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ECONOMIC DEVELOPMENT IN THE AGRICULTURAL AND INDUSTRIAL SECTORS IN THE PEOPLE'S REPUBLIC OF CHINA

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Highlights

This study examines the intersectoral perspective for agricultural and industrial economies in China, including the patterns of sectoral development of the past four decades.

This study reveals that the process of Chinese economic growth fluctuated mainly because of policy changes. Growth of the modern industrial sector influenced Chinese national economy at the expense of the traditional agricultural sector.

In a developing economy characterized with dualism, the interrelationship between growth of the agricultural sector and the industrial sector of the economy is crucial for overall development. Theoretically, agricultural and industrial sectors are closely linked. Agricultural progress would depend increasingly on the growth of industrial development, and vice versa. However, mutual dependency did not occur in the Chinese economic development process. The causality test between the agricultural and industrial sectors of the Chinese economy indicates no cause-effect relationship.

Growth models for the agricultural and industrial sectors were estimated using the two stage least squares estimator. Labor productivity was low in the agricultural sector before 1979, and marginal productivity of labor was negative, also both labor productivity and capital productivity in the industrial sector were low in China. China's industrial development was mainly capital intensive. Labor productivity in the agricultural sector increased significantly after 1979, while productivity in the industrial sector decreased. This indicates that economic reform positively affected the agricultural sector in terms of labor productivity but negatively affected the industrial sector. Rural peasants have supported market-oriented economic reform, more enthusiastically than urban people.

ECONOMIC DEVELOPMENT IN THE AGRICULTURAL AND INDUSTRIAL SECTORS IN THE PEOPLE'S REPUBLIC OF CHINA

1. INTRODUCTION

The interrelationship between the growth of the traditional indigenous agricultural and the modern industrial sectors of the economy are critical for overall development. Policymakers in most developing countries have realized the importance to industrialization and more recently the importance of the agricultural sector. However, economic analysis largely has neglected intersectoral links, concentrating instead on either macroeconomic or single sector and subsector issues (Bacha).

Chinese leadership has promoted a nationwide industrialization program since 1949 when the communist party came to power. For a long time, priority in economic development was given to industry, especially heavy industry, and emphasis was placed on large scale, state owned industry which was highly capital intensive and concentrated mostly in urban areas. Consequently, great progress had been made in China's industrial development. In terms of gross industrial and agricultural output value, the proportion of industry had climbed from 30 percent in the early 1950s to 74.4 percent of the national income in 1987, with agriculture falling from 70 percent to 25.3 percent.

However, no corresponding changes had taken place in the employment structure. About 76.2 percent of the total labor force is still engaged in agriculture. According to a World Bank report (1985), Chinese agriculture will remain one of the largest and most important sectors of China's economy for the next two or three decades. By 2000, food will account for about 50 percent of the household budgets and more than 50 percent of the total labor force still will work in agricultural activities.

Theoretically speaking, agricultural and industrial sectors are closely linked to each other. Agricultural progress will increasingly depend on growth of the industrial demand for agricultural commodities. Similarly, industrial progress will continue to depend on the growth of agricultural purchasing power for inputs, industrial commodities, and agricultural products for industrial processing.

The primary objective of this paper is to evaluate the intersectoral perspective for agricultural and industrial economies in China, including the patterns of sectoral development of the past four decades. The first section describes and evaluates the implication of government policies since 1949 and economic reform since 1978 on economic growth and productivity in the agricultural and industrial sectors. A two-sector development model is created in the second section followed by an empirical study, using time series data from 1952 to 1988. Conclusions then follow.

2. ECONOMIC DEVELOPMENT AND POLICY REFORM IN CHINA

The Chinese economy has grown over time with periods of stagnation. In addition to the expansion of production in both aggregate and per capita values, the growth has changed the output structure, technology, and the level of economic welfare of the Chinese people. Although farmland in China is only

7 percent of the world's arable land, China can supply food for its total population, which is 22 percent of the world population. No large developing country has done as well as China in this regard (World Bank, 1983).

Quantitative indicators of Chinese economic progress toward modern economic growth[1] are shown in Table 1. The growth rate of the Chinese economy has fluctuated from year to year, mainly because of policy changes. Trends in economic growth from 1953 to 1987 are shown in Table 2, Figures 1 and 2.

The past four decades can be divided into six periods of district government policies and economic systems:

1) 1949 to 1952: Recovery from war and Land Reform.

2) 1953 to 1957: The First Five-Year Plan and agricultural collectivization.

3) 1958 to 1962: The Great Leap Forward and formation of the People's Commune.

4) 1963 to 1965: Recovery from economic crisis.

5) 1966 to 1978: Cultural Revolution and strengthening of the collective economy.

6) 1979 to present: Economic reform.

1) 1949 to 1952: Recovery from war and Land Reform

The Chinese Communist Party came to power in 1949 and disrupted the Chinese economy, curtailing both industrial and agricultural production. Railroad lines had been blown up and the channels of distribution cut. The economy was suffering from hyperinflation.

The new regime restored the economy within a relatively short time. By 1951, the process of inflation was arrested, fiscal and monetary stability was restored, and the foundations for the drive toward industrialization were being laid. Both industrial and agricultural output values were restored to pre-1949 peak levels by 1952.

During the initial recovery period, the Chinese leadership transformed economic organization and institutions, expanding government-owned enterprise and redistributing land. The first step the new leadership took to develop agriculture was land reform. This was part of the political and social revolution to replace the traditional rural order with a new socialist order. The ultimate goal was to socialize agriculture and raise agricultural output.

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[1]Modern economic growth, the term used by Simon Kuznets, is similar to "economic development" in meaning. Its key element is the application of science to problems of economic production which in turn leads to industrialization, urbanization, and even an explosive growth in population.

TABLE 1. INDICATORS OF CHINESE ECONOMIC DEVELOPMENT, SELECTED YEARS, 1952-89

Indicator	1952	1957	1965	1978	1980	1985	1986	1987	1988	1989
Gross Social-Value Output[a] (Billion yuan)[b]	101.5	173.5	262.1	736.7	866.5	1,470.2	1,621.4	1,849.7	2,984*	NA
National Income[c] (Billion yuan)	58.9	90.1	116.3	267.1	304.1	486.8	525.7	580.7	1,177*	1,300*
Population (millions)	575	647	725	963	987	1,050	1,065	1,081	1,096	1,112
Average Income Per Capita (current yuan)	102	142	194	315	376	673	746	868	1,074	1,169*
Commodity Output										
Grain (million tonnes)	163.9	NA	194.5	304.8	320.6	379.1	391.5	404.7	394.1	407.5
Cotton (million tonnes)	1.3	NA	2.1	2.2	2.7	4.1	3.5	4.2	4.2	3.8
Coal (million tonnes)	66	NA	232	618	620	872	894	928	980	1,040
Crude oil (million tonnes)	0.4	NA	11	104	106	125	131	134	137	137
Electricity (billion kilowatt hours)	7.3	NA	67.6	256.6	300.6	410.7	449.5	497.3	545.2	582.0
Crude steel (million tonnes)	1.4	NA	12.2	31.8	37.1	46.8	52.2	56.3	59.4	61.2

[a]Gross social value output denotes the total of the gross value output of so-called "material production" sectors, such as industry, agriculture, construction, restaurants, freight transportation, and that part of communications and trade serving material production.
[b]All financial figures are in constant prices except as noted; *: current yuan.
[c]The national income is the value added to the country's material wealth from the seven material productive sectors mentioned above. The national income is the gross social value output net of capital depreciation and other material outlays.

SOURCE: Almanac of China's Economy Editorial Board, Zhongguo Jingji Nianjian, 1988 (1988 Almanac of China's Economy), Beijing, Jingji Guanli Chubanshe, 1989, pp. XI-3, XI-13, XI-23, XI-31; People's Daily (overseas edition), April 10, 1990; Beijing Review, October 2-8, 1989, p. 29, February 26-March 4, 1990, To. Centrefold.

TABLE 2. CHANGES IN AVERAGE ANNUAL RATE OF GROWTH OF GROSS SOCIAL VALUE OF OUTPUT (GSVO) AND NATIONAL INCOME (NI)

Years	Total GSVO	Agricultural GSVO	Total NI	Agricultural NI
	Percent			
1953/57	11.3	4.5	8.9	3.7
1958/62	-0.4	-4.3	-3.1	-5.8
1963/65	15.5	11.1	14.7	11.5
1966/70	9.3	3.9	8.3	3.0
1971/75	7.3	3.3	5.5	2.6
1976/80	8.3	3.2	6.1	0.7
1981/85	11.2	8.2	9.9	8.3
1953/87	8.6	3.8	6.8	3.0

SOURCE: Zhonggo Jingji Nianjian, 1988, pp. XI-7, XI-13, XI-25.

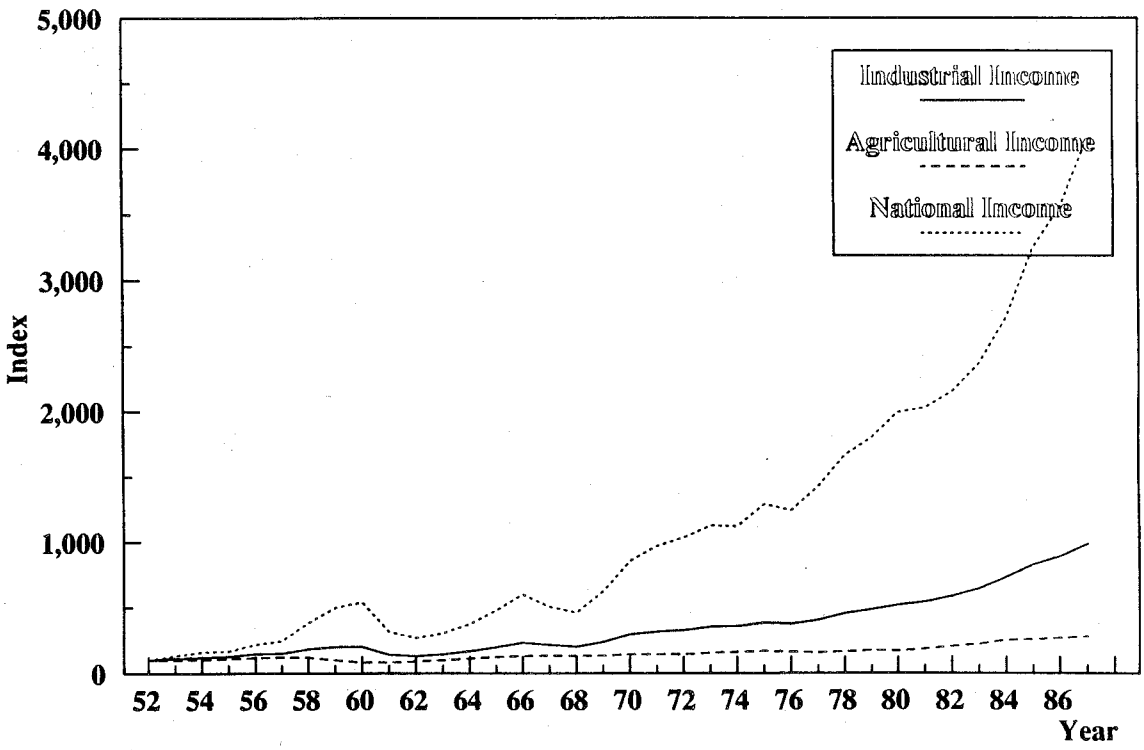

Figure 1. Industrial, Agricultural, and National Income Indices, (base year = 1952), 1952-1987

SOURCE: Almanac of China's Economy Editorial Board, Zhongguo Jingji Nianjian, 1988 (1988 Almanac of China's Economy). Beijing, Guanii Chubanshe, 1989, pp. XI-22.

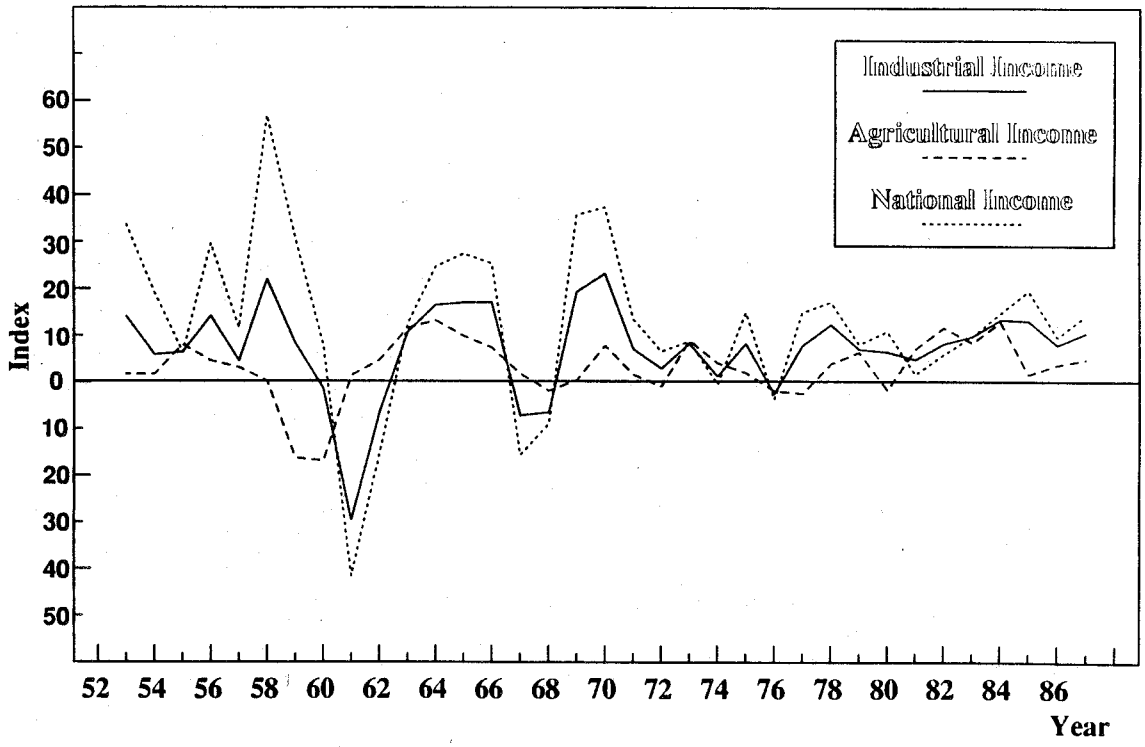

Figure 2. Annual Changes in Industrial, Agricultural, and National Income Indices, 1952-1987

SOURCE: Almanac of China's Economy Editorial Board, Zhongguo Jingji Nianjian, 1988 (1988 Almanac of China's Economy). Beijing, Guanii Chubanshe, 1989, pp. XI-22.

2) 1953 to 1957: The First Five-Year Plan and agricultural collectivization

After completing the nationwide program of land reform in 1952, the Chinese leadership began various programs to develop the economy rapidly and to establish socialism. The Chinese government did not have mature international experience to guide a large agricultural country. The economy was recovering from the war and leaders did not adopt an open economic policy toward the West. Western countries were hostile to the new Chinese government and exercised a trade embargo against China. Under such difficult conditions, China turned to the Soviet Union for economic assistance and designed its development strategy using the Soviet experience as a model. The Chinese government adopted a rigid, highly centralized, planned economic system and the long-time strategy of emphasizing industrial development, particularly heavy industry, rather than agriculture. Industry received 52.4 percent of total investment (of which 89 percent was for heavy industry) and only 7.8 percent was for agriculture (Yang and Li).

The new leadership began to organize agriculture under socialistic ideology. This involved the organization of farms into collectives, the monopolization of product markets, and the lowering of product prices. The industrialization program was subsidized by capital accumulated by these practices in the agricultural sector.

The authorities initially planned three five-year plans to move from rudimentary collectives (mutual-aid teams) to advanced ones, i.e., socialistic collective associations. They believed that large collective farms could control the peasants' consumption and squeeze more economic surplus to finance industrialization and agricultural modernization. By the end of 1957, China's rural population was transformed from individual peasants into members of some 752,000 advanced cooperative farms. Private plots were allocated to peasant households, and during the peasants' spare time they could grow subsidiary crops or raise animals. Both agricultural production and subsidiary production increased at the same rate.

Since 1954, Chinese authorities have adopted a residence registration system to keep the peasant on the farm. Peasants could not move to other sectors or join economic activities with higher marginal productivity. They had to produce farm products for the government at prices less than 1/3 of those of the United States and 1/5 of those of Western Europe and Japan. It lasted until 1985 when the government abolished the monopoly and switched to contract buying.

3) 1958 to 1962: The Great Leap Forward and Formation of the People's Commune

Various problems of imbalance in the economy emerged because economic development emphasized large-scale, state owned industry (especially heavy industry) which was highly capital intensive and concentrated mostly in the large cities. Agricultural growth was slow because of low investment. This created shortages in some raw materials and many of the new plants had to operate below capacity because of no rural demand for industrial products. Rural unemployment or underemployment also existed. The Great Leap Forward was launched to maximize economic growth. Rural resources were mobilized to accelerate the development of agricultural and medium- and small-scale industries and to restore balanced growth. This strategy was called "walking on two legs" and represented a form of balanced development. It involved balancing relationships between (1) industry and agriculture, (2) heavy and light industry, (3) large and medium to small-sized enterprises, (4) modern productive and indigenous methods, and (5) enterprises run either by the central government or by local authorities.

The dualistic development program of "walking on two legs" developed China's small-scale rural industry at an almost unprecedented pace since 1958. During the Great Leap Forward, thousands of small iron and steel plants called "backyard furnaces" were built to increase steel and iron production. By late 1958, however, these plants were wasting large amounts of valuable raw materials to produce nearly useless products, and most of them closed down by the end of 1959.

Together with the introduction of rural industrialization, the Chinese leadership in 1958 campaigned to organize people's communes, which were semi-militarized organizations of 4,000 to 5,000 households. These became the basic units of social organization for agriculture, but also for industry, commerce, education, and security.

Under the commune system, the original cooperative units were reorganized into production brigades, and the original permanent mutual aid teams became the production teams. Each production team of 15 to 50 households formed the basic level of collective agriculture and carried out most of the farm activities. Team members had assigned work tasks and received "work points" for the work completed. These work points were the basis for income distribution. The production brigade, supervised from 15 to 50 constituent teams, coordinated their activities, and organized small-scale rural enterprises and capital projects.

Under the semi-militarized organizational structure, the People's communes successfully mobilized large rural labor forces for the rural industrialization campaign and for large-scale irrigation projects, farmland reconstruction, and development of intensive methods of cultivation. However, because of inefficiency from political interference and mismanagement in farming and constructing irrigation projects, these campaigns contributed little to agricultural development in the late 1950s. The Great Leap Forward freed the so-called "Three Winds," which contributed to the nation's serious economic crisis in the early 1960s.[2]

The natural disasters of 1959 to 1961 and the over-collectivization decreased agricultural production appreciably from 1959 to 1962, contributing to an adverse impact on industrial output because the supply of raw materials was reduced and state investment in industry was cut back. The agricultural crisis spilled over into the industrial and other nonagricultural sectors. By 1961, the whole economy was in an acute depression which lasted until the autumn harvest of 1962. The 1959-61 crisis was so profound that, compared to 1958, there was a 30 percent decline in national income, a 26 percent decline in agricultural national income, and a 30.3 percent decline in industrial national income. With decreased use of plant capacity and large-scale industrial unemployment, the government sent 18.87 million urban workers to rural areas, which already were overpopulated (Zhonggong Dangshi Dashi Nianbiao).

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[2]The "Three Winds" include a "communist wind" characterized by extreme equalitarianism and unpaid-for transfer of resources from one collective to another or from one level of ownership to another; a "wind of boasting," a tendency among cadres to exaggerate production achievements, especially the figures, and a "wind of blind direction," a tendency among the authorities to issue unsuitable orders on the spur of the moment. See Lin, Wei, and A. Chao, China's Economic Reform, University of Pennsylvania Press, Philadelphia, 1982, pp. 127.

4) 1963 to 1965: Recovery from economic crisis

After the Great Leap Forward failed, various policy changes were introduced. The government attempted to correct the excesses in collectivization and to reduce the size of the agricultural production unit to the production team. A three-level system of ownership was established and consolidated. In many areas, the responsibility for production was assigned to individual farms ("bao chan dao hu" system). Ideology emphasized economic incentives and technical expertise. The order of priority in the economy was completely reversed. Agriculture was emphasized in development followed by light and heavy industry. This new emphasis increased manufactured inputs for farming, and 28 million urban dwellers, including some 18.87 million workers, were transferred to the rural area between 1961 and 1963 (Zhonggong Dangshi Dashi Nianbiao). The peasants could reduce the farm product they had to sell to government.

From 1963 to 1965, China recovered from the fall in production of the preceding period. In 1965, grain production had recovered to the 1957 level and agricultural production was higher than in 1957.

The steady recovery of agricultural output after 1962 was partly due to normal weather but more significantly to new economic policies toward the peasant.

5) 1966 to 1978: Cultural Revolution and strengthening of the collective economy

The latter half of the 1960s was the period of the Cultural Revolution, while the first half of the 1970s was the era of the "Gang of Four." A third Five-Year Plan for 1966-70 would have developed the national economy along the lines of the first half of the 1960s but at an accelerated rate. However, by the mid-1960s, Mao and his followers were seriously concerned that the policies responsible for the successful recovery of the economy would deviate from socialism toward capitalism. They would not tolerate any "revisionism" in pursuit of material gains--peasants were devoting more time to their private plots, rural markets were flourishing, and workers and bonuses motivated employees in factories. To reverse this trend, Mao launched the Cultural Revolution in 1966.

Agricultural policy in this period was marked by the overcollectivization, "take grains as the foundation" policy, and the "learn from Dazhai" movement. During the Cultural Revolution, Mao and his followers tried to make the production brigade (and not the production team) the basic accounting unit without considering the low productivity in most rural areas. They exaggerated class struggle based on the Communist doctrine and conducted it on an excessive scale in the rural area. Rural economic undertakings other than the main line of production, such as the peasant's private plots, the country trade fairs, and all mercantile activities, were prohibited as capitalistic. Equalitarianism ruled income distribution.

Under the "learn from Dazhai" movement, annual campaigns to build rural public works, such as water conservation and land improvement projects during the winter-spring season, became a regular component of Chinese rural life.[3] These campaigns, which absorbed a vast amount of manpower, covered a range of activities such as water conservation, afforestation, irrigation, flood control, hydro-electric stations, well-digging, and the leveling, terracing, and reclaiming of land for agricultural purposes. During the mid-1960s, the winter rural public works campaigns occupied about 20 percent of the rural labor force's time while in the early 1970s, the campaigns involved 30 percent of the entire rural labor force (Rawski).

6) 1979 to present: Economic reform

Chinese peasants earned about 100 yuan per capita annually with part of the income in kind, and about 200 million rural persons were in need. Therefore a decision which stimulates peasants' productivity and improves their living standard was made by the third session of the 11th Party Central Committee in December of 1978. Since 1979 a series of reform programs was launched on a grand and spectacular scale. The "contract responsibility system" with remuneration linked to output based on publicly owned land was introduced, but eventually gave way to individual household farming. The distribution of income was based on work performed, not on the principle of egalitarianism. Peasants had decision-making power and could reallocate their own resources. Opening up the labor market freed the surplus labor force and raised their productivity.

Rural markets were freed, and agricultural procurement prices rose significantly. The advantages of the market oriented price mechanism were reflected in more active use of price policy. The purchase price of many agricultural products increased considerably (Table 3). In 1985, the government monopoly of the farm products market was terminated and replaced by a return to contract buying. Agricultural production increased at an almost unprecedented pace from 1979 to 1988.

The government switched from the "take grain as the foundation" policy to promoting a diversified development policy. Being self-sufficient in grain production no longer was required. Peasants could plant nonfood crops, such as sugarcane or cotton, to meet seasonal or local conditions. Private plots were returned to the peasant households. A certain amount of hill wasteland was allocated to the peasants to plant trees, herbs, or grass. After decollectivization, the output of rural industry increased by almost 60 percent during 1983-86 (Watson).

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[3]Located in Xiyang County, Shanxi Province, Dazhai production brigade has developed a series of ultra-left practices which were publicized as a model to emulate on the agricultural front. The production brigade rather than the production team was the level of accounting. It launched a series of campaigns to build rural work, banned the cultivation of private plots by members as well as their household sidelines, introduced "Political Work Points" (working points granted according to one's political attitude), and negated the principle of "to each according to his work" in income distribution.

TABLE 3. INCREASE OF FARM PRODUCT PROCUREMENT PRICE

	1978-1985		1985-1988	
	Total Increase (%)	Average Annual Increase (%)	Total Increase (%)	Average Annual Increase (%)
Procurement price index of farm product	66.6	7.6	46.6	13
Procurement price index of grain	107.1	10.5	46	10.8

SOURCE: Cheng Zhiping, "Study of Grain Procurement Price," Vol. 4, Guangdong Price Research 1989, p. 2.

Agricultural production grew rapidly. From 1978 to 1988, agricultural output value increased at an average annual rate of 6.2 percent, and rural per capita incomes increased from 134 yuan to 545 yuan, an average annual rate of 7.6 percent. Urban per capita incomes from 1978 to 1987 rose from 316 yuan to 1119 yuan with an average annual increase rate of 5.9 percent (Zhong). Per capita grain production grew from 319 kg to 377 kg. China could feed its over 1 billion people and even export some food products. Structural deviations in the distributions of national income gradually have been rectified.

Shortly after launching rural reforms, other reforms gradually increased the decision-making power of some industrial enterprises in 1980. After the Third Plenary Session of the 12th Party Central Committee in October 1984, the reform was focused more directly toward the industrial-urban sector. The industrial-urban reform is also characterized as market-oriented. Although the reform was positive to industrial performance, the market-oriented reform in cities was more difficult than that in rural areas. The peasants enthusiastically supported the rural reform in 1979 and made it a success.

3. DEVELOPMENT OF THE GROWTH MODEL

Growth-promoting interactions between agricultural and industrial sectors have been reviewed in the literature and accepted by many policymakers. The "theology" of development has emphasized that agricultural progress contributes to the support of great productivity throughout the economy. Ricardo believed that limiting the growth of agricultural output set the upper limit on the growth of the nonagricultural sector and to capital formation for economic expansion.

When a dual economy exists, the ultimate question for an economy's future development is how the modern exchange sector can expand while the indigenous agricultural sector contracts. This requires an analysis of the interrelationship between the two sectors. Several models of development have

focused on the structural formation of a dual economy. Sir Arthur Lewis (1954) analyzed the interactions between the two sectors and concluded that when the modern capitalist sector expanded, it drew labor from the reservoir in the traditional noncapitalist sector. For countries that have high rates of population growth and are densely populated, the supply of unskilled labor to the capitalist sector was assumed unlimited. When the capitalist sector offers additional employment opportunities at the existing wage rate, the numbers willing to work at the existing wage rate will be greater than the demand. Through the employment of "unlimited supplies of labor" and the capitalist's surplus, capitalist production expanded and withdrew from the subsistence sector to work. The capitalist's surplus became even larger, and more was reinvested. The process continued progressively by absorbing surplus labor from the subsistence sector.

In the two-sector model developed by professors Ranis and Fei (1964), a labor-surplus dualistic economy is characterized by the coexistence of a large, stagnant subsistence agricultural sector in which institutional forces determined the wage rate and by a small but growing commercialized industrial sector in which competitive conditions shaped the labor market. In such an economy, labor was not scarce but capital was. Development therefore required that "the center of gravity shift through the continuous reallocation of labor from the agricultural to the industrial sector: the related criterion of 'success' in the development effort is thus a rate of industrial labor absorption which is sufficiently fast to permit the economy to escape from the ever-threatening Malthusian trap."

The Mathematical Growth Model

Following Ranis and Fei, a growth model for the Chinese industrial and agricultural sectors can be expressed as follows:

$$(1) \quad AY_t = \alpha_0 AL_t^{\alpha_1} AB_t^{\alpha_2} IY_t^{\alpha_3}$$

$$(2) \quad IY_t = \beta_0 IK_t^{\beta_1} IB_t^{\beta_2} AY_t^{\beta_3}$$

where AY_t = gross national income in the Chinese agricultural sector
AL_t = acres of arable land
AB_t = the quantity of labor in the Chinese agricultural sector
IY_t = gross national income in the Chinese industrial sector
IK_t = the total amount of capital in the Chinese industrial sector
IB_t = the quantity of labor in the Chinese industrial sector

In this model, AY_t and IY_t are treated as endogenous variables under an assumption that the two sectors of the economy help each other in the process of economic development and that the other variables (AL_t, AB_t, IK_t IB_t) are

treated as exogenous. Equations 1 and 2 are a static model in which changes in the value of independent variables (i.e., AL and AB in Equation 1) affect gross national income at the same time. There are, however, some evidences indicating that changes in the value of independent variables in time t affects gross income in t and several periods in the future. Under an assumption that the dynamics take place with the partial adjustment hypothesis (Nerlove), Equation 1 can be rewritten as

$$(3) \qquad AY_t^* = \alpha_0 AL_t^{\alpha_1} AB_t^{\alpha_2} IY_t^{\alpha_3}$$

$$(4) \qquad \left(\frac{AY_t}{AY_{t-1}}\right) = \alpha\left(\frac{AY_t^*}{AY_{t-1}}\right)$$

where AY_t^* is desired or optimal gross income in agricultural sectors, and α is a dynamic adjustment coefficient. Combining equations 3 and 4 yields

$$(5) \qquad AY_t = \lambda\, \alpha_0 AL_t^{\lambda\alpha_1} AB_t^{\lambda\alpha_2} IY_t^{\lambda\alpha_3} AY_{t-1}^{(1-\alpha)}$$

Similarly, Equation 2 is rewritten with the partial adjustment hypothesis as follows:

$$(6) \qquad IY_t^* = \beta_0 IK_t^{\beta_1} IB_t^{\beta_2} AY_t^{\beta_3}$$

$$(7) \qquad \left(\frac{IY_t}{IY_{t-1}}\right) = \lambda\left(\frac{IY_t^*}{IY_{t-1}}\right)$$

$$(8) \qquad IY_t = \lambda\, \beta_0 IK_t^{\lambda\beta_1} IB_t^{\lambda\beta_2} AY_t^{\lambda\beta_3} IY_{t-1}^{(1-\lambda)} \quad .$$

where IY* is desired or optimal growth income in the industrial sector and λ is the dynamic adjustment coefficient. Equation 5 is a dynamic growth model for the Chinese agricultural sector and Equation 8 for the Chinese industrial sector.

Causality Between Agricultural and Industrial Sectors

Equations 5 and 8 are derived under an assumption that one sector of the Chinese economy influences the growth of the other sector. The causal direction between the agricultural and industrial sectors of the Chinese economy is tested using the procedure of Nelson and Schinert (Granger and

Newbold). To test the null hypothesis that the growth of the industrial sector (IY_t) does not cause the growth of the agricultural sector, we specify the following equation (Nelson and Schinert):

$$(9) \qquad AY_t = \sum_{j=1}^{k} d_{1j}\, AY_{t-j} + \sum_{i=1}^{n} d_{2j}\, IY_{t-i} + e_{1t}$$

$$(10) \qquad AY_t = \sum_{j=1}^{k} d_j\, AY_{t-j} + e_{2t}$$

Assume that $\hat{\sigma}_1^2$ and $\hat{\sigma}^2$ denote the residual estimates from Equations 9 and 10, respectively. The test statistic is

$$(11) \qquad T = n(\hat{\sigma}^2 - \hat{\sigma}_1^2)/\hat{\sigma}_1^2$$

which has an asymptotic χ^2 distribution with k degrees of freedom under the null hypothesis that the economic growth of IY_t does not cause that of AY_t.

To test the null hypothesis that AY_t does not cause IY_t, Equations 9 and 10 are respecified as

$$(12) \qquad IY_t = \sum_{j=1}^{k} h_{1j}\, IY_{t-j} + \sum_{i=1}^{n} h_{2j} AY_{t-i} + e_{1t}$$

$$(13) \qquad AY_t = \sum_{j=1}^{k} h_j\, IY_{t-j} = e_{2t}$$

The test statistics in Equation 11 are calculated from estimated residuals from Equations 12 and 13 and are used to test the null hypothesis.

4. EMPIRICAL RESULTS

To estimate the models, we used time series data from 1952 to 1988. Most data used in this study were obtained from 1988 Almanac of China's Economy. Chinese official economic statistics (except for 1958-60) are generally reliable. Other data such as agricultural labor force and land came from Agricultural Statistics of the People's Republic of China (Crook). Land index data were adjusted based on the index from Anthony Tang (1981). National income, as mentioned before, is the value added to the country's material wealth from industry, agriculture, construction, transportation, and trade. Industrial income in the model includes net material product from materially

productive sectors other than agriculture. As an indicator of capital in the industrial sector, accumulated capital is the part of national income used to increase fixed capital assets, working capital, and material reserves.[4]

The Relationship Between Agricultural and Industrial Sectors

The estimated models for the industrial sector are presented in Equations 14 and 15.

$$(14)\quad Iy_t = \underset{(2.480)}{-2.661} + \underset{(4.918)}{0.895}\, Iy_{t-1} - \underset{(0.882)}{0.127}\, Iy_{t-2} + \underset{(3.046)}{0.921}\, AY_{t-1} - \underset{(0.915)}{0.344}\, AY_{t-2} + e_{1t}$$

$R^2 = 0.9755$, se = 0.117

$$(15)\quad Iy_t = \underset{(0.572)}{0.182} + \underset{(7.402)}{1.257}\, Iy_{t-1} - \underset{(1.603)}{0.270}\, Iy_{t-2} + e_{2t}$$

$R^2 = 0.9629$, se = 0.144

The estimated models for the agricultural sector are presented in Equations 16 and 17.

$$(16)\quad AY_t = \underset{(1.213)}{0.637} + \underset{(10.444)}{1.545}\, AY_{t-1} - \underset{(3.679)}{0.677}\, AY_{t-2} - \underset{(0.404)}{0.036}\, IY_{t-1} + \underset{(1.263)}{0.089}\, IY_{t-2} + e_{1t}$$

$R^2 = 0.9685$, se = 0.057

$$(17)\quad AY_t = \underset{(0.405)}{0.123} - \underset{(9.952)}{1.531}\, AY_{t-1} - \underset{(3.354)}{0.544}\, AY_{t-2} + e_{2t}$$

$R^2 = 0.9658$, se = 0.060

Where numbers in parentheses are the t-values for the corresponding parameters and se represents standard error.

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[4]The rest of national expenditure (national income in terms of distribution) is "consumption," which refers to the sum of personal, governmental, and communal consumption. Depreciation of private housing and minor repairs and depreciation of the fixed assets of government agencies, armed forces, and all other nonproductive enterprises are included in consumption. Most of accumulated capital are allocated to industrial sectors.

The value of the χ^2-statistic calculated from Equations 14 and 15 is larger than the critical value of the statistics at the 5 percent significance level, rejecting the null hypothesis that growth of the agricultural sector has not caused the growth of the industrial sector in the Chinese economy.

The χ^2 test with Equations 16 and 17 accepts the null hypothesis that growth of the industrial sector has not caused growth in the agricultural sector in the Chinese economy.

The causality test indicates that growth of the Chinese agricultural sector has contributed to growth of the Chinese industrial sector, but the industrial sector has not contributed to the growth of the agricultural sector. The following factors may explain this result:

1) Industry has developed at the expense of an "agricultural squeeze." In the 1950s, the Chinese leadership adopted many aspects of the Soviet model of economic development. The agricultural sector was a resource base to be "exploited" to serve development strategies. To accumulate capital to serve the development of the country's weak and underdeveloped industry, the government adopted the practice of monopolized state procurement and marketed farm and sideline products at low prices.

The state purchased these commodities at extremely low prices in rural areas and marketed them at similar or slightly higher prices to urban residents and enterprises. This policy kept the low wage expenditure and cost of raw materials for its major industries and created the super profits and the necessary contribution funds for its industrial development. Relevant statistics show that over the 30 years from 1949 to 1978 the differentials between industrial and farm and sideline product prices have meant a "contribution gratis" of 600 billion yuan from the peasants or 45 percent of their total income for this period (Jiang and Luo).

2) An "urban bias" discriminates against agriculture. Chinese leadership recognized the distinct forms that agriculture's contribution could take. Mao said, "It is the peasants who constitute the main market for China's industry. Only they can supply foodstuffs and raw materials in great abundance and absorb manufactured goods in great quantities." "In the future, additional tens of millions of peasants will go to the cities and enter factories." Mao acknowledged both the market and factor contribution of agriculture and the critical role of agriculture's financial contributions to industrialization.

Mao's attitudes toward agriculture changed after 1949. Although Mao recognized agriculture's important contributions to economic growth and seemed to support a policy of current growth between the two sectors, Mao sought to achieve agricultural growth primarily through organizational changes and to accelerate urban industrial development through a high level of state investment expenditures, financed largely through direct and indirect heavy taxes on agriculture. The organizational changes increased the role of the bureaucracy and did not help China's agriculture.

3) The rural area has been isolated from the urban area. A strict system of resident registration had divided the country's urban and rural residents into two. The peasants had to labor on limited arable land. They perceived no possibility of improving their circumstances in this closed or semi-closed natural economy. Agricultural development lost vigor and vitality. The equalitarian practice in distribution, reduced the peasants' enthusiasm for production and productivity.

Growth Model for Agricultural and Industrial Sectors

Growth models for agricultural and industrial sectors (Equations 5 and 8) estimated with two stage least squares estimator indicate that economic growth in the agricultural sector has contributed to growth of the industrial sector. The growth model for the agricultural sector does not include the growth measures in the industrial sector as an independent variable, but the industrial growth model contains the growth measure of the agricultural sector. A dummy variable representing economic reform since 1978 and the variable interacting with the labor variables are included to investigate the impacts of the policy on labor productivities in the People's Republic of China. The agricultural growth model also includes the trend variable to capture effects of improvements in farming technology. The estimated equations are as follows;

$$(18)\quad \underset{}{LogAY_t} = \underset{(0.419)}{-1.854} + \underset{(1.613)}{1.292\ LogAL_t} - \underset{(0.339)}{0.149\ LogAB_t} + \underset{(6.329)}{0.709\ Log\ AY_{t-1}}$$

$$- \underset{(1.950)}{21.33\ D_t} + \underset{(1.955)}{1.694\ (Dt \cdot LogAB_t)} + \underset{(0.618)}{0.0046}$$

$$R^2 = 0.9622$$

$$(19)\quad Log\ IY_t = \underset{(1.263)}{-1.885} + \underset{(4.878)}{0.361\ Log\ IK_t} + \underset{(2.894)}{0.381\ LogIB_t} \underset{(2.897)}{-1.174\ Log\ AY_{t-1}}$$

$$+ \underset{(5.314)}{0.381 Log\ IY_{t-1}} + \underset{(3.957)}{1.308\ Log\ AY_t} + \underset{(2.488)}{4.379\ Dt} - \underset{(2.494)}{0.380\ (Dt \cdot Log\ IB_t)}$$

$$R^2 = 0.9880$$

where D1 is a dummy variable representing 1979 to 1988 in which the Chinese government used a semi-market oriented economic policy. This dummy variable is used to evaluate effects of the economic policy on growth of gross national income in the agricultural and industrial sectors of the Chinese economy. The dummy variable interacting with the labor variable is used to evaluate changes in labor productivity in the agricultural and industrial sectors during 1979 to 1988 compared to 1953 to 1978.

R^2s are 0.96 for the growth model of the agricultural sector and 0.99 for the growth model of the industrial sector, indicating that Chinese economic growth in both the agricultural and industrial sectors can be explained very well by the variables used in the models. In the growth model for the agricultural sector, the estimated coefficients are not highly significant

except for the lagged dependent variables although the model has high R^2. This is due mainly to the high multicollinearity among the independent variables. The estimated coefficients in the growth model for the Chinese industrial sector all differ significantly from zero at the 5 percent significance level.

Two agricultural growth models can be derived from Equation 18 by adjusting the dummy variable and the variable interacting with the labor variables on the intercept term and the estimated coefficients for the labor variable.

The model for 1952 to 1977 is

$$LogAY_t = -1.854 + 1.292\ LogAL_t - 0.149\ LogAB_t + 0.709\ Log\ AY_{t-1} + 0.0046t$$

and the model for 1979 to 1988 is

$$LogAY_t = -23.184 + 1.292\ LogAL_t + 1.545\ Log\ AB_t + 0.709\ LogAY_{t-1} + 0.0046t$$

Equation 19 is divided into two models. The model for 1952 to 1977 is

$$LogIY_t = -1.885 + 0.361LogIK_t + 0.381\ LogIB_t - 1.174\ LogAY_{t-1} + 0.381\ LogIY_{t-1} + 1.308\ Log\ AY_t$$

and the model for 1979 to 1988 is

$$LogIY_t = 2.494 + 0.361\ LogIK_t + 0.001\ LogIB_t - 1.174\ LogAY_{t-1} + 0.381\ LogIY_{t-1} + 1.308\ LogAY_t$$

Some conclusions can be drawn from comparing these two models in the agricultural and industrial sectors:

1) Labor productivity was extremely low in the agricultural sector before 1979, and marginal productivity in labor was negative. 2) Both labor productivity and capital productivity in industrial sector are low, indicating that China's industrial development is based mainly on capital intensity with low efficiency of workers. 3) While labor productivity in the agricultural sector increases significantly after 1979, that in the industrial sector decreases, which indicates that economic reform since 1978 has affected the agricultural sector positively in terms of labor productivity but negatively in the industrial sector.

As discussed earlier, the economic institutions and strategy developed in China since the 1950s have repeated the major features of the traditional Soviet model with only minor variations. Planners attempted to extract the maximum level of surplus agricultural product to meet demand of the planned growth in the industrial sectors of the economy. During the collectivization period of agricultural production, all the agricultural labor was kept on the farmland. Peasants could not work in nonagricultural lines of production and the agricultural sidelines of forestry, animal husbandry, and fishery.

The steady natural growth of the agricultural labor force and the sharp decline in the available arable land per capita have produced an army of surplus agricultural workers. Statistics show that in 1978 the number of

working age people totaled 528 million, of which 298 million were employed, leaving 230 million labor resources available.[5]

The situation regarding the rural labor surplus seems to have been more severe. A detailed study of 30 population teams in Nantong County, Jiangsu Province, concluded that this county had surplus labor with only 1.6 mu (about 0.107 hectares) per head of the agricultural labor force. The study reports that about 4 mu (about 0.267 hectares) per worker would be needed to avoid surplus labor (Song). This is a substantially higher estimate of labor requirements than many others have used in China. The Ministry of Agriculture, Animal Husbandry, and Fisheries uses an estimated average cropping intensity of 9 mu (about 0.6 hectares) per worker in crop production to forecast labor requirements. An estimated one-third of the agricultural labor force is superfluous (World Bank, 1985). Although one billion man-days of labor input were mobilized in China's agriculture, particularly in rural labor-intensive construction work campaigns since the 1950s, agricultural production per man-day fell (Table 4). Consequently, China's success in absorbing rural surplus labor through collectivization has brought with it a substantial decline in the average and marginal productivity of labor.

Since 1978, the new system of production responsibility in rural areas, and the higher prices for state purchases of major farm products, have encouraged the peasants' sideline production, have revived free markets so peasants can sell their private produce, and have increased the peasants' incentive to work for the collective and for themselves. In 1979, the first year the new agricultural policies were put into effect, total output value from agriculture rose 8.6 percent over 1978. Grain production increased by 6.1 percent, reaching 333.12 million tonnes, a record high. Cotton production rose by 1.8 percent, and the three oil-bearing crops (peanuts, sesame, and rapeseeds) increased by 23.5 percent. Each peasant's average income rose from 117 yuan in 1977 to 170 yuan in 1980. Peasants' savings deposits in banks increased from 4.65 billion yuan in 1977 to 12.66 billion yuan in 1980 (Lin and Chao).

Since 1949, the Chinese leaders have combined all efforts and resources for an industrialized state and a modernized national defense. Most capital was allocated to build a comprehensive industrial system, and the capital-labor ratio rose. Robert M. Field reported that the number of workers in the 1952-57 period increased by 49.5 percent while the net value of industrial capital rose

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[5]K.C. Yeh derived total population of working age in 1978 from total population in 1978 from Statistical Yearbook of China, 1983, P. 103, and the percentage of total population at working age, which he assumed to be the same as that for 1982, 54.87 percent, based on tabulations of a 10 percent sample of the third national census, given in Population Census Office, State Council and Development of Population Statistics, State Statistical Bureau, Zhongguo 1982 nian renkou pucha 10 percent chouyang ziliao (10 percent sampling tabulation on the 1982 Population Census of the P.R.C.), Beijing, 1983, pp. 8-9. For total employmetn, see Statistical Yearbook of China, 1983, p. 120. See K.C. Yeh, "Macroeconomic Changes in the Chinese Economy During the Readjustment," The China Quarterly, 100, 1984, p. 692.

TABLE 4. LABOR PRODUCTIVITY IN AGRICULTURE, 1957 AND 1975

Category	1957	1975	Absolute Increase	Percentage Increase
Gross value of agriculture output (billion of 1957 yuan)	53.700	83.907	30.207	56%
Labor input				
Millions of man-years	213.5	328.8	115.3	54%
Billions of man-days	36.9	89.4	52.5	142%
Labor productivity in gross value				
Yuan per man-year	251.5	255.2	3.7	1%
Yuan per man-day	1.46	0.94	-0.58	-36%

SOURCE: Derived from T.G. Rawski, Economic Growth and Employment in China, Oxford University Press, 1979, p. 120.

by 131.9 percent, resulting in a 55.1 percent capital-labor ratio increase. Between 1950 and 1978, fixed assets of industry increased more than 25 times and the number of workers 13 times (Field). Labor productivity before 1978 did not rise in the capital-labor ratio because of low capital productivity. Low labor cost also may have contributed to the labor productivity before 1978. Between 1950 and 1977, wages and salaries for most workers and employees remained the same.

The government crammed about 38 million young people, of whom 66 percent were educated youth who returned from the countryside, into industrial enterprises that already were overmanned.[6] Many enterprises had to employ veterans, females (especially in heavy industry), and children of current or former employees with little consideration to competency training and physical conditions. Labor productivity deteriorated.

The market-oriented reforms in urban areas are difficult when the market legal system and institutional rules are inadequate and the new socialist commodity economic order is not established fully. The government has adopted a policy that permits an enterprise to keep most of its profits and to separate ownership from management. By the end of 1988, about 80 percent of enterprises had become contract ones. These enterprises could do whatever they wanted with the state-owned assets as long as a certain amount of profits and taxes were submitted to the government. However, the relationship of rights, responsibilities, and benefits among the enterprise owner, manager, and worker are unclear and cannot act as a checking mechanism of the enterprise's

[6]According to a sampling taken in 1982, 13 percent surplus workers and employees were in national metallurgical industry. The overmanned of Liaoning Province were as high as 30 percent in industry, transportation, and construction. See Zhuang Qidong and Sun Ke Liang, "Issue on New Style Labor Reserve Systems," Labor Economics and Population, Vol. 6, 1982.

performance. The reform in the urban area consequently has done little to attack the waste and inefficiency inherent in China's planned economy.

Because a sound social security program consistent with the needs of a reformed economy is absent, enterprises still provide many social services instead of economic entities. An enterprise should keep workers unemployed due to economic changes. This redundant work force inevitably conflicts with an increase of labor productivity.

5. SUMMARY AND CONCLUSIONS

Beginning in the early 1950s, China began rapid but uneven modern economic growth. In the past four decades, production both in aggregate and per capita has expanded, and the structure of output has changed.

This economic performance, however, did not rise from nothing. The process of economic growth fluctuated due to some non-economic factors, particularly government policy changes. Growth of the modern industrial sector influenced Chinese national economy at the expense of the traditional agricultural sector.

In a developing economy characterized with duality, the interrelationship between growth of the agricultural sector and the industrial sector are crucial for overall development. Theoretically, agricultural and industrial sectors are closely linked. Agricultural progress would depend increasingly on the growth of industrial development, and vice versa. However, this did not happen in the Chinese economic development process. Empirical testing of a dual growth model indicates that growth of the agricultural sector has increased growth of the industrial sector, but growth in the industrial sector has not increased growth in the agricultural sector. Chinese planners followed Soviet economic development strategies of developing the industrial sector by an "agricultural squeeze." The government monopolized state procurement and marketed farm and sideline produce at low prices to accumulate enough capital to develop modern industry. Agriculture has been discriminated against by an "urban bias." A strict resident registration system, which divided the country's urban and rural residents into two parts and forced peasants to remain on limited arable land, also have contributed to the interrelationship between agricultural and industrial development.

Growth models for the agricultural and industrial sectors were estimated by using the two stage least squares estimator. Labor productivity was low in the agricultural sector before 1979, and marginal productivity of labor was negative. Since both labor productivity and capital productivity in the industrial sector were low, China's industrial development was based mainly on capital intensity with low efficiency of workers. While labor productivity in the agricultural sector increased significantly after 1979, the industrial sector decreased, indicating that economic reform positively affected the agricultural sector in terms of labor productivity but negatively affected the industrial sector. Rural peasants have supported market-oriented economic reform, more enthusiastically than the urban people.

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