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SOCIALIST INDUSTRIALIZATION AND ECONOMIC PERFORMANCE IN CHINA FROM 1952 TO 1989

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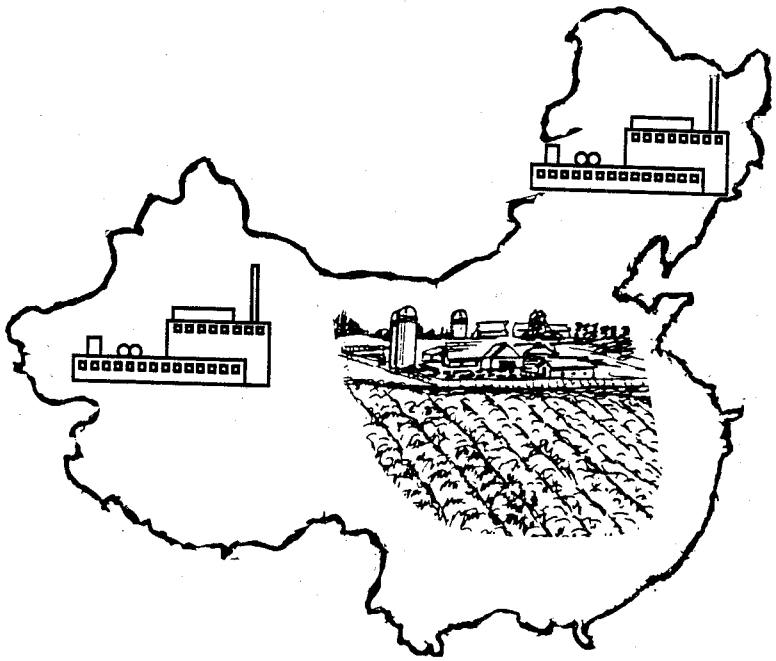

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Highlights

This study examines the Chinese socialist industrialization drive and economic performance from 1952 to 1989.

Industrialization is one way to satisfy patterns of demand growth with varying combinations of factor supplies, assuming the importance of resource allocation associated with market mechanisms is recognized. The Chinese socialist industrialization program under a highly centralized planned economic system shows a different story of economic development.

As a socialistic developing country which has been eager to catch up to the developed economies, China followed the development strategy of Soviet industrialization, which emphasized heavy industry. This strategy has its own characteristics in different sub-periods that respond to different economic policies. Our analytical and empirical study shows that particular patterns of Chinese industrialization have brought significant economic growth at the high cost of low labor and capital productivity and that China's economic policy can be useful if it is divided into five policy regimes focusing on the incentive system, the choice of technique, and the sectoral emphasis of each period. Economic policy did affect economic performance at a significant level.

The estimated Chinese total factor productivity (TFP) growth from 1952 to 1989 generally confirmed the World Bank's estimates from 1952 to 1982 in China (Tidrick, 1986). The Chinese national economy from 1952 to 1989 had high growth of outputs and inputs. Its TFP growth contributed only 23.6 percent to aggregate growth compared to the TFP growth that has contributed about one-third of the aggregate net output growth in middle-income developing countries and nearly one-half in industrial market economies.

Due to market-oriented reform since 1978, the effect of resource reallocation has been significant as a source of growth, particularly in rural areas. The Chinese national economy achieved its higher growth rate from high factor inputs, and high factor productivity in the economic reform period than from 1952 to 1977. However, TFP stagnated or declined from 1978 to 1989 in China's state-owned enterprises. Five possible factors for this include 1) difficulties of reform in urban areas, 2) the miniaturization of the unit investment scale, 3) conflicts between reform and long-term development, 4) lack of stimulation and regulatory mechanisms to raise the economic efficiency, and 5) blindly importing.

Development of subsectors within a national economy must proceed in tandem. The linkages or interactions among these sectors is significant for development planners, who must keep overall macroeconomic balances to ensure consistency. The linkages among agricultural and light and heavy industrial sectors during the economic development process were vulnerable.

The causality test between the agricultural and light industrial and heavy industrial sectors of the Chinese economy does not indicate a cause-effect relationship.

Socialist Industrialization and Economic Performance in China From 1952 to 1989

I. Introduction

Growth of national output and changes in the structure of the economy are two major components of economic development. Many developed countries showed a similar pattern of change as their economies industrialized and grew. The transformation in developing countries from underdeveloped to semi-industrialized countries has been examined carefully. Both time-series and cross-country regression studies suggest a strong association between economic growth and structural change, away from agriculture and into industry.

Neoclassical theory concerning the relation between economic growth and structural transformation emphasizes the significance of changes in factor supplies and productivity. Studies of developing countries show that changes in demand and trade are equally important to continued growth. Industrialization, therefore, can be viewed as a way to satisfy similar patterns of demand growth with varying combinations of factor supplies (Chenery, Robinson, and Syrquin, 1986). This is true assuming the importance of resource allocation associated with market mechanisms is recognized. Economic growth and structural change is different if China's socialist industrialization program is analyzed.

After the communists came to power in 1949, China adopted a highly centralized planned economic system and an industrialization that emphasized industrial development, particularly heavy industry. Through controlled prices, the government purchased agricultural products and drew a portion of primitive accumulation from agriculture as capital to start the industrialization. By 1978, China's industrial modernization drive had made progress and a system of modern industry had been established. The gross industrial and agricultural output value proportion of industry had climbed from 10 percent in the early 1950s to 74.4 percent, and agriculture had fallen from 90 to 25.6 percent (Du, 1989). According to the World Bank (1990), Chinese industry as percentage of gross domestic products (GDP) in 1988 ranks fifth among 121 member countries. However, no corresponding changes had taken place in the employment pattern. GNP per capita still remained low ($320 in 1988).

Why has China achieved a rapid growth in industrial output while the GNP per capita has remained so low? Besides China's base of population, the possible answers might be periodic political and ideological upheavals, resulting in economic fluctuation; imbalances in the ratios between accumulation and consumption, adversely affecting people's livelihoods and economic performance; unusual development of heavy industry, resulting in an uneven structure in the national economy and completely isolating the countryside from the cities and vice versa; and inefficiency in the Chinese national economy.

The primary objective of this paper is to evaluate China's socialistic industrialization, including economic growth, labor productivity and capital productivity growth of the past four decades. The first section describes and evaluates socialistic industrialization and the implication of government policies in five different periods on the economic performance of the Chinese economy. An economic growth model is created for an empirical study, using

time-series data from 1952 to 1989. The second section discusses the growth of total factor productivity (TFP) -- the difference between the rate of growth of aggregate output and that of some aggregate of inputs in China's national economy as well as in state-owned enterprises. The interactions among agricultural, light and heavy industrial sectors are investigated in section three. Conclusions and possible policy implications then follow.

II. Socialist Economic Development Strategy in Five Policy Regimes

1. Law of the priority growth of producer goods and Socialist Economic Development Strategy

Many developing economies have a goal of industrialization, since industry is seen as a key to stimulating national economic growth. In a socialistic country, some ideological factors also should be considered.

To evaluate the industrialization drive in a socialistic country, the law of the priority growth of the producer goods department must be considered. Karl Marx (1976) analyzed the processes of the simple and expanded reproduction of capital. He divided the gross social product (referred to as GSVO, Gross Social Value Output, in Chinese and other socialist countries' statistical literatures) into the gross social product of Department I, which produce means of production, and the gross social product of Department II, which produces means of consumption. Marx deduced functional relationships between these two departments and concluded that Department I must grow more rapidly than Department II.

Lenin (1970) introduced the technical progress factor into the initial Marxian pattern. He reported the phenomenon of the priority growth of Department I is characteristic of economic development in capitalism. This model of economic development was extremely influential (Pairault, 1988).

Stalin adopted the priority growth of Department I into an economic law for Soviet planners. During the 1930s, Stalin worked out a development strategy for Soviet industrialization that emphasized the development of heavy industry. Advocated as the "road of socialist industrialization," this Soviet strategy was regarded as the unique development strategy universally applicable in all socialist countries.

According to Dong (1988), four characteristics can be outlined in this development strategy. First, high-speed growth was needed to expand the socialist economy and overtake or outstrip the advanced capitalistic countries technically and economically. Second, the development of heavy industry was the central task in the economic development. Third, extensive development was the main approach to high economic growth. Therefore, accumulating and building new enterprises was the chief source of reproduction on an extended scale. Fourth, development of the economy was aimed at achieving basic self-sufficiency. The degree of self-sufficiency, therefore, became an important hallmark for the level of economic development.

As a socialist developing country, China has followed this strategy and achieved economic growth. China extricated itself from the long years of

stagnation or even retrogression in the pre-liberation days to build an independent, comprehensive system of industry and of national economy. A high GDP share of industry and manufacturing at low levels of income became one major characteristic of China's socialistic industrialization (Table 1).

The implementation of such an industrialization drive caused many problems in China: adverse effects on agricultural development, restraining people's consumption, and hindering improved economic performance.

2. Five Policy Regimes from 1952 to 1989

However, in different sub-periods, socialistic industrialization has its own characteristics, which respond to differing economic policies. Thus, we divided China's economic policy into five policy regimes. One way to differentiate among the five regimes is to focus on the incentive system, the choice of technique, and the sectoral emphasis of each period (Table 2).

The first period covered the First Five-Year Plan from 1953 to 1957. Collectivization and nationalization of urban and rural means of production characterized socialist transformation. To ensure high-speed economic growth and development of the economy, the government realized that it must develop a strong industrial base in the country. During this period, some 10,000 industrial enterprises and mining operations were established, including 156 Soviet-aid major construction projects worth $2.7 billion. The state's total planned investment for the five-year period came to ¥76,640 million ($31.154 million at the then official exchange rate of 2.46 yuan to the dollar). Nearly 90 percent of all state investment went into capital goods with three-fifths of state investment devoted to capital construction and a similar proportion of the latter earmarked for the ministries of heavy industry, fuel industry, and machine-building industry. Agriculture, on the other hand, was limited to a little more than ¥1 billion or 2.4 percent of planned capital construction investment; another 3.3 percent was allotted to investment in water conservancy (Riskin, 1987).

TABLE 1. SHARE OF GDP FOR INDUSTRY AND MANUFACTURING AT LEVELS OF INCOME AND RANKINGS AMONG WORLD BANK MEMBER COUNTRIES, SELECTED YEARS

Year	GNP/Capita	Rankings	Industry as a Percentage of GDP	Rankings	Manufacturing as a Percentage of GDP	Rankings
	(U.S. $)					
1965	98		39	23	--	--
1979	260	102	47	15*	--	--
1980	290	101	47	15*	--	--
1982	310	101	41	12	--	--
1983	300	100	45	7	--	--
1984	310	100	44	11	--	--
1985	310	96	47	7	37	1
1986	300	98	46	5	34	1
1987	290	102	49	3	34	1
1988	330	100	46	7	33	2

*Poland, Bulgaria, Hungary, USSR, Czechoslovakia, German Dem. Rep. included.

SOURCES: World Bank, World Development Report 1981, 1982, 1984, 1985, 1986, 1987, 1988, 1989, 1990.

TABLE 2. ECONOMIC POLICY REGIMES

Regime	Incentive System	Sectoral Priority	Choice of Technique
1953-1957 1st FYP	Material	Heavy Industry	Capital Intensive
1958-1962 2nd FYP Great Leap	Nonmaterial	Heavy Industry	Labor Intensive
1963-1965 Readjustment	Material	Agriculture	Capital Intensive
1966-1977 4th & 5th FYP Cultural Revolution	Nonmaterial	Heavy Industry	Labor Intensive
1978-1989 6th & 7th FYP Readjustment and Reform	Material	Balanced	Capital and Technology Intensive

SOURCES: Adapted from Chang (1986, p. 4), Eckstein (1977, pp. 31-65) and Adelman and Sunding (1987).

Although priority went to industry, particularly heavy industry, the government did implement its policy of collectivization in the agricultural sector, based on the principles of voluntary participation and mutual benefit. The peasants pooled their land and work and received payments on the basis of their shares of the land and their contributions to the labor. Private plots were allocated to peasant households; during the peasants' spare time, they could grow subsidiary crops or raise animals. The cooperative movement did thrive. Over 80 percent of the cooperatives increased production 10 to 30 percent.

During the second five year plan from 1958 to 1962, regarded as the second policy regime, the People's commune was formed. All sectors of the economy at this period were exhorted to "go all out, aim high, achieve greater, faster, better, and more economical results in building socialism."

In the whole period, the development of heavy industry was emphasized at the expense of the light-industrial and agricultural sectors. A feature of early designs for this Great Leap Forward that presaged its chief characteristics was a high investment rate. China's national rate of accumulation soared to 33.9, 43.8, and 39 percent for 1958, 1959, and 1960, respectively (Table 3). Marginal accumulation rates for the rural collectives were 40 to 60 percent in general and 70 to 100 percent for those reaching

TABLE 3. NATIONAL INCOME BY FINAL-USE, SELECTED YEARS (IN PERCENT)

Year	Private Consumption	Public Consumption	Accumulation
1952	71.5	7.1	21.4
1953	69.9	7.0	23.1
1957	69.4	5.7	24.9
1958	61.1	4.9	33.9
1959	50.3	5.9	43.8
1960	60.1	6.3	39.6
1961	74.5	6.2	19.2
1962	82.3	7.2	10.4
1963	75.7	6.8	17.5
1965	66.4	6.5	27.1
1966	63.1	6.3	30.6
1971	59.5	6.4	34.1
1975	59.1	7.0	33.9
1976	62.0	7.2	30.8
1978	56.2	7.2	36.5
1979	56.9	8.5	34.6
1980	60.1	8.3	31.5
1981	63.3	8.3	28.3
1982	62.7	8.5	28.8
1983	61.9	8.4	29.7
1984	59.6	8.9	31.5
1985	56.6	8.9	31.5
1986	56.7	8.6	34.7
1987	57.0	8.4	34.6
1988	--	--	34.5
1989	--	--	35.4

SOURCE: Zhongguo Jingji Nianjian, 1988 (1988 Almanac of China's Economy), pp. XI-21, XI-25, XI-26, XI-27.

'wealthy middle peasant' level of income (Riskin, 1987). Excessive rates of accumulation caused sectoral imbalances and tensions. Various problems of imbalance in the economy emerged because economic development emphasized large-scale, state-owned industries, which were capital intensive and concentrated mostly in the large cities.

The notion of 'politics in command' to ensure that a great spiritual force will become a great material force dominated the incentive system of thie period. The approach of the Great Leap to technology and management was consistent with the concept of 'politics in command' as was the formation of the people's communes. A portion of income was distributed to commune members free of charge and, thus, was independent of their work efforts.

The Great Leap Forward collapsed following the natural disasters of 1959 to 1961 and the withdrawal of Soviet aid that led to a temporary collapse of

many sectors of the economy. The 1959 to 1961 crisis was so profound that, compared to 1958, national income declined 30 percent, agricultural national income 26 percent, and industrial national income 30.3 percent. This led to the government's call for readjustment, the three-Year Readjustment Period from 1963 to 1965.

The adjustments and reforms of the late President Liu Shaoqi characterized by the third policy regime from 1963 to 1965. After the Great Leap Forward failed, various policy changes were introduced. The national accumulation rate was reduced to 10.4 percent in 1962 and 17.5 percent in 1963 (Table 3). The state's role in planning was decentralized in the hope of achieving a more widespread use of production incentives. 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 national economy was reversed for the first time. Agriculture was emphasized; some 28 million urban dwellers, including some 18.87 million government employed workers, were transferred to the rural area between 1961 and 1963 (Zhonggong Dangshi Dashi Nianbiao, 1981).

Readjustment and reform helped the Chinese economy to recover 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 that in 1957. The industrial sector also had recovered sufficiently to grow rapidly (Beijing Review, 1979).

The massive social unrest of the fourth regime, the Cultural Revolution, coincided with the country's third FYP (1966-1970) and Fourth FYP (1971-1975) and upset the relative economic normalcy of this adjustment period.

By the mid-1960s, Mao and his followers were 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.

Assessing the economic achievements of the decade is still quite difficult. According to the statistics, the nominal rates of growth for GNP (6.5 percent) and industrial and agricultural production (10.4 and 4 percent, respectively) were high. Even consumption per capita for both urban and rural inhabitants grew at respectable rates of over 2 percent annually (Riskin, 1987). However, the decade would have developed the national economy along the lines of the first half of the 1960s but at an accelerated rate if the Cultural Revolution had not been launched.

The fourth regime had the serious disproportion in the allocation of capital resources as well as imbalance in the ratio between accumulation and consumption. Heavy industry developed more rapidly than did light industry or agriculture. These disproportionate allocations increased the output value of the national economy, while the people's standard of living was not improved commensurately.

The prevailing incentive system was also "politics command" oriented. Political indoctrination and mass-education campaigns to ensure that people would conform to the Party's policies and guidelines were carried out. Moral encouragement and other nonmaterial incentives were used to spur workers to heighten performance on the job and to increase productivity. Working points were granted to peasants according to one's political attitude. Although some nonmaterial incentives did motivate workers, generally they failed.

On paper, the economic record from 1966 to 1977 looks good enough to question the need for any adjustment or reform in the future. National income had grown by 6.4 percent per year, industry by 8.1 percent, agriculture by 2.3 percent, and grain output by 3.2 percent (Zhongguo Jingji Nianjian, 1988). Although these figures put China at the top among the low-income countries in growth performance, they masked increasing serious structural problems.

First, the high rate of accumulation was raised out of balance with the consumption rate. Except for a previous period of economic readjustment (1963-65), China's accumulation rate always had been high from 1958, the first year of the Great Leap, to the mid-1970s. The amount of accumulation increased by 9 percent per year from 1966 to 1977, exceeding the growth in national income (6.4 percent), and increased 30.2 percent in 1978. In contrast, the growth in the amount of consumption was slower, especially if population growth (2.3 percent over 1966-77) is considered.

An extension of the scale of capital construction in accordance with the socialist development strategy accompanied the rise in the rate of accumulation. In this period, the nation built new factories, using huge amounts of funds, materials, and manpower. Those heavy industries absorbed huge amounts of investments and took a long time to build. In some cases, construction began before the picture of the resources and geological conditions was complete. Thus, construction sometimes dragged on and never was completed and those that were completed were not commissioned for production on schedule, causing tremendous waste and yielding poor results.

Second, the disproportions among agriculture, light industry, and heavy industry grew more serious. China's agriculture has developed slowly for a long time, particularly during the Cultural Revolution. Chinese peasants earned about 100 yuan per capita annually with part of the income in kind, and until 1978 about 200 million rural people still were in need. The light and heavy industries also were unbalanced.

Third, within heavy industry, the energy, raw and processed material, and building material industries and the communication and transport services lagged further behind the needs for economic development (Zhou and Zhang, 1982).

Therefore, the policy of economic readjustment was raised at the Third Plenary Session of the Eleventh Central Committee of the Chinese Communist Party in December 1978. The communiqué of the session indicated:

> Due to sabotage by Lin Bias and the Gang of Four over a long period there are still quite a few problems in the national economy, some major imbalances have not been completely changed,

> and some disorder in production, construction, circulation, and distribution has not been fully eliminated. A series of problems left hanging for years as regards the people's livelihood in town and country must be appropriately solved. We must conscientiously solve these problems step-by-step in the next few years and effectively achieve a comprehensive balance, so as to lay a solid foundation for rapid development (Beijing Review, No. 52, 1978, p.11)

During the years from 1979 to 1983 China implemented the policy of readjustment, reform, consolidation, and improvement with the focus on readjustment. The policy of readjustment involved reducing capital construction, coordinating in the development of agriculture, light industry, and heavy industry, and maintaining an appropriate ratio between consumption and accumulation. Reform involved the structure of economic management to increase efficiency. Consolidation involved specialization of labor and coordination of economic activities across different enterprises to achieve great economies of scale in production. Improvement involved upgrading existing levels of education, production, technology and management and developing foreign trade (Tung, 1982).

In rural areas, the "contract responsibility system" with remuneration linked to output based on publicly owned land was introduced in late 1978. Eventually the system gave way 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.

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 market-oriented reform was focused more directly toward the industrial-urban sector. Though reform was positive in urban areas, it was more difficult to achieve than in rural areas.

From 1986 to 1990 (Seventh FYP), China's policies of reform and opening to the outside world advanced, the national economy increased, and the plan's targets basically were fulfilled (Table 4). However, because of an overanxiety in pursuing quick results from reform and development, inherent in socialistic economic development strategies, and because some mechanisms of the macro-economic regulatory system were lacking, the national economy fluctuated. Industrial structure was still disproportionate.

Not enough attention was paid to such key sectors as agriculture, energy, transport, and raw materials. The proportion of output value of agriculture in the five years dropped by 6.5 percentage points. While production of basic industries was stagnant, the processing industry increased by 16.5 percent annually. Economic efficiency shifted downward due to the disproportionate industrial structure. During this period, agriculture, industry, construction, transport, and commerce as proportion of the gross product of society did not change noticeably, but the material consumption rate increased from 57.6 percent in 1985 to 62.1 percent in 1989. The profit and tax rate on funds of industrial enterprises that conduct accounting

TABLE 4. ANNUAL INCREASE RATES FOR MAJOR ECONOMIC INDICATORS IN THE SEVENTH FYP PERIOD (PERCENTAGE)

	Plan	Actual
GNP	7.5	7.6
National Income	6.7	7.2
Combined total output value of industry and agriculture	6.7	11.0
Total output value of agriculture	4.0	4.2
Total output value of industry	7.5	12.8

independently decreased from 23.9 percent during the sixth Five-Year Plan period to 20.3 percent. Costs grew and enterprises' losses increased (Beijing Review, 1991). Consequently, economic readjustment was required late in the Seventh Five-Year Plan period to improve the economic environment and rectify the economic order.

3. Empiricial Assessment of Industrialization Drive and Different Policy Regime

It is difficult as well as challenging to assess the industrialization drive under different policy regimes over the past four decades in China. However, based on the analysis above, it is safe to conclude that the particular pattern of industrialization has brought significant economic growth at the high cost of low labor and capital productivity (Table 5).

It is also sound to conclude that China's economic policy since 1952 is usefully divided into five policy regimes, and economic policy affected economic performance at a significant level. Our empirical study supports this conclusion (empirical results presented in Table 6). Economic performance under five policy regimes can be tested empirically with the following model:

$$Y_t = \beta_o I_t^{\beta_1} LB_t^{\beta_2} LD_t^{\beta_3} e^{\beta_4 D_{1t} \cdot \ln I_t} e^{\beta_5 D_{2t} \cdot \ln I_t} e^{\beta_6 D_{3t} \cdot \ln I_t} e^{\beta_7 D_{4t} \cdot \ln I_t}$$
$$e^{\beta_8 D_{1t} \cdot \ln L\beta_t} e^{\beta_9 D_{2t} \cdot \ln L\beta_t} e^{\beta_{10} D_{3t} \cdot \ln L\beta_t} e^{\beta_{11} D_{4t} \cdot \ln L\beta_t} e^{TR} V_t \quad (1)$$

where Y_t is national income, I_t is capital investment, and $L\beta_t$ is labor employed in production. D_{1t}, D_{2t} D_{3t} and D_{4t} are dummy variables representing the first four policy regimes shown in Table 2. These dummy variables affect the national income level under respective policy regimes. Other dummy variables included in this model are (D_{1t}, D_{2t}, D_{3t}, D_{4t}) interacting with capital investment (I_t) and those interacting with labor (LBR_t). These dummy variables affect productivities of the input variables under the respective policy regimes.

TABLE 5. AVERAGE INDEX OF LABOR AND CAPITAL PRODUCTIVITY IN THE CHINESE ECONOMY, 1952-1989 (BASE YEAR = 1952)

Measure	1953-57	1958-62	1963-65	1966-77	1978-89
1. National income	132.5	171.8	170.4	307.4	747.1
2. Labor input	112.0	129.4	128.8	164.2	214.3
3. Capital input	149.8	253.9	181.2	330.0	1158.7
4. Average labor productivity (1÷2)	118.2	132.2	131.9	185.5	341.6
5. Average capital productivity (1÷3)	88.7	96.7	99.2	74.1	65.6

Note: Chinese national income is given here at "comparable prices," that is, linked 1952, 1957, 1970, and 1980 constant prices. National income is the value added to the country's material production from industry, agriculture, construction, transportation, and trade. Correspondingly, labor excludes other sectors that are not classified as materially productive sectors. To indicate capital input in the table, accumulated capital was estimated by multiplying the ratio of accumulation to national income in current prices by the real national income.

SOURCES: Zhongguo Jingji Nianjian, 1988, 1989, (1988, 1989 Almanac of China's Economy), Jingji Guanli Chubanshe, 1988, 1989; Zhongguo Tongji Nianjian, 1990 (Statistical Yearbook of China, 1990), Tongji Chubanshe, 1990.

The models for the entire Chinese economy, agricultural sector, and the nonagricultural sector are estimated using time series data from 1952 to 1988. The model contains either dummy variables interacting with investment or dummy variables interacting with labor employed in production. The model for the agricultural sector uses total areas of arable land instead of capital investment.

Most data used in this study were obtained from Zhongguo Jingji Nianjian, 1988 and Zhongguo Tongji Jianjian, 1990. Chinese official economic statistics (except for 1958 to 1960) 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 is the value added to the country's material wealth from industry, agriculture, construction, transportation, and trade. Non-agricultural national income in the model includes net material product from materially productive sectors other than agriculture. Accumulated capital is the part of national income used to

TABLE 6. ESTIMATED ECONOMIC GROWTH MODELS IN THE PEOPLE'S REPUBLIC OF CHINA

Dependent Variable	LNI	LNI	LAGNI	LNANI	LNANI
Constant (β_1)	3.914 (1.009)	4.499 (1.115)	25.105 (3.907)	3.523 (2.684)	3.920 (3.130)
Log I_t (β_1)	0.367 (12.843)	0.353 (12.307)	--	0.434 (16.812)	0.421 (16.815)
Log LBR_t (β_2)	0.260 (0.644)	0.215 (3.605)	-1.877 (2.051)	0.265 (1.877)	0.232 (0.808)
Log $LAND_t$ (β_3)	--	--	1.162 (1.555)	--	--
$D_1 \cdot LogI_t$ (β_4)	-0.001 (0.144)	--	--	-2.023 (2.690)	-- --
$D_2 \cdot LogI_t$ (β_5)	-0.024 (2.975)	--	--	-0.020 (2.050	--
$D_3 \cdot LogI_t$ (β_6)	-0.021 (3.301)	--	--	-0.027 (1.766)	--
$D_4 \cdot LogI_t$ (β_7)	-0.011 (3.406)	--	--	-0.005 (1.766)	--
D_1 $LogLBR_t$ (β_8)	--	0.0009 (0.252)	0.019 (2.393)	--	-0.011 (0.749)
D_2 $LogLBR_t$ (β_9)	--	-0.009 (2.503)	-0.006 (0.994)	--	-0.009 (2.015)
D_3 $LogLBR_t$ (β_{10})	--	-0.008 (2.983)	-0.016 (2.879)	--	-0.013 (4.983)
D^4 $LogLBR_t$ (β_{11})	--	-0.005 (2.890)	-0.006 (1.712)	--	-0.003 (1.909)
TR (β_{12})	0.023 (3.342)	0.026 (3.624)	0.063 (6.333)	0.022 (3.137)	0.025 (3.934)
R^2	0.9982	0.9980	0.9604	0.9987	0.9987
DW	1.5879	1.4611	1.5081	1.6231	1.6348

Note: Numbers in parentheses are the t-values. NI=national income; AGNI=agricultural national income; NANI=nonagricultural national income; I=investment in national economy and nonagricultural economic sector, respectively; LBR=labor force in national economy, agricultural and nonagricultural sectors, respectively; LAND=land used in agriculture.

increase fixed capital assets, working capital, and material reserves. The investment in state-owned enterprises represents investment in the nonagricultural sector.

The estimated models are shown in Table 6. All the models have high R^2s (above 0.95), indicating that input variables and dummy variables interacting with either investment or labor explain national income fluctuations.

Both variables have a positive sign, indicating that capital and labor productivities are positive. The investment variable is significant at the 5 percent level while the labor variable is not significant, indicating that capital investment influences national income more than labor employed in production. The dummy variables interacting with investment variables are all negative and are significant except for the variable representing Time Period 1.

The negative coefficients imply that capital productivities in China were lower by the magnitudes equivalent to the estimated coefficients (e.g., 0.001, 0.024, 0.021, 0.011) in the first four policy regimes compared to the most recent regime (1978-present). In other words, capital productivity has been the highest since 1978 in the People's Republic of China. A similar interpretation can be given to the dummy variables interacting with the labor variables, which indicate that labor productivity in the Chinese economy has been the highest since 1978..

The growth models for the non-agricultural sector (Models 4 and 5) are similar to the models for the entire economy. However, the growth model for the agricultural sector differs from those for the entire economy and nonagricultural sector. The labor productivity is significant and negative mainly because of a rapid increase in rural population. On the other hand, the land productivity is positive and large in magnitude but is not significant. The one variable positively and significantly influencing the Chinese agricultural sector was agricultural technology represented by the trend variable in model 3. The estimated coefficient of the variable is positive, significant, and large in magnitude (0.063) compared to those in other models, indicating that farming technology was important to income growth in the agricultural sector.

IV. The Growth of Factor Productivity

1. A Neoclassical Framework to Estimate the Sources of Growth

Economic growth results from the growth of productive resources and from increased efficiency in their use. The methodology commonly used to estimate the sources of growth in a neoclassical framework has evolved from Solow's basic formulation (1957). An aggregate production function of the following general form is assumed:

$$(2) \quad Q = F(K, L, t)$$

where Q is the aggregate output of the economy, K and L are aggregate capital and labor inputs, and t is time. The simplest assumption about the effects of time is that technical progress is neutral. That means the output achievable is raised from a given combination of capital and labor without affecting

their relative marginal products. With this assumption, the production function can be written as

(3) $Q_t = A_t F(K_t, L_t)$

The three sources of output growth can be derived by differentiating this equation with respect to time and divided by Q

(4) $$\frac{\dot{Q}}{Q} = \frac{\dot{A}}{A} + A\frac{\partial F}{\partial K}\frac{\dot{k}}{Q} + A\frac{\partial F}{\partial L}\frac{\dot{L}}{Q}$$

where dots indicate time derivatives. Substituting $a_k = \partial F/\partial k)(k/Q)$ and $a_L = (\partial F/\partial L)(L/Q)$ gives the basic neoclassical growth equation

(5) $G_y = G_A + a_k G_k + a_L G_L$

where G_y, G_k, and G_L are the growth rates of aggregate output, capital, and labor.

The growth of total factor productivity (TFP), G_A is defined as the difference between the growth rate of output G_y and the weighted sum of total inputs growth $a_k G_k + a_L G_L$. a_k and a_L are the elasticities of output with respect to capital and labor, usually assumed to equal their distributive shares. The difference represents quality changes in inputs (education, new techniques embodied in new capital goods), advances in knowledge, economies of scale associated with rapid growth of markets, and resource reallocation from low-productivity sectors to high-productivity sectors.

2. Estimates of China's Total Factor Productivity Growth

Based on the growth-accounting equation, the World Bank (1986) once estimated total factor productivity growth from 1952 to 1981 in China. Since the relative weights that should be attached to the different inputs are particularly hard to determine in the case of China, the World Bank experimented with various weights for labor and capital. Table 7 shows the estimated result. The weights for labor and capital are 60 and 40 percent, repsectively, in Column A and 40 and 60 percent in Column B.

TABLE 7. CHINA'S TOTAL FACTOR PRODUCTIVITY GROWTH ESTIMATED BY WORLD BANK

Years	TFP Growth (% p.a.)		TFP Share of of output growth (%)	
	(A)	(B)	(A)	(B)
1952-81	0.5	-1.0	8	-17
1952-75	0.3	-1.1	5	-18
1975-81	1.0	-0.3	17	-5

SOURCE: World Bank, China Economic Structure in International Perspective, The World Bank, Washington, D.C., U.S.A. 1985 pp. 39.

Our estimated weights differ from but are similar to those the World Bank uses to calculate China's total factor productivity growth (Table 8). Also shown is total factor input growth ($a_k G_k + a_L G_L$).

Chenery et al. (1986) assembled sources of growth estimates for a large number of developing and developed economies in several periods between 1950 and 1980 in other countries. His summary of the results facilitates international comparisons by plotting the relation between total factor inputs and total factor productivity growth in each country (Figure 1). The chart plots the trade off between factor inputs and productivity growth along lines of constant growth and also relates these elements to the rate of growth.

Figure 1 shows that most of the developed countries fit within a small cluster, A, characterized by relatively low factor growth, with total factor productivity accounting for between 50 and 70 percent of overall growth. Japan is the chief exception; it doubled the average growth rate for a developed country with a higher proportion from factor inputs. The developing countries in Figure 1 are divided into two clusters. The large one, B, TFP between 0.15 and 2.0 percent. The small one, C, is composed of five developing economies plus Japan, with aggregate growth, G, averaging more than 10 percent. This performance was achieved by the higher factor inputs and higher factor productivity than in other developing countries.

The Chinese national economy from 1952 to 1989 had high growth of outputs and inputs, with total factor productivity growth contributing only 1.5 percent to aggregate growth. Due to market-oriented reform since 1978, effect of resource reallocation was significant as a source of growth, particularly in rural areas. The Chinese national economy achieved a high growth rate from high factor inputs and a higher factor productivity in the economic reform period than from 1952 to 1977.

China's apparently poor comparative performance (Figure 1) could be due to the absence of other low-income countries, since surplus labor in agriculture can drag down TFP growth in all low-income countries. But Table 7 shows that TFP growth was slow in China's state-owned enterprises.

TABLE 8. AVERAGE ANNUAL GROWTH OF OUTPUTS, INPUTS, AND TOTAL FACTOR PRODUCTIVITY IN CHINA, 1952-1989

	Real National Income	Labor Force	Capital	Total Input	Total Factor Productivity	TFP Share of Output Growth
National Economy						
Weight of 56% for labor						
Weight of 44% capital						
1952-1989	6.2	2.3	7.9	4.7	1.5	23.6
1952-1977	5.1	2.2	7.4	4.5	0.6	11.4
1978-1989	9.2	2.7	14	7.7	1.5	16.3
State Owned Enterprises						
Weight of 44% for labor						
Weight of 56% for capital						
1952-1989	7.5	4.3	8.3	6.6	0.9	12.8
1952-1977	6.7	4.7	6.3	5.6	1.1	16.4
1978-1989	9.9	2.7	14.8	9.5	0.4	4.3

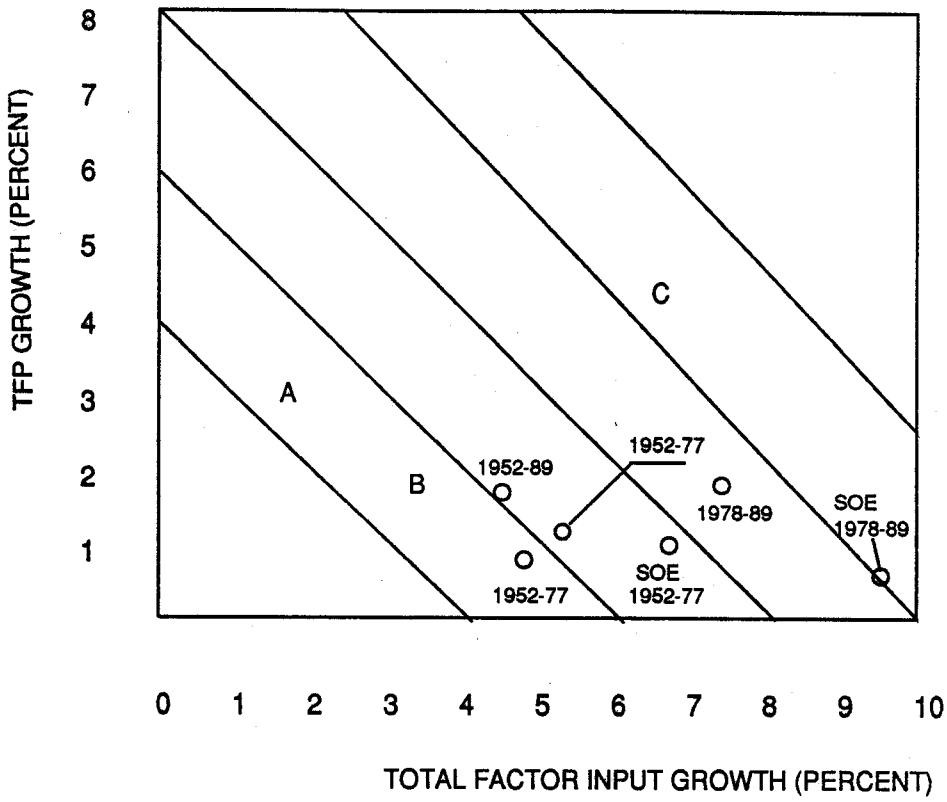

Figure 1. Relationship Between Total Factor Productivity Growth and Total Factor Input Growth.

A = Belgium (1949-59), Denmark (1950-62), Ecuador (1950-62), France (1950-73), Germany (1950-73), Italy (1952-73), Netherlands (1951-73), United Kingdom (1949-73);

B = Argentina (1950-74), Brazil (1950-74), Canada (1947-73), Chile (1950-74), Columbia (1950-74), Greece (1951-65), Honduras (1930-62), Ireland (1953-65), Mexico (1950-74), Peru (1950-70), Philippines (1947-65), United States (1947-73), Venezuela (1950-73);

C = Hong Kong (1955-70), Israel (1952-65), Japan (1960-73), Korea (1955-73), Spain (1959-65), Taiwan (1955-60);

SOE = state owned enterprises.

SOURCE: Cheney, Robinson, and Syrquin, Industrialization and Growth: A Comparative Study, Oxford University Press, 1986, Table 2-2, and Figure 2-2.

3. An Enigma and Possible Explanations

In China's state-owned enterprises, TFP stagnated or declined from 1978 to 1989 (Table 7). The following may explain this enigma.

First, unlike rural areas, the market-oriented reforms in urban areas are difficult when the market legal system and institutional rules are inadequate and when the new socialist commodity economic order is not established fully. The government has adopted a policy that permits a state-owned 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 relationships of rights, responsibilities, and benefits among the enterprise owner, manager, and worker are unclear and cannot act as a checking mechanism of the entity's performance. The reform in the state-owned enterprises consequently has done little to attack the waste and inefficiency inherent in China's planned economy (Lin and Koo, 1990).

Second, the miniaturization of unit investment scale seriously hampered economic performance. Along with the increase in the share of enterprise-retained profit, decentralization in investment authority, and expansion of the overall level of investment, miniaturization of the scale of investment project looms. In a China Economic System Reform Research Institute (CESRRI) survey of 10 cities, only 5.5 percent of 3,212 capital construction projects in 1984, exceeded 10 million yuan, and 5.2 percent were lower than 0.5 million yuan, averaging 0.237 million yuan. In 1984, none of the 130 washing-machine factories in the country met the minimal optical production scale. Of 110 refrigerator factories nationwide, average output was 4,600 units per year, which is far below the rational scale. Over 100 motor factories are distributed all across Chine except in Tibet and Ningxia. Their average scale is 2,000 cars per annum (Chen et al. 1988).

Third, economic reform conflicts with effective long-term development. Reform implemented in urban areas seeks to lodge the retained profit distribution decision in those enterprises that are responsible for their own losses and gains. But the enterprise prefers to expand consumption, nonproductive investment and short-term investment for a quick turnover rather than for innovative productive equipment.

Reducing the portion for state fiscal use because enterprises retain more profit implies the government has less funds for renewing productive equipment. Therefore, equipment in many industrial sectors has become obsolete. In the early 1980s an estimated 20 percent of China's industrial technology was of 1960s and 1970s vintage while another 20 to 25 percent was backward but still could serve present needs. Of the remaining 50 to 60 percent, 35 percent should be renovated or scrapped (because of excessive energy consumption, outmoded products, etc.) and 20 to 25 percent should be scrapped gradually (Ma, 1981). According to a survey in 1985, the age of the productive equipment of China's metallurgical industry included 15 percent from the 1970s, 70 percent from the 1950s and 60s, and 15 percent from the 1940s (Chen et al. 1988). Even in the late 1980s, within some subsectors in

China's economy, economically obsolete equipment continues to be used and outmoded or even obsolete equipment continues to be produced and incorporated into new investment, increasing cost and productivity differentials.

Fourth, no stimulation and regulatory mechanisms to raise the economic efficiency were in place during the period of reform and opening to the outside world. Along with the deepening of the reform, the marketing mechanism has had more and more effect on state-owned enterprises. The sovereign status of enterprises as independent buyers is rising, while the monopoly status as sellers is receding. However, enterprises as buyers still have constraints as does enterprises as sellers. Therefore, according to the survey by CESRRI (Chen et al. 1988), enterprises still prefer to have more input inventory than is necessary to prevent an input shortage, which would increase operating costs and losses. The Kornai index[1] of the sample enterprises was 4.5 in 1983, 4.4 in 1984, and 3.8 in the first half of 1985. The same index was 1.5 in Australia (1972-77), 0.7-0.74 in Sweden (1968-72), and 0.94-1.16 in the United States (1960-77)(Kornai, 1985).

The phenomenon of importing blindly and continuously building the same kind of project was glaring. For example, since 1949, imports of laminated products has increased constantly but never enough to meet demand. From 1953 to 1962, average annual imports were 0.8 million tonnes. From 1966 to 1983, average annual imports rose to 4.4 million tonnes. While these massive imports imply a serious shortage of the product, they actually conceal overstocking--at the end of 1982, China had 18 million tonnes of unsold and unsalable laminated goods (Pairault, 1988).

IV. Linkages Among Agriculture, Light, and Heavy Industries

Development of subsectors within a national economy must proceed in tandem. For example, industry can supply agriculture with inputs, such as fertilizer and simple farm equipment, that raise agricultural productivity. The relationship is reciprocal, because agriculture supplies raw materials for manufacturing, such as cotton and other fibers, rubber, or tobacco. Agriculture and industry also provide reciprocal consumer-goods markets. If agricultural incomes grow, then manufacturing will have a wide and growing market for its product, one that may enable it to achieve scale economies in both production and marketing. Similarly, the growth of urban incomes, stimulated by industrial expansion, should provide a continuing stimulus to agricultural output and productivity by increasing demand for food.

The linkages (or interactions) between these sectors is of crucial significance for planners, who must keep overall macroeconomic balances in view to ensure consistency. Linkages, described by Alber Hirschman (1958), show the relationship between industries, i.e., industries with backward

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[1]The Hungarian economists Janos Kornai takes the ratio between the input inventory and the output inventory of an enterprise as the most important comprehensive index, capturing the essential difference between the resource-constrained sellers' market economy and the demand-constrained buyers' market economy. This index is referred to as "Kornai index."

linkages make use of inputs from other industries. Forward linkages occur in industries that produce goods that become inputs for other industries. Industries are linked to other industries in ways that can be taken into account when deciding on a development strategy. Manufacturing generally has more backward linkages than other sectors. Since developing countries are interested in accelerating growth, they usually emphasize manufacturing industries because these industries will stimulate production in the greatest number of additional sectors.

To test the interaction or causality among agricultural, light and heavy industrial sectors, the Nelon and Schinert procedure[24] is used. To test the causality relationship between Y_1 and Y_2, we specify two equations as follows:

$$(6) \quad Y_{1t} = \sum_{j=1}^{k} d_{1j} Y_{1,t-j} + \sum_{j=1}^{k} d_{2j} Y_{2,t-j} + e_{1t}$$

$$(7) \quad Y_{1t} = \sum_{j=1}^{k} d_{1j} Y_{1,t-j} + e_{2t}$$

If $\hat{\sigma}_1^2$ denotes the residual variance estimate for Equation 3 and $\hat{\sigma}_2^2$ is the residual variance estimate for Equation 4, the test statistic is $T = n(\hat{\sigma}_2^2 - \hat{\sigma}_1^2)/\hat{\sigma}_1^2$, which has an asymptotic χ^2 distribution with k degrees of freedom under the null hypothesis that Y_2 does not cause Y_1.

Causal directions among light, heavy, and agricultural sectors are tested by using this procedure. Equations (6) and (7) are estimated using time-series data from 1952 to 1988 to test the following null hypotheses: 1) the growth of the agricultural sector is not caused by the light or heavy industrial sector, 2) the growth of the light industrial sector is not caused by the agricultural or heavy industrial sector, and 3) the growth of the heavy industrial sector is not caused by agricultural or light industrial sectors. The nine estimated models based on Equations 6 and 7 are shown in Table 9.

The χ^2 statistics with Models 1 and 3 and those with Models 2 and 3 accept the null hypothesis that growth of the light and heavy industrial sectors has not caused growth in the agricultural sector of the Chinese economy. Similarly, the χ^2 statistics with Models 4 and 6 and those with Models 5 and 6 indicate that growth of the agricultural and heavy industrial sectors has not caused growth in the light industrial sector.[1]

The value of the χ^2 statistic calculated from Models 7 and 9 and that from Models 8 and 9, respectively, are larger than the critical value of the statistics at the 90 percent significant level, rejecting the null hypothesis that growth of both the agricultural and light industrial sectors has not caused the growth of the heavy industrial sector in the Chinese economy.

TABLE 9

EMPIRICAL RESULTS

	M1	M2	M3	M4	M5	M6	M7	M8	M9
Dependent Variable	AY_t	AY_t	AY_t	LY_t	LY_t	LY_t	HY_t	HY_t	HY_t
Constant	18.352	4.391	-2.946	-36.251	-25.727	-28.755	-726.601	3.713	-14.124
	(1.555)	(0.399)	(0.684)	(0.425)	(1.519)	(1.787)	(3.023)	(0.073)	(0.254)
AY_{t-1}	1.332	1.417	1.397	1.736			4.483		
	(8.004)	(8.639)	(8.218)	(1.443)			(1.250)		
AY_{t-2}	-0.509	-0.455	-0.350	-1.688			2.872		
	(2.617)	(2.182)	(1.898)	(1.200)			(0.630)		
LY_{t-1}	-0.005			1.205	1.160	1.216		0.111	
	(0.175)			(6.906)	(5.200)	(6.490)		(0.167)	
LY_{t-2}	0.031			-0.064	0.094	-0.059		0.918	
	(1.046)			(0.294)	(0.312)	(0.271)		(1.189)	
HY_{t-1}		-0.010			0.020		1.015	1.118	1.402
		(1.077)			(0.290)		(5.175)	(5.507)	(7.856)
HY_{t-2}		0.015			-0.062		-0.246	-0.449	-0.311
		(1.884)			(0.908)		(1.400)	(2.211)	(1.560)
R^2	0.988	0.988	0.987	0.994	0.994	0.994	0.986	0.989	0.985
Standard Error	8.44	8.47	8.8	61.04	61.72	61.13	185.18	183.62	211.42
χ^2 statistics	1.57	1.57		0.049	0.317		4.67*	4.99*	

NOTE: t-statistics are in parentheses.

*Reject the null hypothesis that growth of the agricultural and light industrial sectors have not caused the growth of the heavy industrial sector in the Chinese economy at the 90 percent level.

AY=National Income in Chinese agricultural sector;

LY=National Income in Chinese light industrial sector;

HY=National Income in Chinese heavy industrial sector.

The causality test indicates the growth of the Chinese agricultural and light industrial sectors have contributed to or stimulated growth of the Chinese heavy industrial sector, but the heavy industrial sector has no contributions or linkages to the growth of the agricultural and light industrial sectors. The relationship among three sectors can be shown as follows:

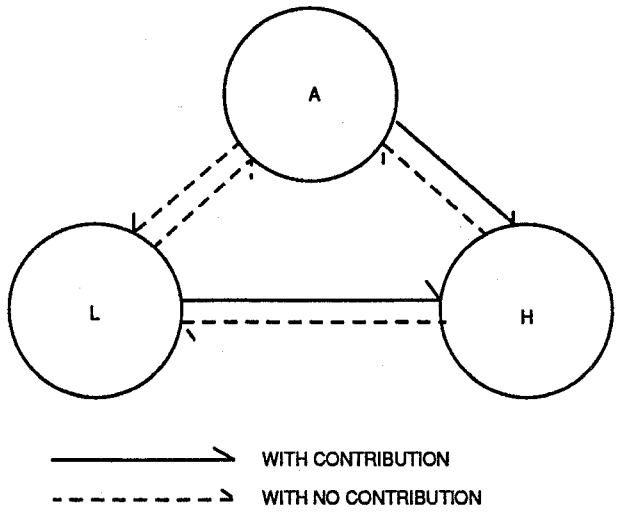

Figure 2. Interaction Among Agricultural, Light and Heavy Industrial Sectors.

The following factors may help to understand this result:

1) Industry has developed at the expense of an "agricultural squeeze." Agriculture has lagged far behind industry since the 1950s when Chinese leadership adopted socialistic economic development strategies, with pronounced emphasis on machinery and steel as leading sectors in China's industrialization drive. The agricultural sector was a resource base to be "exploited" to serve the development strategy. 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 lower prices in rural areas and marketed them at similar or slightly higher prices to urban residents and enterprises. This policy kept wage expenditure and cost of raw materials low for its major industries and created the super profits and the necessary contribution funds for its heavy industrial development. 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 1989).

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 in 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 egalitarian practice in distribution reduced the peasants' enthusiasm for production and productivity.

2) Light industry remains underdeveloped; the inadequate attention paid to light industry over the years has created a wide gap between its growth rate and that of heavy industry. Statistics indicate that investment in light industry accounted for 9.3 percent of total investment in capital construction in 1952, and the percentage tended to decrease in subsequent years. The ratio between investment in heavy industry and that in light industry was 2.22 to 1 in 1952; 5.56 to 1 in 1957; 8.40 to 1 in 1978; 4.42 to 1 in 1980; 6.05 to 1 in 1985; 5.71 to 1 in 1989 (Zhongguo Jingji Nianjian, 1990 VIII-7).

3) Heavy industry developed in isolation from agriculture and light industry. In the 1950s China restructured its fundamentally agricultural economy into one based on machinery and steel. Because the main demand for steel and machinery from other sectors did not yet exist, heavy industry was developed without any interaction with other sectors of the economy.

Absence of market mechanisms that can guide production aggravated this isolation (Hong and Lin, 1990). Because the scale of heavy industry and the speed of its development are both beyond the possibilities of the nation's material and financial resources, much harm is done to agriculture and light industry, and ultimately to heavy industry as well. Disproportions have arisen among the different branches of heavy industry. China's heavy industry does not link up satisfactorily with the agriculture, light industry, and the national economy as a whole.

V. Conclusion and Possible Policy Implications

Recognizing the importance of resource allocation associated with market mechanisms, industrialization can be viewed as a way to satisfy patterns of demand growth with varing combinations of factor supplies. China's highly centralized planned economic system with its socialistic industrialization program shows a different story of economic development.

As a socialistic developing country, China has followed the Soviet development strategy for industrializaiton with the development of heavy industry as the top priority. However, in different sub-periods, the implementation of this strategy has its own characteristics that respond to different economic policies. The adoption of this development strategy enabled China to improve its economic growth and gave rise to many problems at the same time.

Based on our analytical and empirical study, particular patterns of industrialization have brought significant economic growth at the high cost of low labor and capital productivity. China's economic policy is usefully divided into five policy regimes, focusing on the incentive system, the choice of technique, and the sectoral emphasis of each period. Economic policy did affect economic performance at a signficant level.

During Chinese industrialization, investment has reached a high level compared to other developing countries. International experience suggests that a high rate of investment, though necessary, will not be sufficient to attain development targets unless accompanied by a growth of total factor productivity. Our estimated total factor productivity growth from 1952 to 1989 in China generally confirmed the World Bank estimates from 1952 to 1981

in China. The Chinese national economy from 1952 to 1989 had high growth of outputs and inputs, with total factor productivity growth contributing only 23.6 percent to aggregate growth, comparing to TFP growth that has typically contributed about one-third of aggregate net output growth in middle-income development countries and nearly one-half in industrial market economies.

Due to market-oriented reform since 1978, effect of resource reallocation was significant as a source of growth, particularly in rural areas. The Chinese national economy achieved a high growth rate from high factor inputs and a relatively high factor productivity in economic reform compared to that from 1952 to 1977. However, in China's state-owned enterprises TFP stagnated or declined from 1978 to 1989. Five possible reasons include: difficulties of reform in urban areas, the miniaturization of unit investment scale, conflicts between reform and long-term development, lack of stimulation and regulatory mechanisms and blindly importing.

Developing subsectors within a national economy must proceed in tandem. The linkages (or interactions) between these sectors is of crucial significance for planners, who must keep overall macroeconomic balances in view to ensure consistency. The linkages among agricultural, light and heavy industrial sectors during the Chinese economic development process seem to be vulnerable. Empirical testing indicates the growth of agricultural and light industrial sectors have increased growth of the heavy industrial sector, but the heavy industrial sector has no contribution or linkages to the growth of the agricultural and the light industrial sectors.

Chinese planners followed Soviet economic development strategies of developing the industrial sector by an "agricultural squeeze." Light industry remains underdeveloped; the inadequate attention paid to light industry over the years has created a wide gap between its growth rate and that of heavy industry that serves for itself and develops in isolation from agriculture and light industry. Three possible policy implications can be suggested as follows:

1. China as well as many developing economies have a development goal of industrialization since industry rightly has been seen as a key to the goal of reducing dependence. Many developing countries continue to establish modern, capital-intensive industries. To the extent that modern manufacturing is a goal in itself, the best thing that can be done "is to point out how much could be accomplished with alternative policies and measure the cost of industrialization in terms of other goals that remain to be achieved" (Gillies et al. 1987). The study suggests the need for a balanced allocation of resources among sectors. Favoring industry at the expense of other sectors does not seem to generate rapid and efficient growth.

2. A high rate of growth of total input factor never will be sufficient to gain China's development targets. High rates of investment must be accomplished by increased efficiency and improved technology--that is, growth of total factor productivity. To increase TFP growth, efforts should go to improved technology and knowledge, increased division of labor, and incentives to economize on materials and capital and to use workers more effectively.

3. How to correctly handle the relationship among the development of heavy, light industrial and agricultural sectors is debatable. Our finding suggests that the core of imbalances among heavy industry, light industry and agriculture is not emphasis on heavy industry, but lack of linkages among these three sectors. Theoretically, many industries in heavy industrial sectors have stronger backward and forward linkages. Development of these industries will stimulate development of light industry as well as agriculture. Since their linkage failed to materialize, China's heavy industry failed to stimulate other sectors' development. Therefore, the linkages (or interactions) between sectors are crucial for Chinese planners, who must keep overall macroeconomic balances in view to ensure consistency.

References

Adelman, I., and Sunding, D. "Economic Policy and Income Distribution in China," in Chinese Economic Reform, How Far, How Fast? edited by Reynolds, B.L., Academic Press, Inc., San Diego, 1988, pp. 154-171.

Beijing Review, No. 52, 1978; No. 48, 1979 No. 1 1991.

Chang, S., "China's Agricultural Policy: An Independent Appraisal," Economic Planning 22, 2:3-8, May-August, 1986.

Chen, Y., Wang, X. and Colleagues, "Reform: Results and Lessons from the 1985 CESRRI Survey," in Chinese Economic Reform, How Far, How Fast? edited by Reynolds, B.L., Academic Press, Inc., 1988, pp. 172-188.

Chenery, H.B., Robinson, S. and Syrquin, M., Industrialization and Growth: A Comparative Study, Published for the World Bank, Oxford University Press, 1986.

Crook, F.W., Agricultural Statistics of the People's Republic of China, 1949-86, published for the United States Department of Agricultural, Washington, D.C., 1998.

Dong, F., "Development Theory and Problems of Socialist Developing Economies" in The State of Development Economics: Progress and Perspectives, edited by Ranis, G. and Schultz, T.P., Basil Blackwell, New York, 1988, pp.228-253.

Du, R., "Advancing Amdist Reform" in China's Rural Development Miracle edited by Longworth, J.W., University of Queensland Press, pp. 3-10.

Eckstein, A., China's Economic Revolution, Cambridge University Press, 1977.

Gillis, M., Perkins, D.H., Roemer, M. and Snodgrass, D.R., Economics of Development, Second Edition, W.W. Norton and Company, New York, 1987.

Hirschman, A.O., The Strategy of Economic Development, Yale University Press, 1958.

Hong, Y. and Lin, J., General Theory of Economic Development, People's Publishing House, Jiangsu, 1990.

Jiang, J. and Luo, X., "Changes in the Income of Chinese Peasants since 1978," in China's Rural Development Miracle, edited by Longworth, J.W., University of Queensland Press, 1989, pp. 171-186.

Kornai, Janos, "The Dual-Dependency of State Industry," Economic Research, 10, 1985.

Lenin, V.I., The Developmetn of Capitalism in Russia, Progress Publishers, Moscow, 1960.

Lin, J., and Koo, W.W. Economic Development in the Agricultural and Industrial Sectors in the People's Republic of China, working paper No. 263, Department of Agricultural Economics, North Dakota State University, Fargo, 1990.

Ma, H., "Zhongguo Jingji Jiegou Wenti Yanjiu (Analysis of the Structural Problems of the Chinese Economy), People's Publishing House, Beijing, 1981.

Marx, K., Capital Vol.e, Penguin, Harmondsworth, 1976.

Nelon, C.R. and G.W. Schwert, Tests for Predictive Relationships between Time Series Variables: a Monte Carlo Investigation, J.Am. Stat. Assoc. Vol 77:11-18, 1982.

Pairault, T. "Ideology and Industrialization in China 1949-83," in Transforming China's Economy in the Eighties, Volume II: Management, Industry and the Urban Economy, edited by Feuchtwang, S., Hussain, A., and Pairault, T., Westview Press, 1988, Boulder, CO, pp. 26-50.

Riskin, C., China's Political Economy: The Quest for Development Since 1949, Oxford University Press, 1987.

Solow, R.M., "Technical Change and the Aggregate Production Function," Review of Economics and Statistics No. 39 (August) 1957, pp. 312-320.

Tidrick, G., Productivity Growth and Technological Change in Chinese Industry, World Bank Staff Working papers, No. 761, 1986.

Tang, A., "Chinese Agriculture: Its Problems and Prospects," working paper 82-W09. Department of Economics, Vanderbilt University, 1981.

Tung, R.L., Chinese Industrial Society After Mao, Lexington Books, Lexington, Mass., 1982.

World Bank, China: Long-Term Development Issues and Options, The Johns Hopkins University Press, 1985.

World Bank, China: Economic Structure in International Perspective, Annex 5 to China: Long-Term Development Issues and Options, The World Bank, 1985.

World Bank, World Development Report, Series, Oxford University Press, 1981-1990.

Zhonggong Dangshi Dashi Nianbiao (Chronologic Major Events in the History of Chinese Communist Party), Renmin Chubanshe, Beijing, 1981.

Zhongguo Jingji Nianjian, 1988, 1990 (1988, 1990 Almanac of China's Economy), Jingji Guanli Chubanshe, Beijing, 1988, 1990.

Zhongguo Tongji Nianjian, 1990 (Statistical Yearbook of China, 1990), Zhongguo Tongji Chubanshe, Beijing, 1990.

Zhou, S. and Zhang, Z., "The Policy of Readjustment and Its Application," in China's Economic Reforms, edited by Lin and Zhao, University of Pennsylvania Press, 1982, pp. 28-43.