Development in Beijing

(1) Introduction of Beijing

Beijing is located in the northern China, mainly surrounded by

³⁸ Census of population data were collected on July 1, 1990, and rural industrial output data were reported on December 31, 1989.

Hebei province. Beijing also shares part of its boundary with Tianjin municipality. The map on the lower left corner of Fig VII-1 situated Beijing in China.

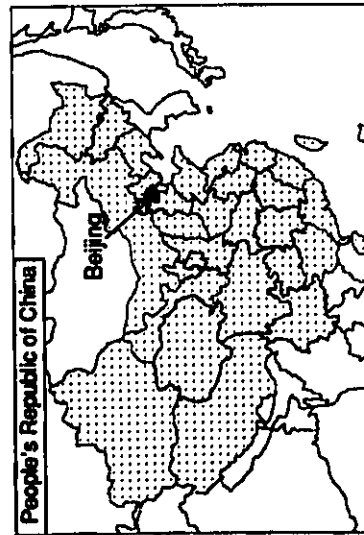
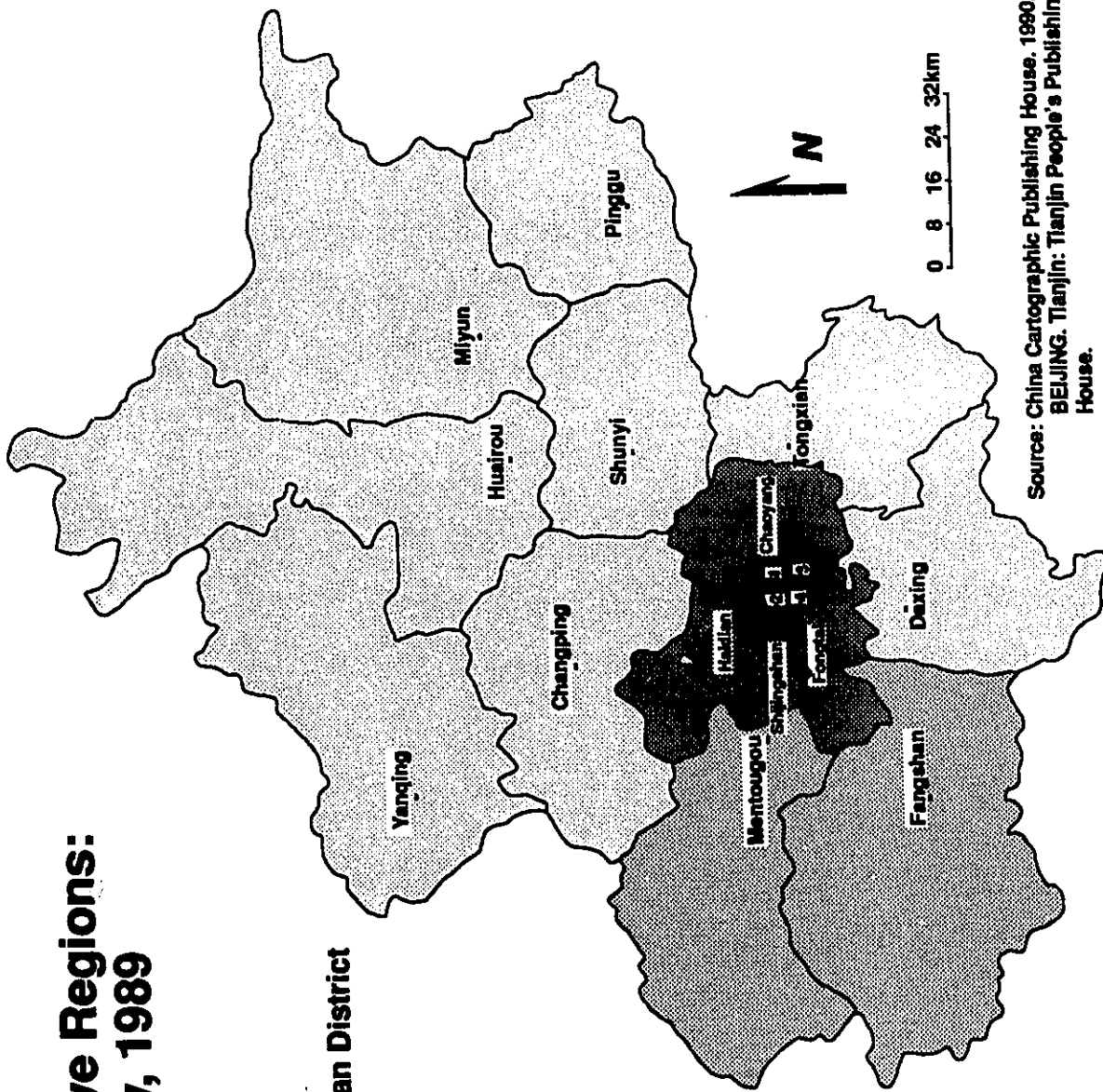
Beijing is a large metropolitan area with suburban districts and some rural counties. Fig VII-1 shows Beijing's administrative regions. The urban built up area of 395.4 square kilometres includes 4 urban districts and part of the near suburban districts appear as darker shades. The built up area forms the regional core of Beijing municipality. The distribution of towns is shown in Fig VII-2. Town and township are the lowest level of government in China's administrative hierarchy. The definition of town and township is similar as those used in Canada. A town is a community that has a small built up area surrounded by rural areas. But in China, town status has to be granted by higher level of government. As a result, a town is also called a designated town (jianzhizhen). Township³⁹ is a community that could have a smaller built up area (market town) surrounded by rural areas or can be a complete rural community. Two levels' towns, which are county town and town, can be identified from the figure. Officially, county towns are at the same administrative level as other towns, they are all administered by county government. But in reality, county towns are usually larger and have more urban functions and more privileges than other towns because local governments are located there. In Beijing, most county towns have over 60,000 population, they are the second level's core in the region. The other towns can be classified as third level's core.

³⁹ For more information about townships, please refer to appendix 1.

Fig VII-1
Beijing's Administrative Regions:
Beijing Municipality, 1989

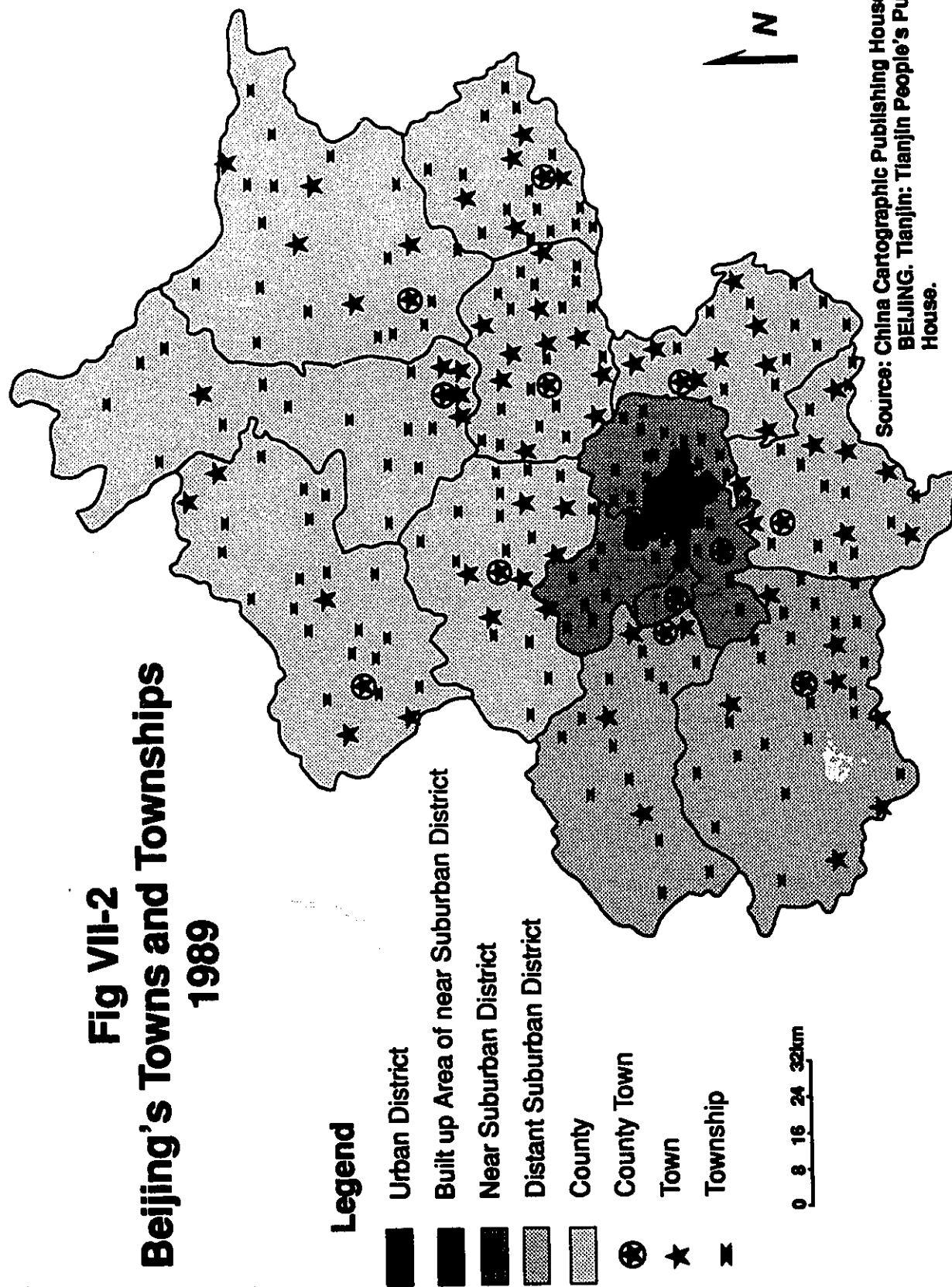
Legend

-  Urban District
-  Built up Area of Near Suburban District
-  Near Suburban District
-  Distant Suburban District
-  County
- 1 East Town
- 2 West Town
- 3 Chongwen
- 4 Xuanwu



Source: China Cartographic Publishing House, 1990.
 BEIJING. Tianjin: Tianjin People's Publishing House.

Fig VII-2
Beijing's Towns and Townships
1989



Source: China Cartographic Publishing House, 1990.
 BEIJING, Tianjin: Tianjin People's Publishing House.

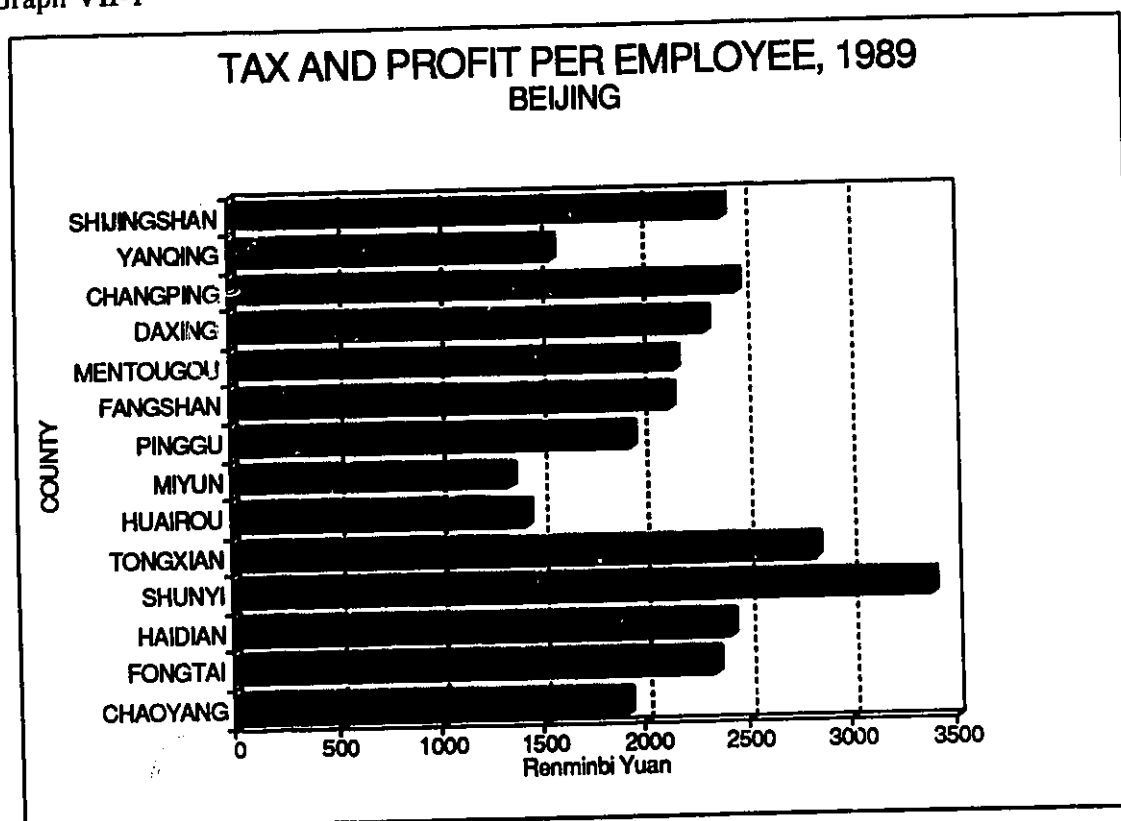
(2) Beijing's Rural Industrial Development

As the provincial level analysis has already shown, Beijing's rural industrial development is at the highest level. Rural industry has become the main source of rural income. The increase of rural income from 1980 to 1987 is 9.6 billion Yuan and the rural industry brought in 4.9 billion or 51 percent of the value of production. Other rural enterprises such as construction, transportation, and the tertiary sector brought in 20 percent. In 1990, the income from rural industry was 60.1 percent of the total rural income, and if taking other non-agricultural activities into account, the proportion was as high as 83 percent.

Although Beijing's rural industry is highly developed and Beijing is not a big region, the spatial distribution of rural industry in Beijing is unbalanced. The tax and profit⁴⁰ of rural industry per rural capita is gradually decreasing from suburban districts, counties on the plain, to counties in mountainous region. Graph VII-1 shows the differences of the rural industrial tax and profit per employee at county level. Two counties, Shunyi and Tongxian, achieved the highest value of tax and profit per employee in Beijing. Besides the successful management of rural industry, those two counties benefit from the location between Beijing and Tianjin municipalities. Most suburban districts have higher tax and profit value than other counties, such as Haidian, Fongtai, Shijingshan, Mentougou, and Fangshan. Counties such as Miyun, Huairou, Yanqing in the mountainous region have the lowest tax and profit per rural inhabitant.

⁴⁰ Please refer to Appendix 4.

Graph VII-1



Source: Data from field work.

Note: The value of tax and profit includes product sales tax actually paid, income tax actually paid, and net profits of profit-making enterprises.

At the town and township level, the unbalanced distribution of rural industry is showed more clearly. Fig VII-3 displays Beijing's rural industrial output at the township level. Five output levels are displayed on the map. Those five rural industrial output levels will be used as the rural industrial development classes in the analysis. Generally speaking, most towns and townships in suburban districts have highly developed rural industry; the towns and townships in the counties close to the central urban area, especially in the east and southeast of Beijing, also have highly developed rural industry; mountainous regions in the north and west Beijing have the lowest rural industrial development level. Besides, most county towns and towns have higher rural industrial output than townships. The unbalanced distribution of rural industrial output within county is also showed clearly on the map. Some rural industrial developed counties such as Tongxian and Shunyi are more evenly distributed than the others. How this distribution correlates with the regional indicators will be next analyzed.

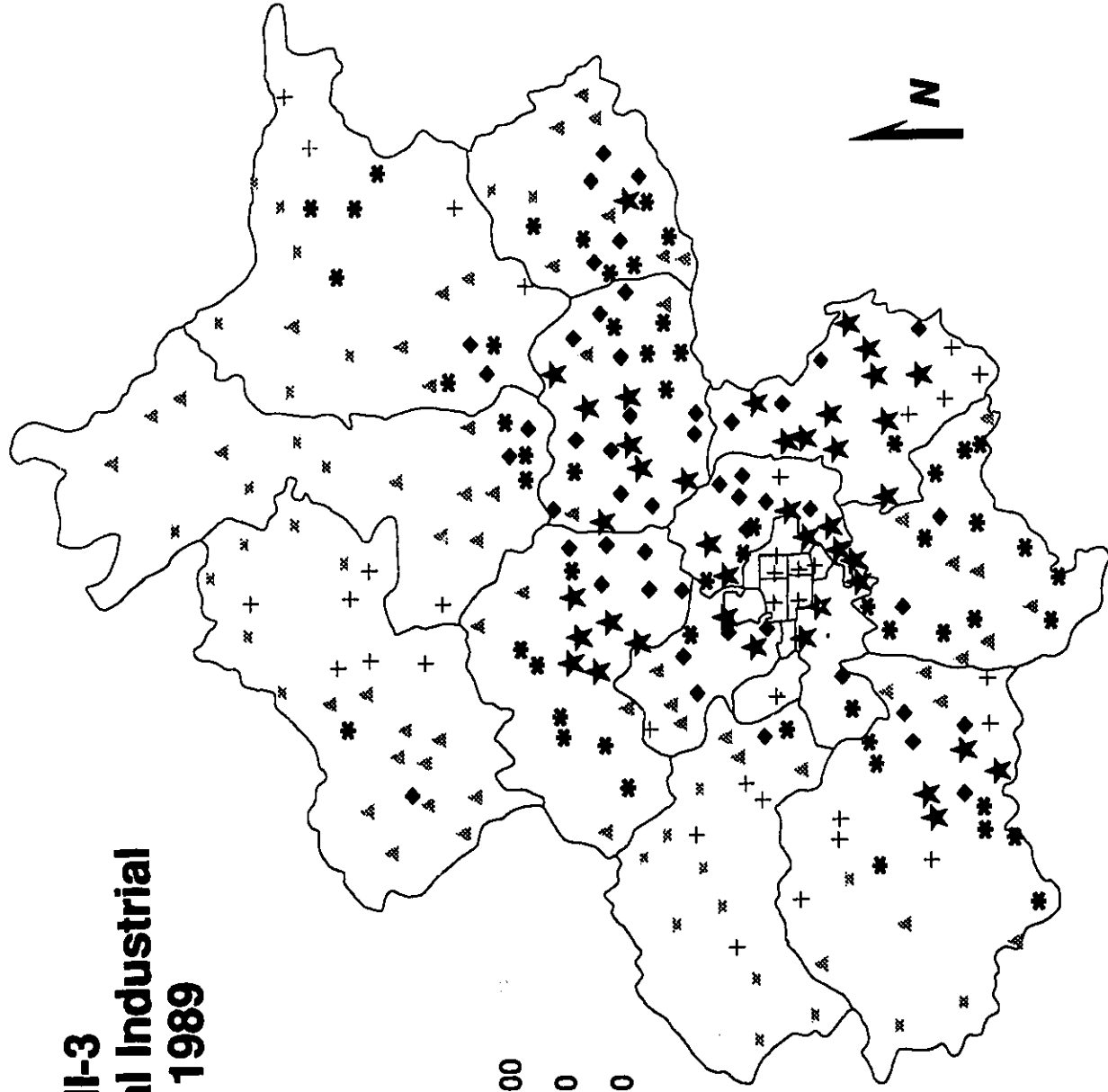
Fig VII-3
Beijing's Rural Industrial
Output, 1989

Rural Industrial Output

Renminbi Yuan

- ★ > 100,000,000
- ◆ 60,000,001 - 100,000,000
- * 30,000,001 - 60,000,000
- ▲ 10,000,000 - 30,000,000
- × < 10,000,000
- + Data not available

0 8 16 24 32km



Source: China Cartographic Publishing House.
1990. BEIJING. Tianjin: Tianjin
People's Publishing House.
Beijing Statistical Bureau. 1990.
SOCIAL ECONOMIC STATISTICAL
YEARBOOK OF BEIJING, 1990. Beijing:
China Statistical Publishing House.

(3) Selection of Regional Characteristic Indicators

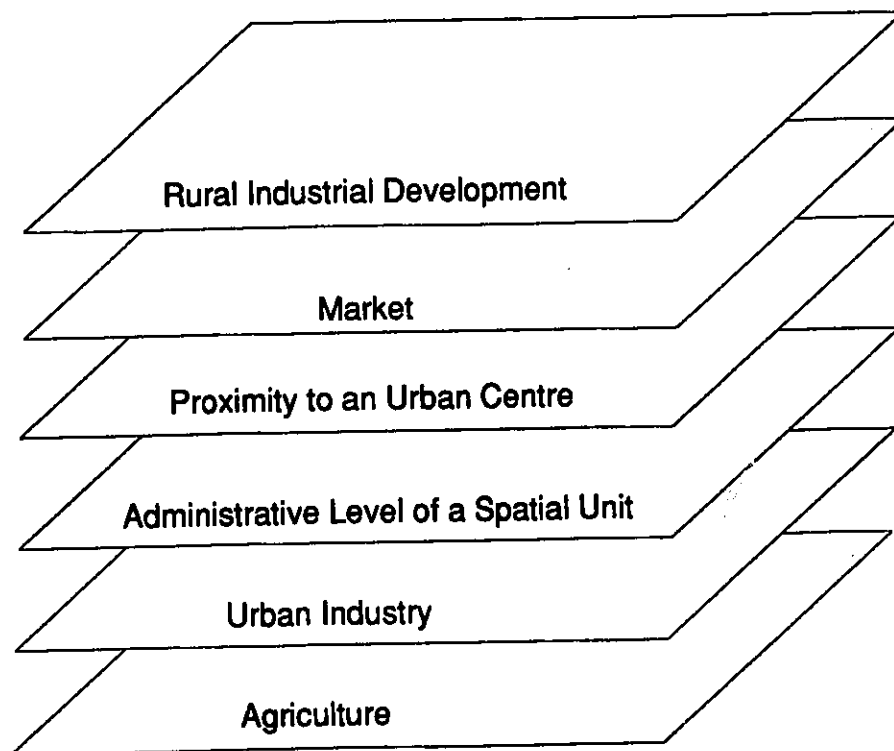
Graph VII-2 shows the relationship between rural industrial development and the regional characteristics. Five general regional aspects are included, which have been tested at the provincial level. The variables include market orientation, industry, agriculture, proximity to an urban centre, and the administrative level of the spatial unit. The map layers which represent those five general aspects for Beijing's case study is listed in Table VII-1 and will be discussed one by one in following section.

Table VII-1 List of Map Layers

Regional Characteristic	Map Layer
Market Orientation	Population Density
Proximity to an Urban Centre	Highway System
	Railway Network
	Physiographic Division
Urban Industry	Industrial Output
Agriculture	Agricultural Output
Administrative Level of the Spatial Unit	Town and Township

Graph VII-2

**The Relationship Between Rural
Industry and Regional Characteristics**



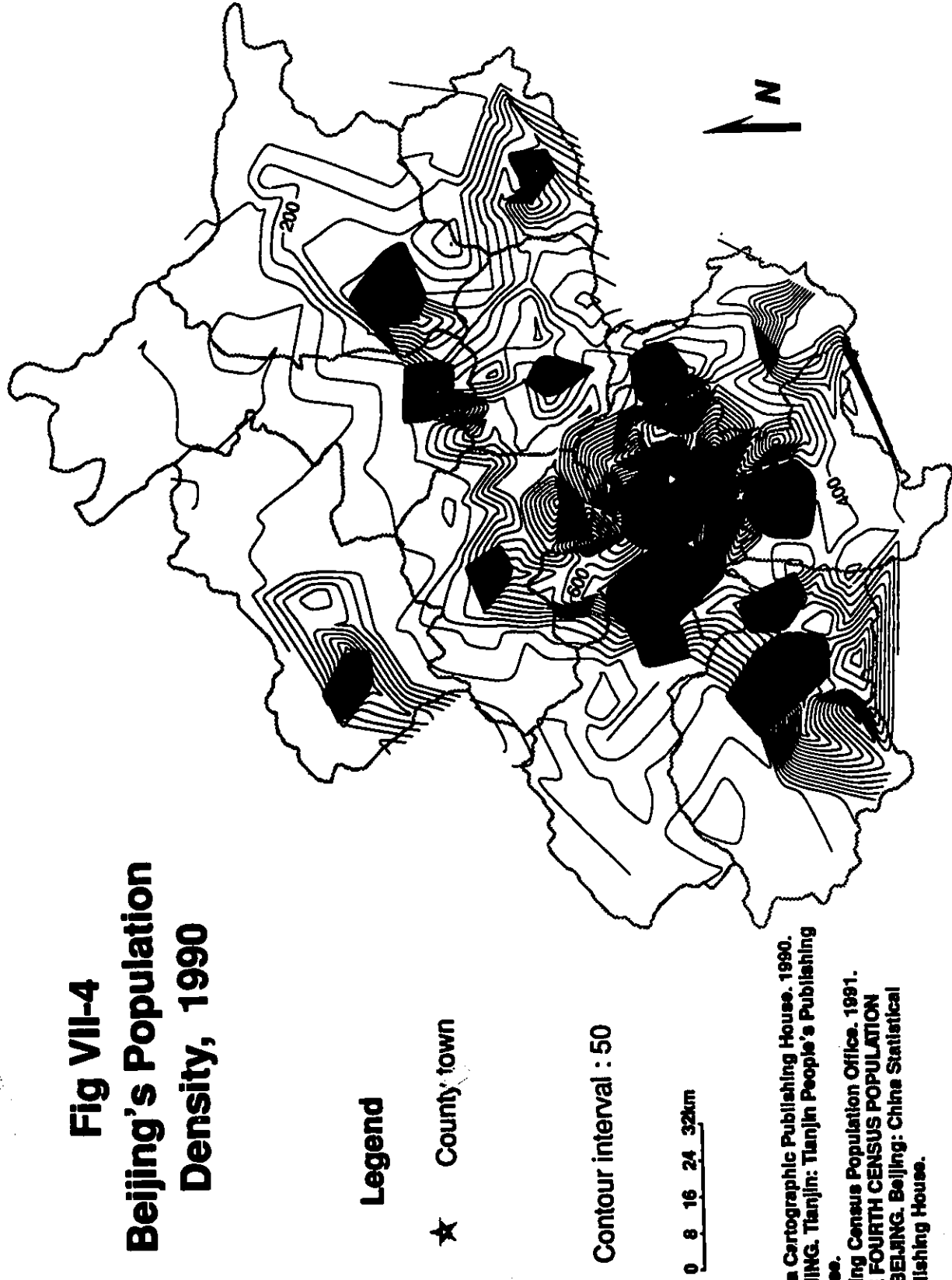
1) Beijing's Population

According to the Fourth Census of Population, 10.8 million people lived in Beijing in 1990 and 30% of them are classified as rural population. Fig VII-4 displays the population density⁴¹ in Beijing. The most densely populated area in Beijing is the downtown area which is about 25,000 to 30,000 population per square kilometre. Most county towns have higher population density than the surrounding areas and small towns. The population density in county towns is about 600 people per square kilometre. The sparsely populated area is in the mountainous region and the population density can be as low as 30 people per square kilometre.

Population density is one of the most important indicators in economic analysis, and it is an important indicator for rural industrial productivity in the analysis of the variation at the provincial level. Since household expenditure data are not available at the local level, population density is used to represent market and labour force potential. Fig VII-4 is the map layer used in the research.

⁴¹ The contour lines are created by PC ARC/INFO TIN module based on population density data of 288 town and townships.

Fig VII-4
Beijing's Population
Density, 1990



Source: China Cartographic Publishing House, 1990.
 BEIJING. Tianjin: Tianjin People's Publishing House.
 Beijing Census Population Office, 1991.
 THE FOURTH CENSUS POPULATION
 OF BEIJING. Beijing: China Statistical
 Publishing House.

To simplify the analysis, population density has been reclassified into 4 levels:

level 1: over 600; this level covers urban centre, part of near suburban districts, and most county towns.

level 2: 400 to 600; this level covers the rest of the near suburban districts, this area surrounds county towns and industrial centres.

level 3: 200 to 400; this level basically covers the rest of the area on the alluvial plain, smooth terrain region, and a small portion of the mountainous area.

level 4: below 200; The line of population density 200 people per kilometre generally divides Beijing to two major parts which are associated with topographical features, mountainous area and plain. This lowest level covers most of mountainous area in Beijing.

2) Proximity to an Urban Centre

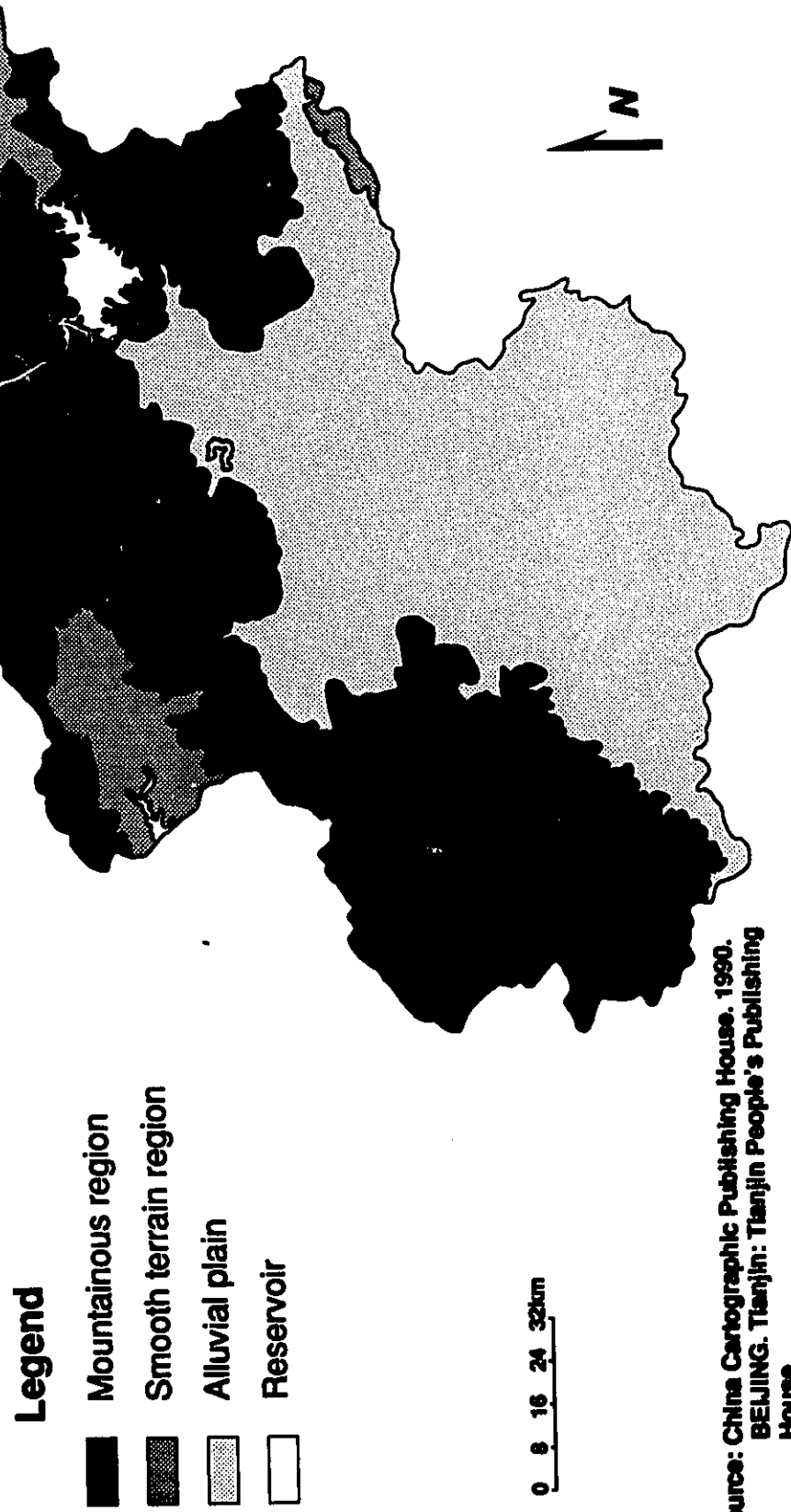
Three map layers, highway system, railway network, and physiography, are included in the category. Transportation accessibility is another very important factor in regional characteristics. As indicated in the provincial level's analysis, rural industry is no longer a local product producer. Rural industry involves services of the national market and even enters into international market competition. Transportation clearly plays an important role in rural industrial development. The manner in

which transportation influences rural industrial development in Beijing will be examined later.

The physiography layer is included in this category, because the accessibility of a location is influenced by its topographic characters. Highways in the mountainous areas may close more often for maintenance during the rainy and snow seasons, the speed limit in mountainous area is also lower than that in the flat area. Railway transportation is in the same situation. Topography influences population density, which has been shown clearly in the population density map, industrial land use, and market. It also influences the suitability of certain regions for industrial development, i.e. slope, drainage, water, etc.

The physiography layer is showed in Fig VII-5, the four classes on the map are the classes for the analysis. The mountainous region covers the area at high elevation (500-1500m), with deep slopes and small level areas. A smooth terrain includes the area with a high elevation (about 1000m) but with large area of flat land. This type of area is usually the local centre in mountainous area, i.e. Yanqing county town. The alluvial plain is the area which is very flat, and lies at 50-100m elevation. Beijing's urban centre and most county towns are located in this area. Since Beijing does not have a large water surface except for three reservoirs, water areas are classified as reservoirs.

Fig VII-5
Beijing's Physiographic Division



Source: China Cartographic Publishing House, 1990.
BEIJING, Tianjin: Tianjin People's Publishing House.

Beijing has a highly developed highway system, the highway density in Beijing municipality was 0.56 km/km² in 1989, and it was the highest in the whole country at the provincial level⁴². There are three types of highway: a) main highway, b) secondary highway, and c) local highway, and they are digitized and displayed in Fig VII-6. Unpaved local roads and urban streets are not included in the research. In order to identify the area accessible to the highway system, a buffer analysis has been employed using PC ARC/INFO system. The accessible distance for the three level's highway is 2 kilometres on each side for a main highway, 1.5 kilometres on each side for a secondary highway, and 1 kilometre for a local highway. The accessible distance is an empirical value. It was determined by rural industrial entrepreneurs during the author's field work in 1991.

The railway is the most important transportation facility for both passenger and freight at the medium and long distance in China. The influences of the railway network on rural industrial development has been examined in previous provincial level's analysis. Although railway transport is not that important within Beijing proper, some peripheral areas still benefit from the railway, and is therefore included. Fig VII-7 shows the railway network in Beijing. The area accessible to railway network is the area close to railway stations. Another buffer zone map has been created by PC ARC/INFO. The accessible distance to a railway station is 3 kilometres, it is also an empirical value and obtained from the field work.

⁴² Shanghai and Tianjin municipalities are included.

Fig VII-6
Area Accessible to
Beijing's Highway System
1989

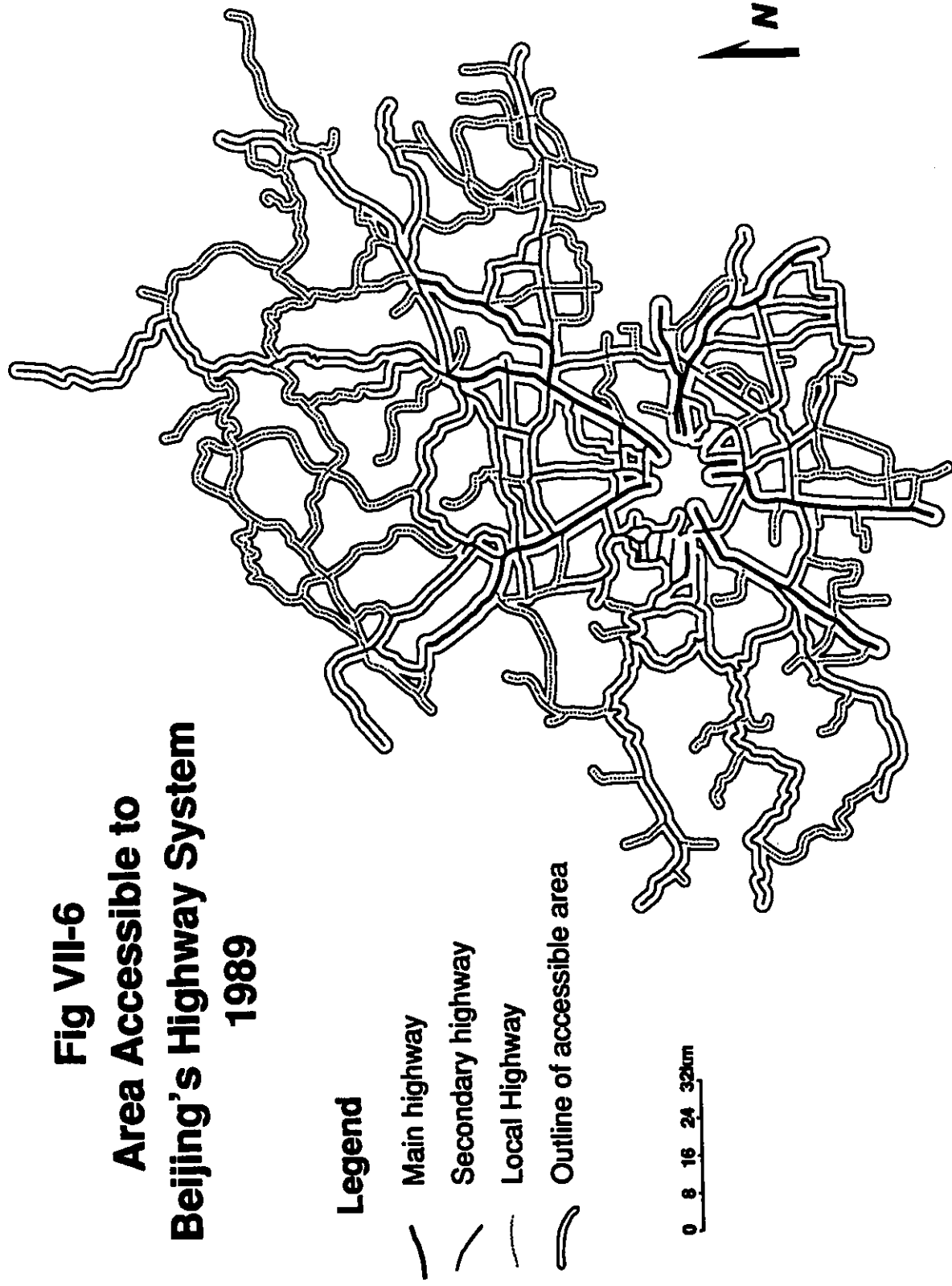
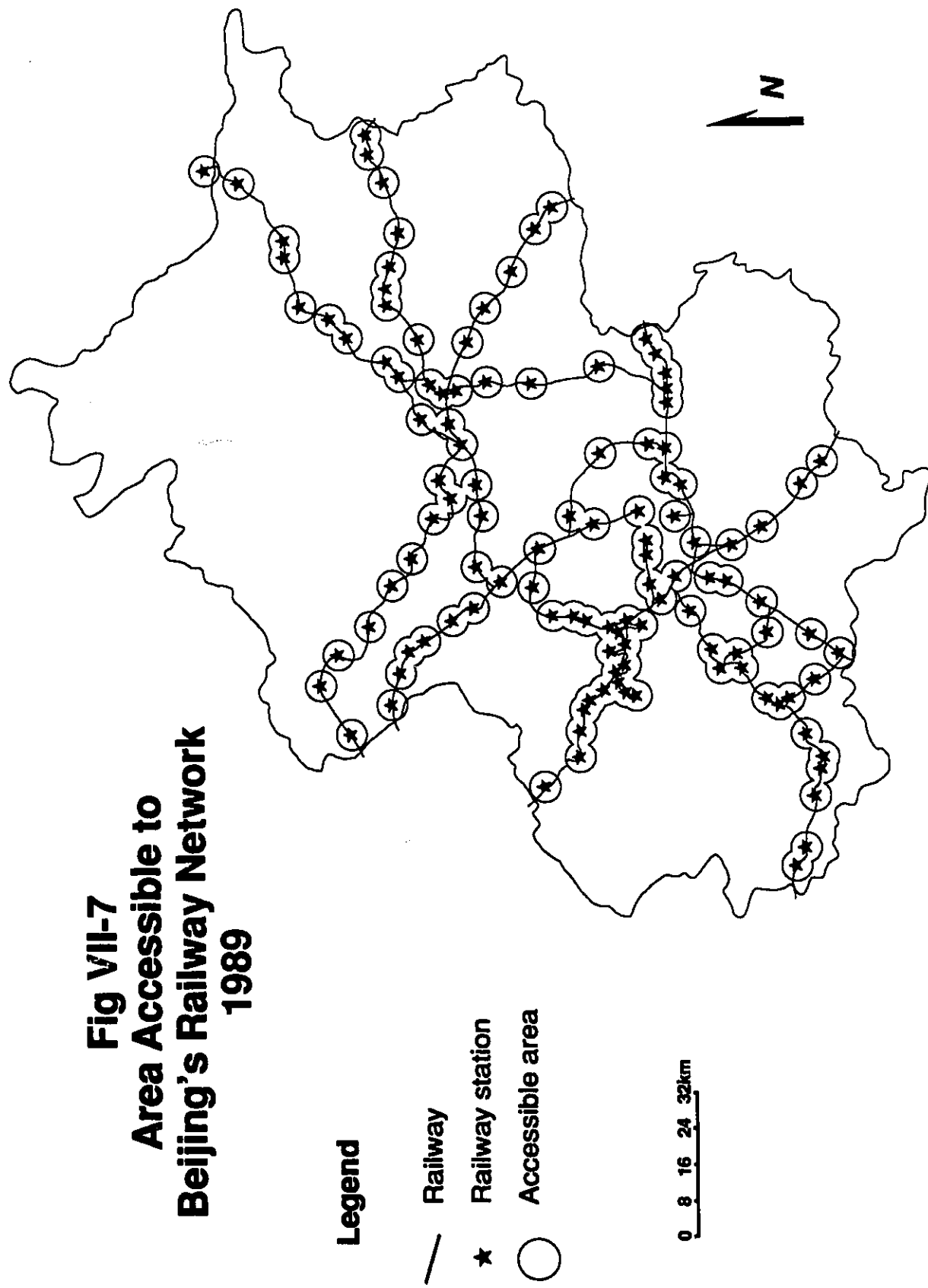


Fig VII-7
Area Accessible to
Beijing's Railway Network
1989



3) Industrial Development

Since urban industrial output reflects the local industrial development level, rural industry in the same region can benefit from urban industry both by subcontracting, technical support, and the availability of skilled labour force. As indicated in the provincial level's analysis, urban industrial development level obviously influences rural industrial development. Beijing's urban industrial output data are only available at the county level. As a general indicator, it is accepted. Fig VII-8 shows Beijing's urban industrial output. The largest industrial output is near the suburban districts, and Fangshan where a huge petroleum company is located. Downtown Beijing districts are at the second level, and the third level includes counties in the southeast of Beijing. The lowest level of industrial production is observed in mountainous counties.

4) Administrative Level of the Spatial Unit

As indicated above, there are three levels of administrative organizations in Beijing. They are the urban centre, county town, and town. The urban centre's influence on the whole region can be observed everywhere. The county towns and towns are the local nucleus that could influence rural industrial development. Three levels of administrative units are identified, they are the county town, the town and the township Fig VII-2.

Fig VII-8
Gross Value of Urban Industrial Output
Beijing, 1989

Value of industrial output

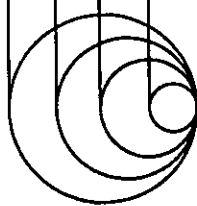
Renminbi Yuan ,000,000

3,500 - 10,000

1,500 - 2,500

700 - 1,400

< 500

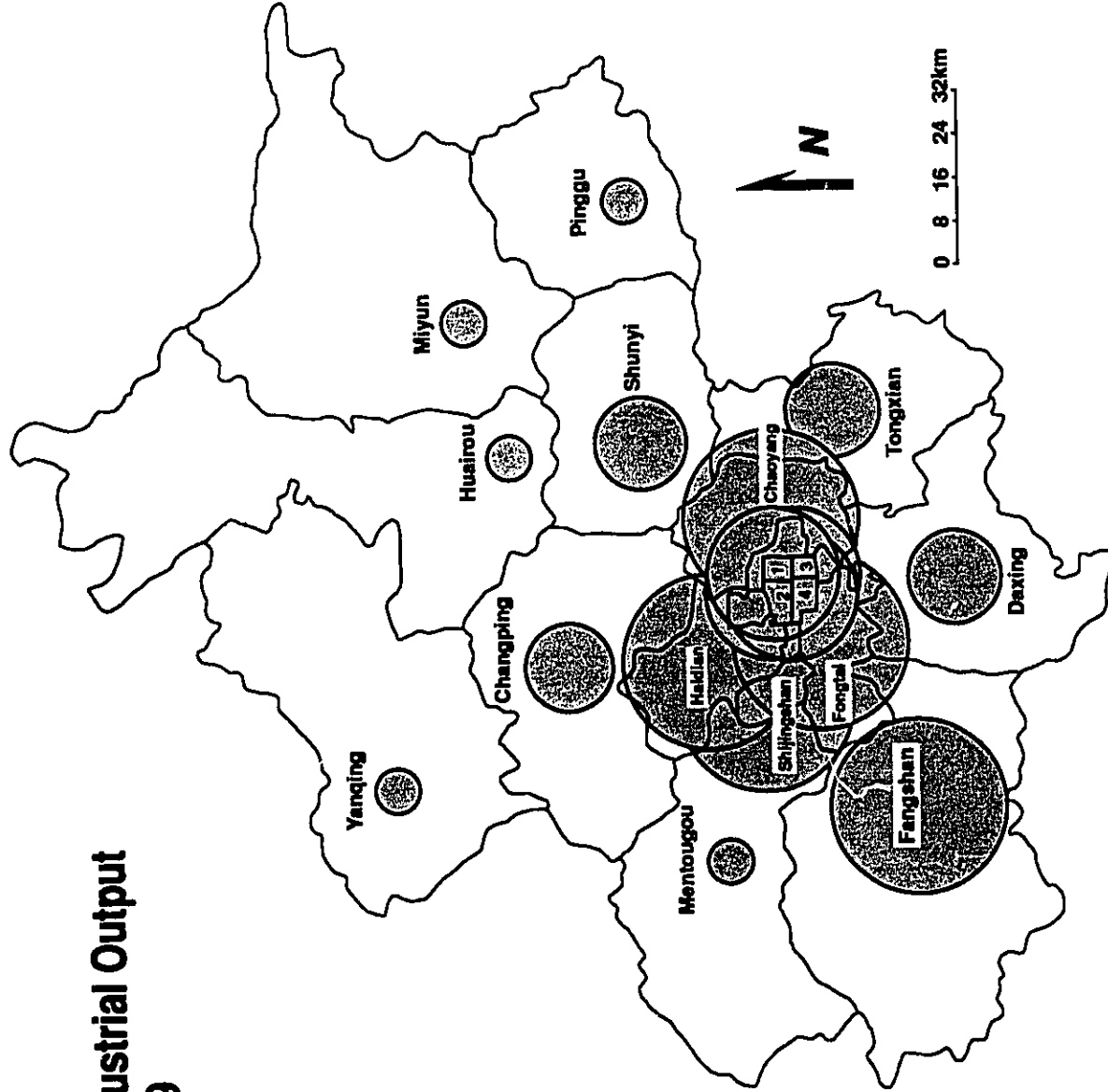


1 East Town

2 West Town

3 Chongwen

4 Xuanwu



Source: China Cartographic Publishing House.
 1990. BEIJING. Tianjin: Tianjin
 People's Publishing House.
 Beijing Statistical Bureau, 1990.
 SOCIAL ECONOMIC STATISTICAL
 YEARBOOK OF BEIJING, 1990.
 Beijing: China Statistical Publishing
 House.

5) Agriculture

Agricultural indicators did not have a significant correlation with rural industrial development at the provincial level's analysis. However, the correlation between agricultural development and rural industrial development will be tested again at regional level. Agricultural output per rural worker at the county level is displayed on Fig VII-9. The regions with the highest output are three suburban districts and two counties, Changping and Shunyi. The lowest levels of agricultural output can be observed in mountainous areas. The distribution of agricultural output per rural worker seems similar to the distribution of rural industrial development.

Fig VII-9
Value of Agricultural Output per
Rural Worker, Beijing, 1989

Agricultural output per worker

Renminbi Yuan

5,200 - 10,000

3,200 - 4,500

< 3,000

Urban built up area

1

East Town

2

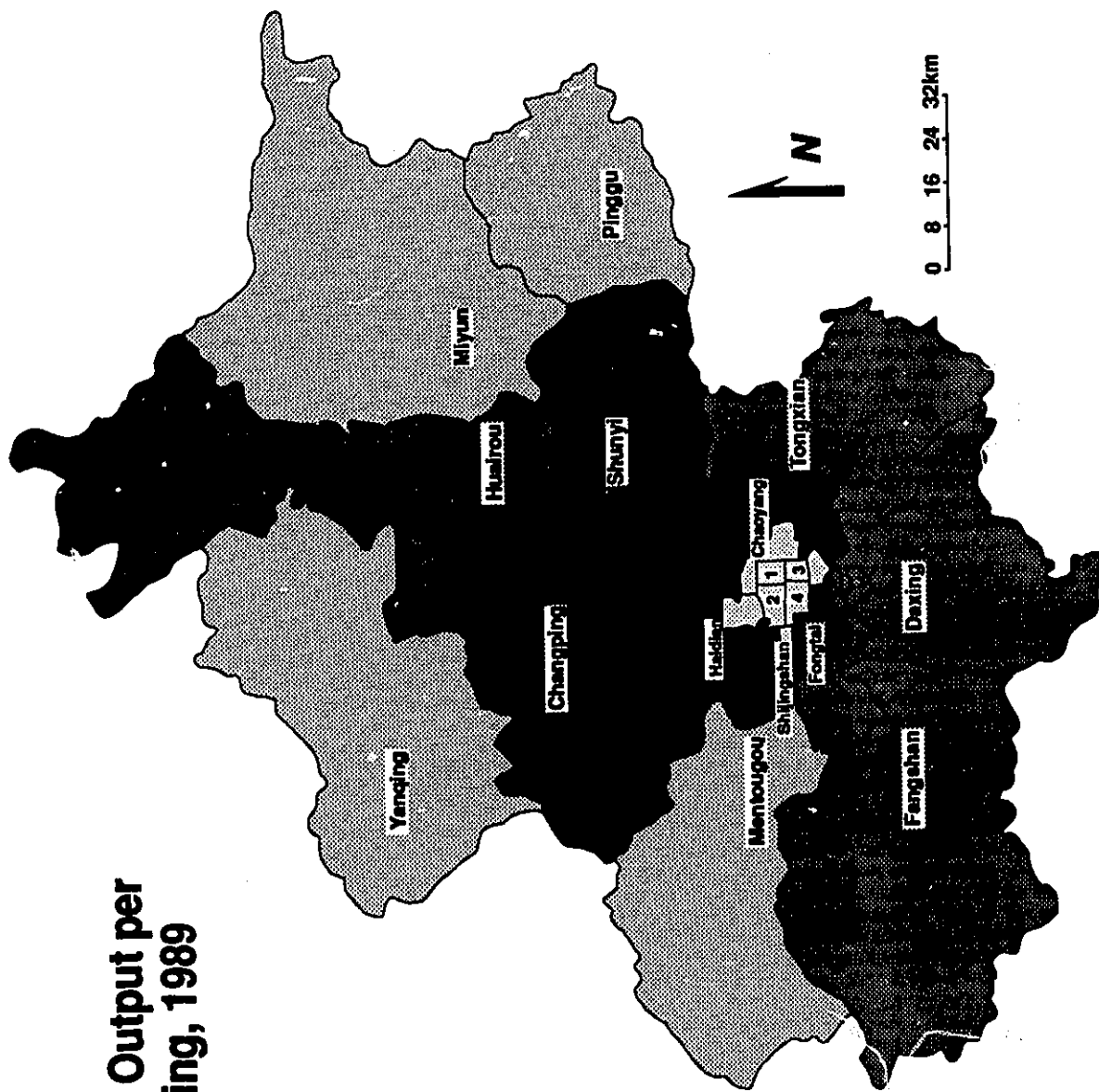
West Town

3

Chongwen

4

Xuanwu



Source: China Cartographic Publishing House.
 1989. BEIJING. Tianjin: Tianjin
 People's Publishing House.
 Beijing Statistical Bureau, 1990.
 SOCIAL ECONOMIC STATISTICAL
 YEARBOOK OF BEIJING, 1990.
 Beijing: China Statistical Publishing
 House.

(4) Criteria of the Optimum Location of Rural Industrial Development

Map overlays have been conducted for all of seven regional characteristic layers. The result of the map overlays is one map with 2,500 polygons⁴³, and the attributes⁴⁴ from all of 7 layers included in each polygon. The optimum area for rural industrial development is selected according to the criteria listed in Table VII-2.

As described above, the basic criteria that reflect the hypotheses, such as a nearby main highway can provide better opportunity for rural industrial development, have been established before those indicator layers were created. The classification on each layer was done according to the criteria and the data availability, i.e. three levels of highway, four levels of population density, three levels of administrative units. The final criteria for the two level's optimum areas are decided after the map overlay operation. The decision on the final criteria is based on the minimum area of level 1 optimum area covers maximum number of high level of rural industrial output, and the minimum area of level 2 optimum area covers maximum number of middle level of rural industrial output. Several combination of criteria have been attempted for selecting final criteria, and also testing the relationships among indicator layers. The final criteria of the

⁴³ Please refer to Fig A5-1 in Appendix 5.

⁴⁴ Please refer to Table A5-5 in Appendix 5.

analysis are listed in Table VII-2.

Table VII-2 Criteria of Optimum Area for Rural Industrial Development

Level 1:

1. Population density over 400 per square kilometre⁴⁵
2. Physiographic feature is plain
3. Accessible to main highway or secondary highway
4. Urban industrial output is higher than 800 million Yuan
5. Value of agricultural output per rural worker is higher than 3,200 Yuan
6. County town is included in this level even it does not meet the criteria above

Level 2:

1. Physiographic feature is Plain or smooth terrain areas
2. Population density is 200 - 400 people per square kilometre⁴⁶
3. Accessible to secondary highway or local highway
4. Accessible to railway station
5. Urban industrial output is higher than 235 million Yuan
6. Value of agricultural output per rural worker is higher than 2,200 Yuan
7. Town is included in the level, even it does not meet the criteria above

5. Result of the Analysis

The final result of the GIS analysis is shown in Fig VII-10. The optimum areas for rural industrial development coincide with the first three level's rural industrial output. The optimum areas for rural industrial development selected by the criteria are

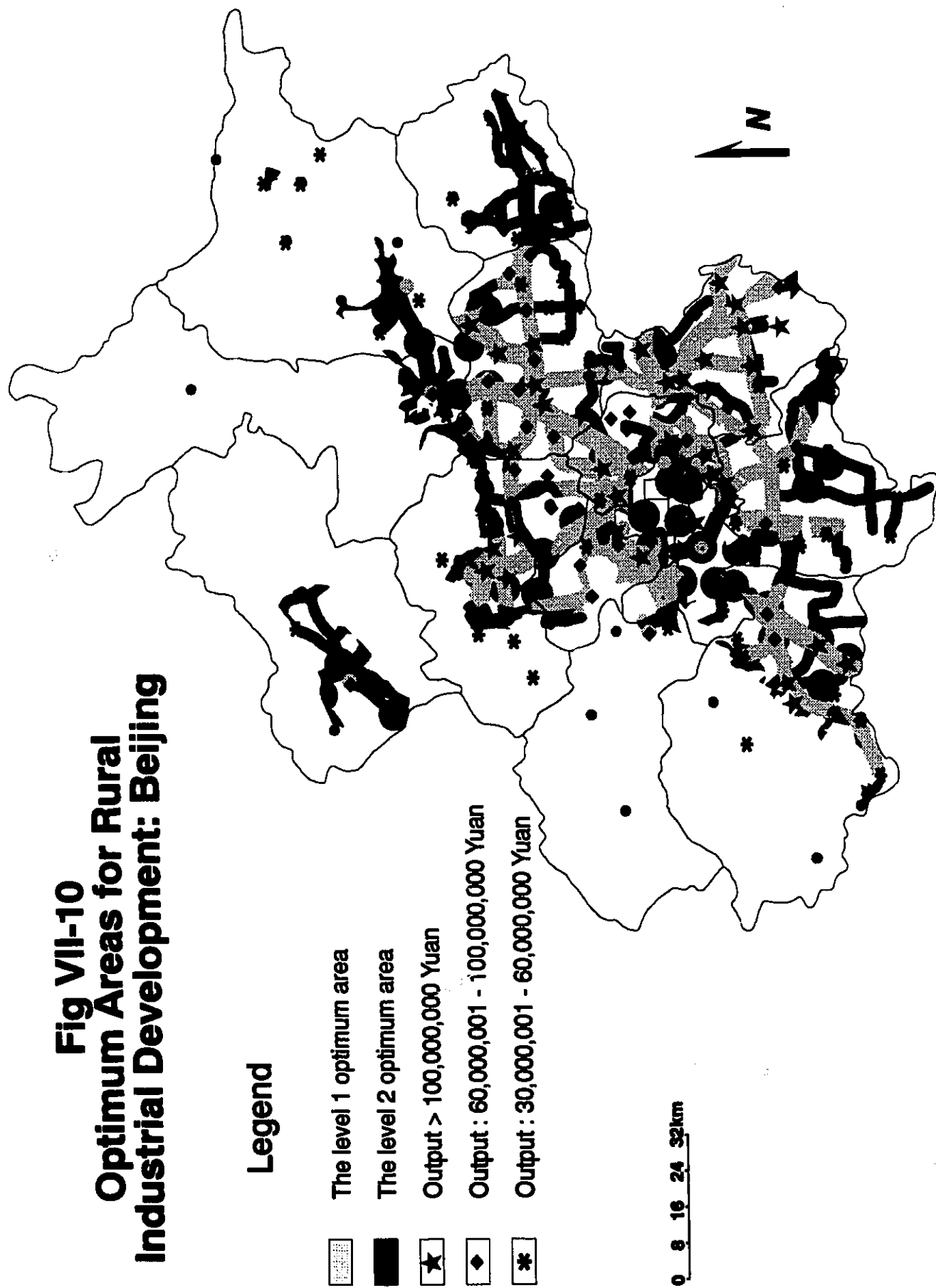
⁴⁵ The area covers urban centre, near suburban districts, county towns, and the area surrounds county towns and industrial centres (Fig VII-4).

⁴⁶ The area covers the rest of the area on the alluvial plain, smooth terrain region, and a small portion of the mountainous area.

yellow (optimum level 1) and blue areas (optimum level 2) on the map. The optimum level 1 covers 1,897 square kilometres which is about 11 per cent of Beijing's area. The optimum level 2 covers 2,154 square kilometres, and it is about 15 per cent of Beijing's area. The rest of the area in Beijing is classified as the area out of optimum area and occupies about 74 per cent of total Beijing's area.

Observing the first three level's rural industrial output on the map, the relationship between rural industrial development and optimum areas can be seen clearly. Most of the highest level's rural industries located in the level 1 optimum areas, and most of the second level's rural industry located in both level 1 and level 2 optimum areas. The third level's rural industry located mostly in level 2 optimum areas and out of the optimum areas.

Fig VII-10
Optimum Areas for Rural
Industrial Development: Beijing



The statistics obtained from the map overlay gives a more detailed picture of the relationship that exists between rural industrial development and regional economic and physiographic characteristics. A two way frequency analysis has been done using SAS® frequency procedure, and the result is shown in Table VII-3. Three optimum levels are included in the table, 1 represents the optimum level 1 selected by the criteria level 1; 2 represents the optimum level 2 selected by the criteria level 2; 3 represents the area that is out of the optimum areas. Five rural industrial output levels which covers all of town and township level units on Fig VII-3 are included in the model. They are OUTLEVEL (Output Level) 1 to 5 and OUTLEVEL 1 represents the highest output. The correlation between the rural industrial output and the optimum areas is shown very clearly in the table. In 1989, seventy eight percent of the highest level's rural industries were located in the level 1 optimum area, 17 percent of them were located in the level 2 optimum area, and only 5 percent are located out of the optimum areas. On the other side, 93 percent of the lowest level's rural industries were located out of the optimum areas, and 7 percent of them were located in the level 2 optimum area, but none of them were located in level 1 optimum area. The percentage of rural industries located in the level 1 optimum area drops down very quickly from 78.05% of OUTLEVEL 1 to 0% of OUTLEVEL 5. But the percentage of rural industries located out of the optimum areas is increased quickly from 4.88% of OUTLEVEL 1 to 93.1% of OUTLEVEL 5. The middle level's rural industries such as OUTLEVEL 3, OUTLEVEL 4, located in the level 2 optimum areas more then other areas.

Table VII-3 Two Way Frequency Table

Table of Rural Industrial Output (OUTLEVEL) by
Optimum Location Level (OPTIMUM)

OUTLEVEL OPTIMUM					
Frequency	Expected				
Percent	Percent				
Row Pct	Row Pct				
Col Pct	Col Pct	1	2	3	Total
1	32	7	2		41
	12.602	15.974	12.424		
	13.85	3.03	0.87		17.75
	78.05	17.07	4.88		
	45.07	7.78	2.86		
2	24	19	7		50
	15.368	19.481	15.152		
	10.39	8.23	3.03		21.65
	48.00	38.00	14.00		
	33.80	21.11	10.00		
3	12	34	9		55
	16.905	21.429	16.667		
	5.19	14.72	3.90		23.81
	21.82	61.82	16.36		
	16.90	37.78	12.86		
4	3	28	25		56
	17.212	21.818	16.97		
	1.30	12.12	10.82		24.24
	5.36	50.00	44.64		
	4.23	31.11	35.71		
5	0	2	27		29
	8.9134	11.299	8.7879		
	0.00	0.87	11.69		12.55
	0.00	6.90	93.10		
	0.00	2.22	38.57		
Total	71	90	70		231
	30.74	38.96	30.30		100.00

STATISTICS FOR TABLE OF OUTLEVEL BY OPTIMUM

Statistic	DF	Value	Prob
Chi-Square	8	136.815	0.000
Likelihood Ratio Chi-Square	8	139.044	0.000
Mantel-Haenszel Chi-Square	1	99.187	0.000
Phi Coefficient		0.770	
Contingency Coefficient		0.610	
Cramer's V		0.544	
Sample Size = 231			

This result supports the hypothesis that the distribution of rural industries in Beijing represents a viable or even optimum location pattern, although the individual entrepreneurs do not try or are not allowed to change locations to achieve the location conditions of success. The obvious spatial concentration of rural industry and strong correlation with regional characteristics shows that rural industrial development is influenced by market forces much more than government policy even in the highly controlled national capital region. This result reveals the spatial aspect of rural industrialization at regional level very clearly.

The influence of each regional indicator on rural industrial development has been tested during the selection process of optimum areas. This was done by changing one criteria in one test to see the influence of that particular indicator. This provided a better understanding of the relationship between rural industrial development and regional characteristics in Beijing.

Among those seven regional indicators, two of them, population density, and areas accessible to highway system, have more influence on rural industrial distribution than others. This result indicates the strong market bias of rural industrial distribution in Beijing.

The administrative level of the spatial unit also has obvious influence on the rural industrial development. All of the county towns and over 60 percent of towns have a high level of rural industrial development (OUTLEVEL 1 or OUTLEVEL 2), but only 29 percent of townships are at the high level rural industrial output

categories. This distribution reflects the core periphery hierarchy in Beijing and the hierarchy is reinforced because the rural industry adds higher output to local cores but not to the peripheries.

It is found during the test that the railway network accessibility only affects peripheral areas, so it is not included in the level 1 optimum area. It is also noted that the railway network does not influence rural industry very much even in peripheral areas. This gives the information that the highway system is the major transportation facility for economic activities in Beijing.

The clear message delivered by the great similarity between physiographic features and the distribution of population density or transportation facilities is that the physical environment is the most important bases for any human being's activities.

The urban industry layer and agriculture layer do not show a significant influence on rural industry, the aggregated county level's data are partly responsible for that. Even though, urban industrial output shows better correlation with rural industry than agricultural output per rural worker. This result states again that rural industry is a market oriented industry more than an agricultural products processing industry.

In summary, Beijing's case study has given a clear picture on rural industrial development at the regional level. Other region's experience may vary, but it is believed that the basic trend is similar. This trend is that rural industrial development is a function of market economic factors instead of an agricultural

processing or agricultural service centre; its behaviour obeys market rules; its spatial distribution is influenced by market force more than by government policies.

VIII. Conclusion and Future Research

1. Conclusion

This study has tested the spatial behaviour of rural industry, the largest and fastest growing market economic sector in China, at both the provincial and regional level. The spatial analyses have been accomplished using statistical analysis and GIS methods on 1989 data and base maps. For rural industry, 1989 data is the first officially released complete rural industrial data in China. Several conclusions can be drawn from the study.

(1) Unbalanced Spatial Distribution of Rural Industrial Development

Although government policy was obviously attempting to diffuse the process of rural industrialization as much as possible throughout the national territory, the very unbalanced spatial distribution of China's rural industrial development has been displayed at both the provincial and regional level analyses. At the provincial level, the factor analysis on 12 rural industrial indicators has shown that the developed rural industries are highly concentrated along the east coast, and the development level is decreasing from east to west. In Beijing, the national capital region, the situation is the same. Those towns and townships with high rural industrial output are distributed either close to a urban centre or along the east and southeast main highways which are the gateway to Tianjin municipality, Tangshan city, and the

other part of China.

The core periphery theory has been used to analyze the unbalanced distribution. It divides the space economy into a dynamic, rapidly growing central region and its periphery. Four orders of core regions suggested by Friedmann are the national metropolis, regional capital, sub-regional capital and the local service centre. This appears to be the case in the Chinese example as well. Metropolitan regions and regional centres are the ones which have rural peripheries that have the highest levels of rural industrialization.

(2) Rural Industry is Developed more in Economic Developed Region

The relationship between rural industrial development and regional characteristics have been analyzed using the multiple regression method at the provincial level, and a GIS map overlay method on Beijing's case. The indicators which have strong influence on rural industrial development have been identified by the analyses. They are household expenditure, population density, investment, transportation facilities, and industrial indicators at the provincial level. At the regional level, Beijing's case study has identified transportation facilities, population density, and the administrative level of the spatial unit as the most important regional indicators. Due to the lack of data, some other factors can not be included in the analysis, although they can influence rural industrial development, i.e. lack of land in a city proper forces state-owned industries to cooperate with rural industry to

build jointly owned enterprises that can take advantages of the land and workers in a rural area, and the equipment and technical personnel in state owned industry. Since the indicators listed above are the major indicators of regional economic development, the results at both the provincial and regional level support the hypothesis that China's rural industry is developed more in the economic developed region.

(3) Rural Industry and Agriculture - Very Weak Relationship

It is usually expected that rural industry is developed in association with agricultural production. Agricultural income is seen as providing initial funds for rural industrialization. This is also one of the government objectives for developing rural industry. It is hoped that the rural surplus labour and income can be used to develop rural industry, and the income from rural industry can be reinvested partially into local agriculture to promote agricultural productivity. This may be occurring in some areas, but the overall situation as seen in this analysis, is just the opposite. The results from both the provincial and intra provincial analyses have shown a very weak, even negative relationships among rural industry and agricultural indicators. This result indicates: first, rural industrial development does not depend on the funding accumulated from agricultural output, and today's rural industry is not an agriculturally oriented industry any more; second, the income from rural industry is seldom reinvested into local agricultural production, otherwise one would

expect the relationship between rural industries and agricultural production to have been better. The consequence is "the rapid decline of grain production and a deficit of grain in the east coast regions in 1994" (RMRB. Nov.15, 1994). The Chinese government has expressed a serious concern on this point recently, and new policies and regulations may be issued soon but the effects will not be seen in less than one or two years (RMRB. Nov.15, 1994).

(4) Rural Industry and China's Dual Economy

Although China's rural industry has maintained some collective ownership and has kept some "rural" industry's characteristics such as agricultural product processing, small scale, seasonal operation, and the serving of a local market. The spatial behaviour revealed by this research however indicates that rural industry is a market-oriented sector above all else in China's reformed economy. The hypotheses tested in the research are the experiences drawn from a market economy, and supported by the case of China's spatial rural industrial development. Considering that 37 percent of the total national industrial output was produced by rural industry in 1993, what appears clear is that the Chinese economy has become a dual economic system which contains the element of a planned economy as well as that of a market economy. Furthermore, rural industry is presently playing the most important role in China's fast growing market economic sector in China.

Although this research is focused on the Chinese case, the light that this case throws on the link between political shifts

and spatial industrial change in an evolving socialist country has possibly provided an empirical example for other socialist countries engaged in large scale structural transformations.

2. Future Research

Although this research has provided a thorough empirical understanding of spatial characteristics of market economic development in China's dual economy based on 1989 data, the continuing rapid growth of the market economy in China has drawn more and more attentions worldwide, raised other research questions, and therefore requires additional research. Responding to the challenge of providing further understanding of China's perplexing dual economy, research efforts will be made in following areas.

(1) Time Series Analysis

Time series analyses can reveal the trend of the rural industrial development in space much more clearly than the analysis of cross-sectoral data. Since 1989, the Department of Rural Enterprise of the Ministry of Agriculture of China has continued to publish the China Rural Enterprise Yearbook series, and has maintained the same definitions and major indicators for rural industry. At present, the 1992 Yearbook is already available. Hopefully, this Yearbook series can continue to be published utilizing the same definitions and categories in the future. Time

series analysis could then be applied at the provincial level for a number of years. If the result of time series analysis continues to show a continued concentration of rural industry in space, the arguments provided in this research would be greatly reinforced. Predictions might also be made from these long term trends in the rural industrial development.

(2) Rural Industrialization and Urbanization

Rural industrial development has had a great impact on the urbanization process in China, including the expansion of large cities, the growth of middle and small cities, and the emergence of many new towns and small urban settlements. It is believed that there is a strong relationship between the spatial distribution of rural industry and the spatial pattern of urbanization. This research did not deal with this issue due to the limited resources of data, time, and funding. Future research in this area will reveal the most significant changes that rural industrialization has brought to people's daily lives in China. Those changes are a great challenge to China's urbanization policies and regulations.

(3) Institutional Organization of Rural Industry

Since this research focused on the spatial issue of rural industrial development, only those relevant and important institutional organization and government policies were introduced and discussed in this thesis. The terms used in this thesis such as

'market economic sector', 'outside of centrally planned system', are defined relative to state owned and completely centrally controlled sectors in China. Actually, there is no absolute free market environment in China if one compares the Chinese case with real market economies of the world. The Chinese government plays an important role in all economic activities and the people's daily life directly or indirectly. The economic reforms and the rapid growth of market economic sector in China have made the dual economic environment much more complex, and further research is required. Although this thesis has revealed that the spatial characteristics of rural industry in China has been strongly influenced by market forces even in this complex economic environment, future research on the institutional organization of rural industry can provide a better understanding of 'the market economic sector' in a socialist country with Chinese characteristics.

(4) From the Empirical Analysis to a Spatial Decision Support System

This research focused on an empirical analysis of China's rural industrial development using statistical methods at the provincial level and GIS methods at regional level. Based on empirically defined location criteria for rural industry, a future study can attempt to predict or provide a decision support system for rural industrial location, especially at the regional level. Latest developments in GIS have provided the possibility for this

future development. The combination of GIS and a decision support system is not only an interesting future avenue of research for China's rural industrial development, but also is an important development trend in the GIS and spatial analysis methods domain.

Hopefully, the thesis itself and the future research can make significant contributions to both an understanding of the ongoing market economic development in China and the application of GIS in economic geography and decision making.

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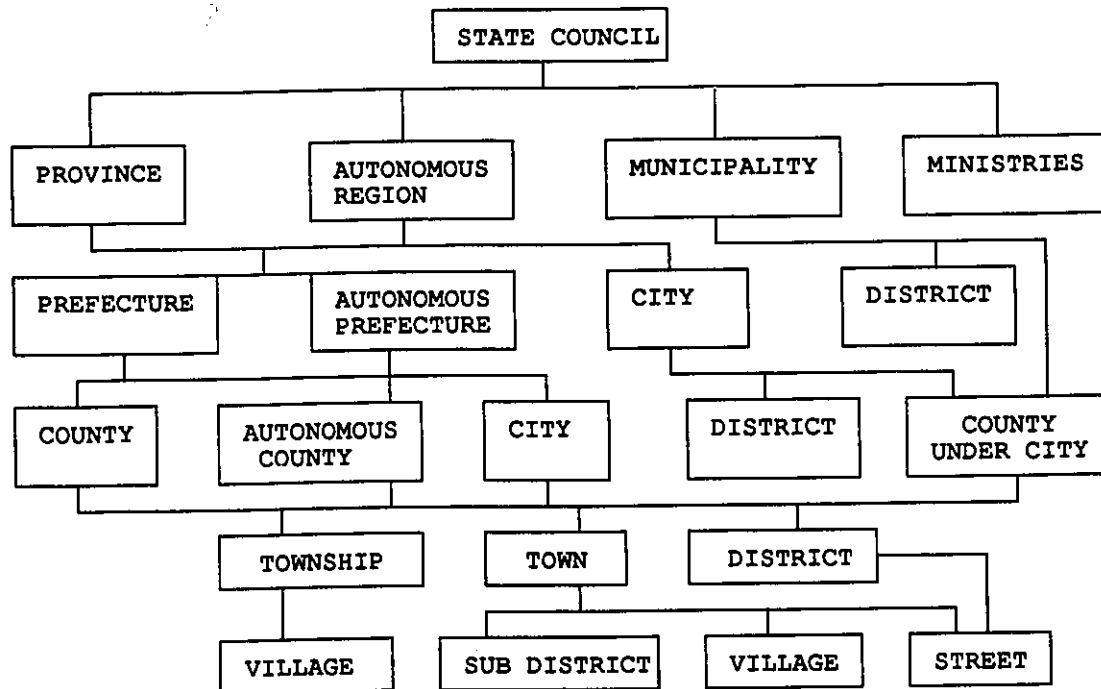
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Appendix 1 China's Administrative Hierarchy



Note: Under the State Council, there are four government levels which are province, prefecture, county and township. This is basic organization in China's hierarchy society. Many different systems follow this hierarchy, regional administrative system and industrial system will be described below.

1. Regional administrative system:

Provincial level: There are 22 provinces, 3 municipalities directly under central government, and 5 autonomous regions in China. These 30 units are at the same level as government ministries.

Prefectural level: One level lower than province, there are 151 prefectures and autonomous prefectures, and 185 prefectural level's cities in 1989 (provincial capitals and some important cities), urban and suburb districts in three municipalities are at this level also.

County level: There are 1919 counties and autonomous counties, and 185 county level cities in 1989.

Township level: In rural area, it was commune before 1984. Township (or town) is the lowest level's rural government in Chinese government hierarchy. There are 44,704 townships in China, and the average population per township is 20,000, according to the Statistical Yearbook of China 1989. In urban area, it is town or district.

Village level: It was brigade in rural China before 1984. It is a rural community and administrated by the community's committee. There are 746,432 villages in China, and the average population is 1,200 (SSBC. 1990. p.3).

2. Industrial system within plan:

State level's enterprises: The enterprises are directly under ministries according to industrial sector. Before 1978, most of large scale key industrial firms were in this category. After reform, many of them are decentralized to provincial management. But central government still controls their production through mandatory plan. Some very large scale company may have special position in local industrial system.

Provincial level's enterprises: The enterprises are subordinated to provincial industrial departments according to their industrial sector. (please refer to Fig III-1, China's Urban Administrative Structure) There are two types of ownership in this category, public ownership and collective ownership, but very small proportion of collective owned enterprises at this level. Most of enterprises at this level are large or medium scale.

Prefectural level's enterprises: They are subordinated to prefectural government departments or prefectural level city's departments according to their industrial sector. The industries at this level are mainly medium scale, a few large scale, and some small ones. The proportion of collective ownership is higher than provincial level.

County level's enterprises: They are administered by county industrial bureau which is the industrial department in county government. The industries at this level are medium scale and small scale. The proportion of collective owned industries are much higher than prefectural level (Field work).

Table A1-1 China Administrative System 1989

Province	Prefecture	City			County	District Under City
		Total	Prefecture	County		
BEIJING					8	10
TIANJIN					5	13
HEBEI	8	21	10	11	128	33
SHANXI	6	13	6	7	93	18
NEIMONGGU	8	16	4	12	72	16
LIAONING		20	14	6	38	56
JILIN	2	21	6	15	26	18
HEILONGJIANG	4	25	10	15	54	63
SHANGHAI					9	12
JIANGSU		24	11	13	51	42
ZHEJIANG	2	24	9	15	52	20
ANHUI	7	18	9	9	63	35
FUJIAN	3	14	6	8	56	17
JIANGXI	5	15	6	9	75	15
SHANDONG	5	32	11	21	78	34
HENAN	5	25	12	13	104	40
HUBEI	7	29	8	21	50	27
HUNAN	6	25	8	17	78	30
GUANGDONG		19	18	1	76	38
GUANGXI	8	12	5	7	76	21
HAINAN		3	2	1	16	
SICHUAN	10	23	11	12	169	34
GUIZHOU	7	8	2	6	75	6
YUNNAN	15	11	2	9	114	4
TIBET	6	2	1	1	76	1
SHAANXI	6	11	4	7	86	14
GANSU	9	13	5	8	67	10
QINGHAI	7	3	1	2	37	4
NINGXIA	2	4	2	2	16	6
XINJIANG	13	16	2	14	71	11
ALL CHINA	151	447	185	262	1919	648

Source: SSBC. 1990. China Statistical Yearbook 1990. Beijing: China Statistical Publishing House. p.3.

Appendix 2 Definition of City

1. Definition of City

"City (shi) is defined as an officially approved urban area also known as "designated cities" (jianzhi shi). No urban settlement may have official city status without the approval of the State Council. The criteria the State Council has used to establish cities (shi) were first approved in June 1955 and published three months later. The criteria were based mainly on an urban centre's administrative status and population size:

The city (shi) is an administrative unit that belongs to and is under the leadership of a province, autonomous region or autonomous prefecture. Cities and towns with a clustered population of more than 100,000 may be designated shi. If indeed necessary, cities and towns with a clustered population of less than 100,000 may acquire shi status provided that they are important industrial and mining bases, seats of province level state government agencies, relatively large centres for the collection and distribution of goods, or important cities and towns in remote border regions. The suburban districts of shi should not be too large (State Council of China. 1955)." (Cited from: Ma, 1987, p. 374)

In 1963, the State Council was further specified the minimum size requirement of a city. It emphasized 100,000 population, but it still kept the other criteria of a city status (Ma, 1987, p.375)

2. City Grade

Cities are officially classified into three categories on the basis of the size of a city's non-agricultural population residing in the city proper (shiqu) and in suburban districts (jiaoqu).

a. Cities with a population of over one million are classified as huge cities;

b. Cities with a population of between 500,000 and one million are classified as large cities;

c. Cities with a population of between 200,000 and 500,000 are

classified as medium-sized cities;

d. Cities with a population under 200,000 are classified as small cities. (States Council of China, 1984, Regulation on city planning. Cited from: SSBC. China Urban Statistics 1985, p.173)

3. Administrative Ranking of City

A city typically consists of the city proper (shiqu or shixiaqu) which is officially designated as urban, and some rural counties under its administration (jiaoxian or shixiaxian) which may be predominately agricultural.

China's administrative structure has five basic levels: central government (zhongyang), province (sheng), prefecture (diqu), county (xian), and township (xiang or zhen). Cities are also ranked according to this hierarchy which determines political and economic autonomy. Beijing, Tianjin, and Shanghai are equivalent to a province for administrative purposes and reports directly to the central government. Below the provincial level there are 185 (in 1989) prefectural level cities reporting directly to the provincial governments. These include provincial capitals and other major cities. Finally, there are county level cities which report to prefectures. Entire rural counties can become county level cities when the "non-agricultural" (feinongye) population reaches eighty percent of the total population. Some special provisions also apply for border counties and those adjacent to special economic zones. (SSBC. China Urban Statistics 1988. New York, p.xi)

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Appendix 4 Glossary of Major Indicators

Gross Output Value of Industry

The output of industrial products in terms of money (list price x quantity produced). This reflects the general achievement and overall scale of industrial production within a certain period. Note that in summing up the output value of enterprises to get Gross Output Value of a sector, the value of intermediate goods is double counted. From 1958 to 1984, only township run enterprises were included into industrial output. Since 1984, all of rural industrial enterprises are included.

The industrial output value is calculated with two kinds of prices:
a: Constant prices, which remove the influence of price changes to ensure comparability between the different areas, different periods;

b: Current prices, which refer to the producer's prices of products at the time of reporting. (SSBC. (3), 1988, p.xiii; SSBC. (1), 1985, p.174; SSBC. (15), 1990. p.84)

Gross Output Value of Rural Industry

From 1958 to 1984, enterprises run by townships, formerly people's communes, were included in Gross Output Value of Industry. Enterprises run by villages, formerly production brigades and teams, were included in Gross Output Value of Agriculture. Since 1984, village run, and below village level's jointly and private owned industries were transferred from agriculture to industry. However, this category includes several kinds of ownership, collective, joint, and individual ownership. In rural areas, for cotton ginning, rice husking, wheat milling, animal slaughtering, and sewing, only processing charges instead of the whole value of products are counted in Gross Output Value of Industry. (SSBC.(3) 1988, p.xiii)

Rural Labour Force

Able-bodied and semi-able-bodied rural residents working regularly in cooperatives (including rural enterprises) and family sideline production. (SSBC. (1), 1985. p.173; SSBC. (15) 1990, p.149)

Rural Population

Population in townships. (NOCPUCC. 1991. p.32)

City and Town Population

There are two concepts used in the 1990 population census in collecting the population data of city and town.

The first concept refers to total population enumerated in city (excluding counties under the jurisdiction of city) /town according to the "Statute of 1990 Population Census".

In the second concept, city population refers to people living in the districts of cities which are sub-divided into districts; and town population refers to people living in neighbourhood districts and those living in neighbourhood committees of towns directly under county's jurisdiction. In this research, the second concept is used to define city, town, and rural population. (NOCPUCC.

1991. p.71)

Rural Industrial Labour Force

Rural labourers who engage in rural industrial production fairly regularly (over six months in a year), excluding labourers in tractor stations, transport teams, catering trade. (SSBC. (1), 1985; DREMAC. 1990. p.149)

Rural Industrial Enterprise

Rural industrial unit is a relatively stable economic entity that has stable organization, production place, facilities, and employees. It has accounting system, takes economic responsibility and turns in taxes. (SSBC. (15) 1990. p.405)

Tax

a. Product Sales Tax: the tax that should be paid by an enterprise for products actually sold within the period of report. It includes product tax, appreciation tax and business tax.

b. Natural Resources Tax: resources tax paid by oil, natural gas and coal mining enterprises when the sales of their taxable products (including products produced for self-consumption) have brought a profit rate of over 12% (excluding enterprises that are under trial for replacing profits with tax, because their resources tax was included in the turnover of their profits).

c. Income Tax Actually Paid: the income tax actually paid by enterprises at a fixed tax rate (55%), and progressive rate tax. (SSBC. (1), 1985. p.174)

Total of Tax and Profit

Products sales tax plus natural resources tax, education fee, and total profit. (SSBC. (15), 1990. p.482)

Value of Export

The value of goods exported to countries or regions out of China. (SSBC. (15), 1990. p.662)

Original Value of Fixed Assets

The money actually paid at the time of buying or building various kinds of fixed assets and the additional investment made in later reforms or expansions. (SSBC. (1), 1985. p.174)

Electricity Consumption

Consumption includes electricity sold by power enterprises to users and the electricity consumed and sold by industrial firms from their own subsidiary power plants. (SSBC. (1), 1985. p.175)

Grain Output

Grain includes rice, wheat, potato, corn, Chinese sorghum, millet, soyabean and other food grains. Potatoes include sweet potatoes and potatoes, excluding taro and cassava. Taro falls into the vegetable category, and cassava falls into the category of other industrial crops. (5 kg fresh potato counts as 1 kg grain.) (SSBC. (1), 1985. p.173; SSBC. (15), 1990. p.404)

Household Expenditure

All of expenditures of personal consumption, excluding bank saving and investment in business. (SSBC. (15), 1990. p.325)

Total Investment in Fixed Assets

The building and purchasing of fixed assets reflected in terms of money. As a complex indicator reflecting the scale and direction of investment in fixed assets, this contains the capital construction and technical reforms of state establishments, the investment in fixed assets by collective enterprises, and the investment in housing and production fixed assets (which can be used for more than two years and unit value is over 50 RMB Yuan) by individual person.

The amount of investment in capital construction is the amount of finished capital construction reflected in terms of money; an overall measurement for the scale and progress of capital construction in a certain period; the amount of work calculated with budget prices according to the actual progress of construction. Building materials not yet put into construction and equipment not yet installed are not included in the finished amount of investment.

Investment in improvements and technical reforms is the amount of work in improvements and reforms in terms of money. (SSBC. (1), 1985. p.175; SSBC. (15), 1990. p.222)

Commercial Employee

The employees in retail, catering, and service industries. (SSBC. (15), 1990. p.602)

Railway Freight Volume

All goods transported through railway station procedures on all operational and temporarily operational lines. (SSBC. (1), 1985. p.174; SSBC. (15), 1990. p.568)

Highway Goods Transport Volume

Weight of goods transported on power-driven and non-power-driven road vehicles. (SSBC. (1), 1985. p.174; SSBC. (15), 1990. p.568)

Total Communication Services

The services of the Post Offices in terms of money. The Post Offices include all post offices, confidential communications offices, distant communications offices, urban telephone bureaus, telecommunications bureaus, post and telecommunications offices, temporary post offices and agents that serve clients directly. (SSBC. (1), 1985. p.175; SSBC. (15), 1990. p.569)

Telephone Quantity

The total of urban and rural telephones. (SSBC. (15), 1990. p.564)

Foreign Investment

Loans and other funds raised from abroad by the Chinese government, enterprises and other economic bodies, including direct investment by foreign firms, funds raised by issuing securities and stocks.

The investment includes cash, material objects, industrial property rights and technology.

a. Joint Ventures

Businesses in which the Chinese side, foreign firms, overseas Chinese businesses, or businessmen from Hong Kong, Macao, and Taiwan make common investment according to an agreed-upon percentage of shares for each side, and share the management, risking loss and collecting profits or suffering deficits.

b. Joint Operation

Cooperation by contract. This means that, according to agreements or contracts, the Chinese side provides land, natural resources, labour services, buildings and other facilities, while the guest companies present funds, technology, equipment and semi-processed materials for the operation. The profits are divided according to the fixed percentage or the provisions of the contract.

c. Joint Exploitation

The exploitation of oil, coal, nonferrous metals and other resources that involve foreign investment.

d. Independent Business

A business in which the means of production, products and income belong to foreign businessmen, overseas Chinese businessmen, or Chinese Businessmen in Hong Kong, Macao, and Taiwan. (SSBC. (1), 1985. p.176; SSBC. (15), 1990. p.662)

Educational Level

Referring to the highest level of formal education or its equivalent attained by people aged 6 years and over at the reference time. All educational levels include the people who are graduated, non-graduated or studying at school. The university refers to people having educational level of college and above; the senior secondary includes general senior secondary and technical secondary education. (NOCPUSCC. 1991. p.71)

Appendix 5 Tables and Figures

Table A5-1 Factor Scores of Rural Industrial Development of
China, 1989

OBS	PROVINCE	FACTOR1 (Productivity)	FACTOR2 (Employment)	FACTOR3 (Energy Consumption)
1	BEIJING	1.53	-1.03	-0.55
2	TIANJIN	1.99	-1.24	0.29
3	HEBEI	0.39	0.99	-0.17
4	SHANXI	-0.01	0.02	2.28
5	NEIMONGGU	-1.18	-0.05	-1.03
6	LIAONING	1.03	0.11	0.18
7	JILIN	-0.12	0.14	-0.42
8	HEILONGJIANG	-0.11	-0.06	0.26
9	SHANGHAI	2.30	-1.10	-0.02
10	JIANGSU	1.30	0.85	-0.27
11	ZHEJIANG	1.33	0.40	-0.55
12	ANHUI	-0.43	1.34	-0.96
13	FUJIAN	0.32	0.35	0.03
14	JIANGXI	-0.57	1.11	-0.05
15	SHANDONG	0.81	0.68	0.25
16	HENAN	-0.22	1.43	1.20
17	HUBEI	-0.10	0.48	-0.08
18	HUNAN	-0.49	0.63	0.46
19	GUANGDONG	0.93	0.18	-0.03
20	GUANGXI	-0.97	0.82	-0.91
21	HAINAN	-0.79	-1.60	-3.26
22	SICHUAN	-0.51	1.09	0.12
23	GUIZHOU	-1.12	0.05	0.92
24	YUNNAN	-1.00	-0.16	0.73
25	SHAANXI	-0.62	0.36	-0.11
26	GANSU	-0.83	-0.32	0.30
27	QINGHAI	-1.05	-2.52	1.29
28	NINGXIA	-0.94	-2.00	1.39
29	XINJIANG	-0.89	-0.98	-1.25

Table A5-2 Comparison of Skewness Between Original and Log Transformed Regional Characteristic Data

ORIGINAL DATA	SKEWNESS	LOG TRANSFORM	SKEWNESS
AOUTPRLB	1.04	LAOUTPRL	0.39
LANDPPOP	1.66	LLANDPOP	0.76
GRAINPRL	2.43	LGRAINPL	1.21
POPPKM2	3.44	LPOPKM2	-1.09
HOUSEXP	1.85	LHOUSEXP	0.94
COMEMPP	1.31	LCOMEMPP	0.31
INVESTPP	2.59	LINVESTP	0.8
UOUTPEMP	1.13	LUOUTPEM	0.45
FIXASTSE	1.58	LFIXASTS	0.84
TAXPROFE	1.73	LTAXPROF	0.74
INDUINVE	0.98	LINDUINV	-0.08
RAILWAYD	2.52	LRAILWAY	0.28
HIGHWAYD	0.69	LHIGHWAY	-1.55
FREIGHTR	2.36	LFREIGHR	0.9
FREIGHTH	2.5	LFREIGHH	0.89
TOTBUSNI	3.06	LTOTBUSN	1.32
PHONPE	3.0	LPHONPE	1.05
UNIVTY	3.02	LUNIVTY	1.64
JUNIORAB	0.97	LJUNIORA	0.13

Table A5-3 Residuals of Multiple Regression for Dependent Variable of Productivity

OBS	PROVINCE	PRODUCTIVITY (FACTOR1)	
		Predicted	Residual
1	BEIJING	1.770	-0.243
2	TIANJIN	1.666	0.328
3	HEBEI	0.044	0.342
4	SHANXI	-0.421	0.407
5	NEIMONGGU	-1.085	-0.090
6	LIAONING	0.876	0.150
7	JILIN	0.231	-0.348
8	HEILONGJIANG	-0.070	-0.037
9	SHANGHAI	2.713	-0.418
10	JIANGSU	0.787	0.513
11	ZHEJIANG	0.725	0.605
12	ANHUI	-0.083	-0.348
13	FUJIAN	0.216	0.103
14	JIANGXI	-0.400	-0.171
15	SHANDONG	0.206	0.606
16	HENAN	-0.469	0.253
17	HUBEI	0.147	-0.243
18	HUNAN	-0.196	-0.293
19	GUANGDONG	0.842	0.093
20	GUANGXI	-0.653	-0.321
21	HAINAN	-0.069	-0.718
22	SICHUAN	-0.373	-0.133
23	GUIZHOU	-0.904	-0.215
24	YUNNAN	-1.102	0.109
25	SHAANXI	-0.410	-0.213
26	GANSU	-1.087	0.259
27	QINGHAI	-1.325	0.274
28	NINGXIA	-0.612	-0.327
29	XINJIANG	-0.963	0.075

Table A5-4 Residuals of Multiple Regression for Dependent Variable Employment

OBS	PROVINCE	EMPLOYMENT (FACTOR2)	
		Predicted	Residual
1	BEIJING	-1.973	0.947
2	TIANJIN	-0.869	-0.371
3	HEBEI	0.573	0.415
4	SHANXI	0.338	-0.316
5	NEIMONGGU	0.163	-0.208
6	LIAONING	-0.048	0.158
7	JILIN	-0.129	0.273
8	HEILONGJIANG	0.166	-0.223
9	SHANGHAI	-0.717	-0.384
10	JIANGSU	0.687	0.161
11	ZHEJIANG	0.116	0.283
12	ANHUI	0.816	0.526
13	FUJIAN	0.518	-0.172
14	JIANGXI	0.906	0.208
15	SHANDONG	0.316	0.369
16	HENAN	1.064	0.367
17	HUBEI	0.234	0.246
18	HUNAN	0.913	-0.279
19	GUANGDONG	0.655	-0.478
20	GUANGXI	0.485	0.334
21	HAINAN	-1.009	-0.587
22	SICHUAN	1.562	-0.471
23	GUIZHOU	0.371	-0.325
24	YUNNAN	-0.266	0.110
25	SHAANXI	0.570	-0.213
26	GANSU	-0.299	-0.019
27	QINGHAI	-2.287	-0.234
28	NINGXIA	-1.675	-0.324
29	XINJIANG	-1.181	0.205

Table A5-5 Residuals of Multiple Regression for Dependent Variable
Energy Consumption

OBS	PROVINCE	ENERGY CONSUMPTION (FACTOR3)	
		Predicted	Residual
1	BEIJING	-0.530	-0.020
2	TIANJIN	-0.329	0.617
3	HEBEI	0.860	-1.030
4	SHANXI	1.898	0.377
5	NEIMONGGU	-0.062	-0.966
6	LIAONING	0.559	-0.378
7	JILIN	-0.113	-0.307
8	HEILONGJIANG	-0.164	0.422
9	SHANGHAI	-0.106	0.087
10	JIANGSU	-0.492	0.222
11	ZHEJIANG	-0.578	0.027
12	ANHUI	-0.244	-0.721
13	FUJIAN	-1.183	1.217
14	JIANGXI	-0.598	0.550
15	SHANDONG	0.619	-0.371
16	HENAN	0.522	0.663
17	HUBEI	-0.226	0.143
18	HUNAN	-0.044	0.504
19	GUANGDONG	-0.626	0.595
20	GUANGXI	-0.285	-0.627
21	HAINAN	-2.068	-1.189
22	SICHUAN	0.500	-0.382
23	GUIZHOU	0.519	0.397
24	YUNNAN	0.683	0.051
25	SHAANXI	0.243	-0.358
26	GANSU	1.133	-0.833
27	QINGHAI	0.739	0.547
28	NINGXIA	0.576	0.810
29	XINJIANG	-1.204	-0.048

Table A5-6 A Data Dictionary of Beijing's Map Layers

No.	Layer Feature	Class	Attribute	Value	Description
1	Population Density	Polygon	POPDEN	1	>= 600
				2	400 - 599
				3	200 - 399
				4	< 200
2	Physiographic Division	Polygon	FEATURE	1	alluvial plain
				2	smooth terrain region
				3	mountainous region
				4	reservoir
3	Area Accessible to Highway System	Polygon	HIGHWAY	0	not accessible to highway
				1	accessible to main highway
				2	accessible to secondary highway
				3	accessible to local highway
4	Area Accessible to Railway Network	Polygon	RAILWAY	0	not accessible to railway
				1	accessible to railway
5	Urban Industrial Output	Polygon	INDUOUT	1	>= 800 million Yuan
				2	235 - 799 million Yuan
				3	< 235 million Yuan
6	Agricultural Output per Rural Worker	Polygon	AGROUT	1	>= 3200 Yuan
				2	2200 - 3200 Yuan
				3	< 2200 Yuan
7	Legal Status of the Spatial Unit	Point	TWNLEVEL	1	county town
				2	town
				3	township
8	Rural Industrial Output	Point	RUROUT	1	> 100,000,000 Yuan
				2	60,000,001-100,000,000 Yuan
				3	30,000,001-60,000,000 Yuan
				4	10,000,001-30,000,000 Yuan
				5	< 10,000,000 Yuan

Fig A5-1
Output of Map Overlay
Beijing

