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THE RELATIONSHIP BETWEEN THE AGRICULTURAL AND INDUSTRIAL SECTORS IN CHINESE ECONOMIC DEVELOPMENT

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THE RELATIONSHIP BETWEEN THE AGRICULTURAL AND INDUSTRIAL SECTORS IN CHINESE ECONOMIC DEVELOPMENT

Abstract

This study examined the interdependency between Chinese agricultural and industrial sectors. A dual economic model was developed to investigate the relationship between the two sectors and factors affecting Chinese economic development.

The study reveals traditional inputs, such as labor, are still important to Chinese economic development. Capital investment contributed significantly to the growth of the Chinese industrial sector, but not to the agricultural sector. The results also suggest that foreign trade has made a significant contribution to Chinese economic development. It was found that the growth of the Chinese agricultural sector depends on its industrial growth, but the growth of the Chinese industrial sector does not rely on the agricultural growth.

Keywords: Chinese economic development, dual economy, growth model, agricultural sector, industrial sector, foreign trade

Highlights

The purpose of this study is to examine the economic growth between the Chinese agricultural and industrial sectors and their interdependency. A dual economic growth model was developed to investigate the relationship between the two sectors and factors affecting Chinese economic development.

Following are some of the major findings of the study:

- The agricultural growth in China is contributed by its industrial growth, but the industrial growth is not contributed by the agricultural growth, indicating a diminishing role of the Chinese agricultural sectors as the Chinese economy makes a major progress in its economic development.

- Labor has been a significant factor to the growth of both agricultural and industrial sectors. However, marginal productivity of labor in the agricultural sector is much smaller than that in the industrial sector, indicating that labor has made greater contribution to the industrial growth than agricultural growth.

- Agricultural investment does not play a significant role in the agricultural growth in China. For the industrial sector, the investment variable is positively related to its income growth.

- China's foreign trade has a significant impact on the growth of both agricultural and industrial sectors, suggesting that China's "open door" policy has achieved a great success.

- A disparity of economic growth exists in both agricultural and industrial sectors in China. China's coastal area contributed more to the current economic growth than its inland area.

The Relationship Between the Agricultural and Industrial Sectors in Chinese Economic Development

Won W. Koo and Jianqiang Lou*

Introduction

The interdependency between traditional agricultural and modern industrial sectors of an economy is crucial to a country's overall economic development. Agricultural growth depends on the industrial demand for agricultural commodities. Similarly, industrial growth depends on an increase in purchasing power of the agricultural sector for industrial commodities and on the supply of raw materials for processing. Many developing countries have realized the importance of the agricultural sector and its role in industrialization in their economic development.

Since the economic reform of 1979, China has experienced dramatic economic growth. The country's GDP grew from 447 billion yuan ($298 billion) in 1980 to 3,138 billion yuan ($544 billion) in 1993, with real annual growth rate averaging close to 7 percent (Table 1). The Chinese economy can be divided into an agricultural sector based on rural communities and an industrial sector based mainly on urban areas. The Chinese economy has experienced a shift of resources from the agricultural sector to its industrial sector as have other countries such as Korea and Japan. This is mainly because the industrial sector grows faster and has higher labor productivity than the agricultural sector. China has also experienced major increases in its international trade. Exports increased about 20 times from 27 billion yuan in 1980 to 528 billion yuan in 1993, and imports also increased about 20-fold during this period.

Table 1. GDP, Per Capita GDP, and Total Trade Values in China

	Unit	1980	1990	1993
GDP	Bil. Yuan	447	1,768	3,138
GDP (Per capita)	Yuan	570	1,555	2,665
Trade				
Exports	Bil. Yuan	27.12	298.58	528.53
Imports	Bil. Yuan	29.88	257.43	598.57

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The objective of this study is to examine the interdependency of China's agricultural and industrial sectors during 1988 to 1992. Efforts are made to determine the key factors contributing to growth in China's agricultural and industrial sectors and to evaluate the impacts of external trade on China's economic development.

Few researchers have studied the interdependency between China's agricultural and industrial sectors. Most studies have focused either on the aggregate economic development (Rabushka, Lu, World Bank) or on individual sectors (Lin, Tung, McMillan et al.). Lin and Koo investigated the interdependency between China's agricultural and industrial sectors from 1952 to 1988. They found that growth of the Chinese agricultural sector contributed to the growth of the industrial sector, but growth in the industrial sector did not increase growth in the agricultural sector. They attributed this to Chinese adoption of Soviet economic development strategies, in which industrialization was stressed at the expense of agriculture.

Policy with an "urban bias" has discriminated against agriculture. A strict resident registration system, which divided the country's population into urban and rural residents and forced farmers to remain on limited arable land, also contributed to this kind of interdependence between agricultural and industrial development. Lin and Koo did not consider foreign trade as a contributing factor in economic growth. Their study found labor productivity in both agricultural and industrial sectors was low, and industrial development was mainly based on capital intensity.

This study is organized as follows: Section 2 provides an overview of economic reforms in China. Section 3 presents a growth model for the Chinese agricultural and industrial sectors. Section 4 describes a procedure to estimate the models and the data used for this study. Section 5 examines empirical results of the model. The last section includes concluding remarks and implications.

Economic Reform in China

China's economic reform has led to profound changes in its economic system. Economic reforms in China's agriculture began in 1978. The agricultural reform started with establishing a family production responsibility system, which featured small-scale production and fragmentation of output and factor markets. This reform shifted the basic production management unit from collective farms to individual households. Other changes under the reform included sales of commodities to private parties and free flows of surplus rural labor to local industries and urban areas. The agricultural sector responded to these reforms with increased production of most major commodities (Wang, Wailes, and Cramer).

The industrial sector in China had always received top priority in economic development. From 1949 to 1978, the Chinese industrial sector was developed at the expense of the agricultural sector through an "agricultural squeeze." The agricultural sector was a resource to be "exploited" to serve economic development strategies. To accumulate capital to serve economic development of the country's underdeveloped industry, the government adopted a monopolized procurement

system for agricultural products and marketed them at low prices. This policy helped to maintain the low costs of labor and raw materials for major industries and created sufficient profits and capital investment for its industrial development.

As agricultural production efficiency improved through economic reform, an underemployment problem emerged in the agricultural sector. This called for faster industrial sector expansion to transfer surplus labor from the agricultural sector to the industrial sector. With the successful initial reform in agriculture, the government was encouraged to take a bolder step to carry out a similar reform in the industrial sector in 1985.

Before 1985, there were only a few experimental reforms in the industrial sector. The Chinese government made a decision to shift the focus of the economic reforms from the agricultural sector to the industrial sector in 1985. The reforms concentrated on strengthening the vigor of enterprises along with forming market mechanisms, mainly pricing and macro-economic management systems. The market-oriented rural industrial sector grew quickly across China. Millions of laborers were moved from the agricultural sector to the industrial sector. Meanwhile, China began to establish special economic zones and opened 14 coastal port cities. Most experimental reforms in the industrial sector were conducted in these areas and gradually spread into other regions.

In 1992, further steps were taken to establish a market economy. Measures included allowing state-owned enterprises to become independent corporate entities and market competitors. In agriculture, the government abandoned its tight control over production of major crops such as grain and oilseeds. Private groups were allowed to compete with state-owned enterprises in grain and other agricultural commodity markets. In addition, the price reform has led to the liberalization of prices for about 80 percent of all capital goods, over 85 percent of agricultural products, and over 95 percent of industrial consumer goods (*Beijing Review*).

From 1979 to 1993, China's total agricultural output value increased at an average annual rate of 6.1 percent, far surpassing the average annual growth rate of 2.6 percent for the 1953 to 1978 period. But most significant agricultural growth happened during the 1979 and 1985 period. After 1985, agriculture as a whole has grown at a rate of 4.1 percent per year, and production of grain crops has stagnated. On the other hand, the industrial sector showed a strong growth after 1985 (Figure 1).

China's open door policy has greatly increased its involvement in international trade. From 1978 to 1993, the total trade value increased by 128.8 percent annually (Figure 2). The Chinese government has adopted a strategy of exporting labor-intensive manufactured goods and acquiring advanced technology and management skill from developed countries. Advanced technology and management skills have greatly improved productivity in both agricultural and industrial sectors and China's competitiveness in international markets. Exports of labor-intensive manufactured goods have contributed to the growth of the China's national economy.

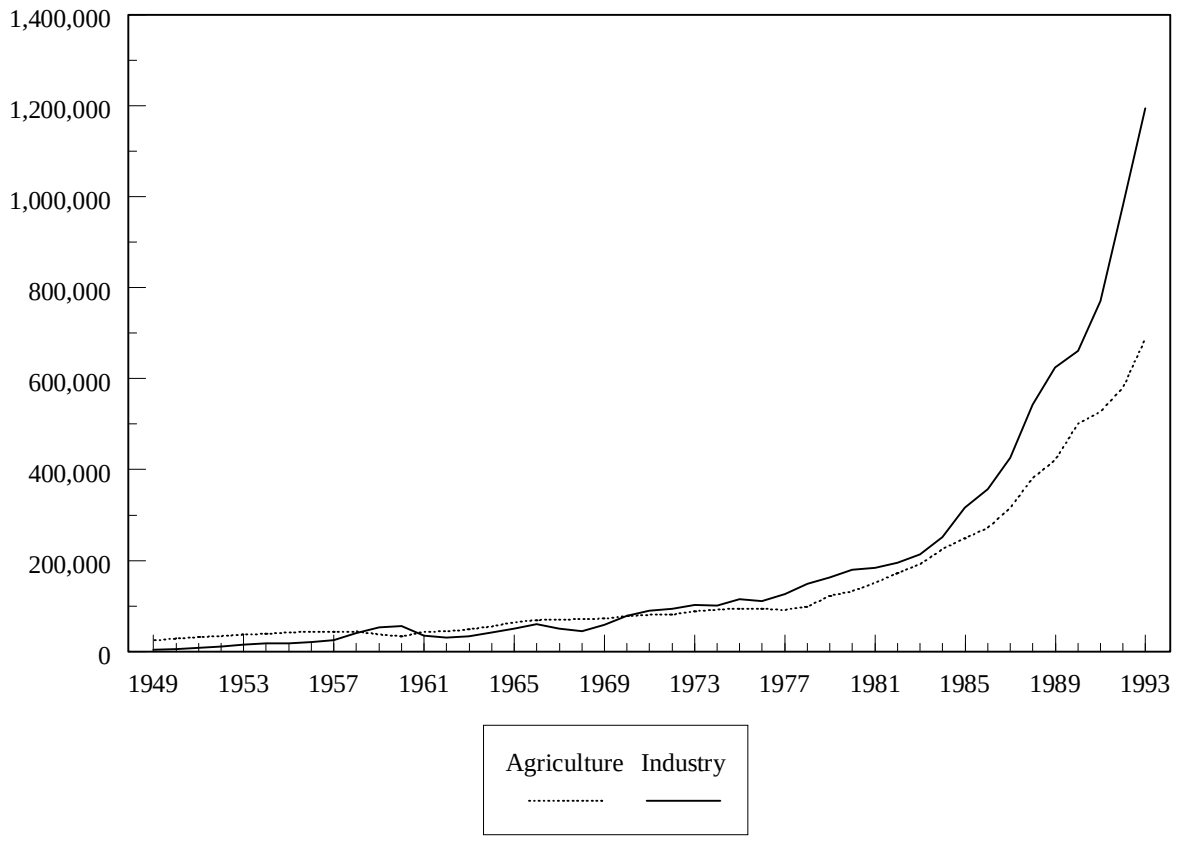

Figure 1. Growth of National Income in Agricultural and Industrial Sectors

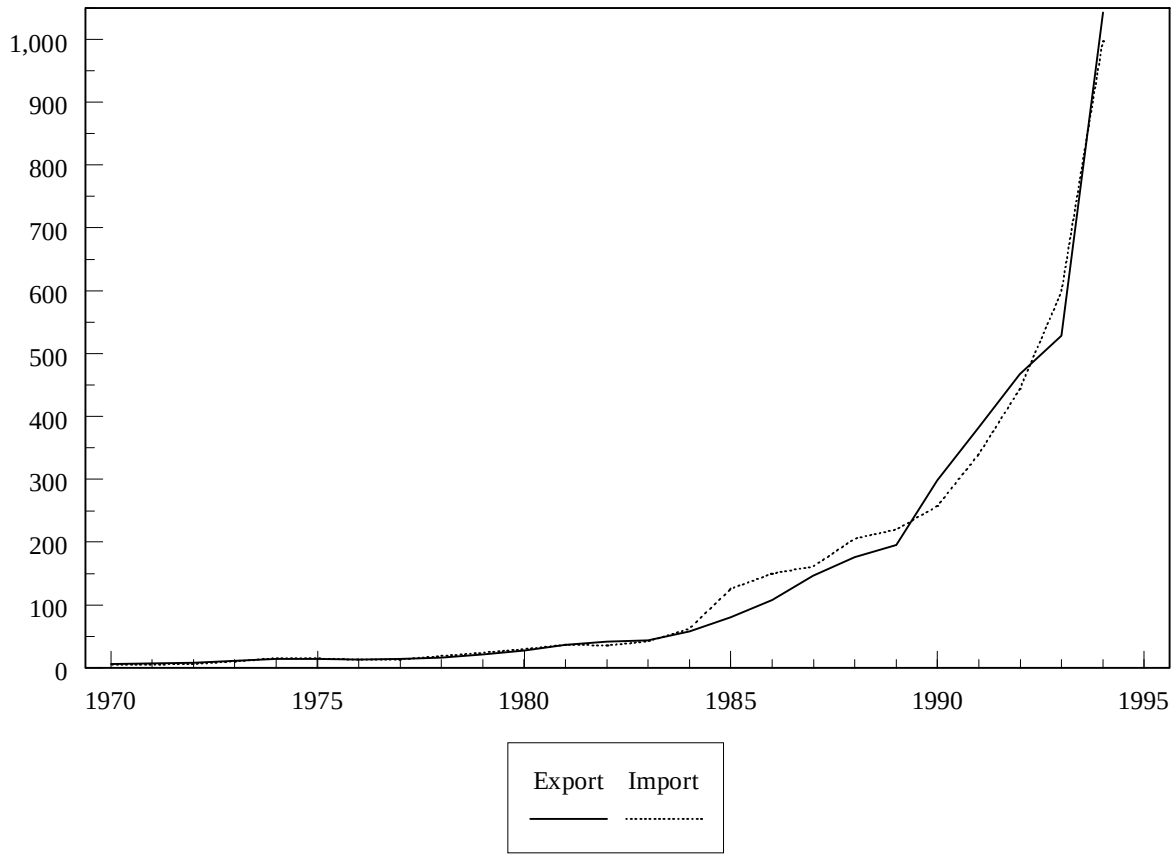

Figure 2. China's Foreign Trade Between 1970-1994

The Chinese Economic Growth Model

Economists have recognized the interdependency between agricultural and industrial sectors and designed models to explain major connections between them.

Ricardo, who examined the relationship between agricultural and industrial sectors, assumed that the agricultural sector is subject to diminishing returns and that surplus agricultural labor can be drawn to the industrial sector without causing a rise in wages (Gillis, et al.). This relationship has been refined by Lewis and Ranis and Fei.

Lewis developed a modern version of the two-sector labor surplus model which focused on the implications of surplus labor for income distribution. Ranis and Fei also developed a labor-surplus model to capture the relationship between agricultural and industrial sectors in the process of economic development. In the model, the economy was characterized by the coexistence of a large agricultural sector and a small but active and dynamic industrial sector. In such an economy, labor is not scarce but capital is. In the dual economic growth models, these two sectors are assumed to depend upon each other.

An economic growth model for the Chinese agricultural and industrial sectors was developed on the basis of the dual economic growth model by Ranis and Fei as follows:

$$(1)\ AY = f_a(AL, AN, L, TD, IY)$$

$$(2)\ IY = f_i(IL, IN, TD, AY)$$

where

AY = gross national income in the Chinese agricultural sector

AL = the quantity of labor in the Chinese agricultural sector
AN = the total amount of capital invested in the Chinese agricultural sector
L = the total area of arable land
TD = the total value of external trade
IY = gross national income in the Chinese industrial sector
IL = the total quantity of labor in the industrial sector
IN = the total amount of capital invested in the industrial sector

The land variable is included in the agricultural sector model to capture the impact of decreases in arable land resulting from economic development on the Chinese agricultural income. In addition, the trade variable is included in both agricultural and industrial models to examine the impacts of the Chinese open door policy on the economic growth of the agricultural and industrial sectors. In the model, AY and IY are treated as endogenous variables under an assumption that the two sectors of economy help each other in the process of economic development, and other variables (AL, AN, L, IL, IN, and TD) are treated as exogenous.

China is divided into 30 provinces to capture regional characteristics in economic development in both agricultural and industrial sectors and their interdependency in each province for the 1988 - 1992 period. Thus, the model is based on both cross-section and time-series data.

Equations (1) and (2) are static in which changes in the value of independent variables affect gross income at the same time. There are, however, some evidences that indicate that changes in the value of independent variables in time t affect gross income in t and several periods in the future. Assuming that the dynamics take place under the partial adjustment hypothesis (Nerlove) in a linear functional form, Equation (1) is expressed as follows:

$$(3)\ AY_{it}^{*} = \beta_0 + \beta_1 AL_{it} + \beta_2 AN_{it} + \beta_3 L_{it} + \beta_4 TD_{it} + \beta_5 IY_{it} + e_{it}$$

$$(4)\ AY_{it} - AY_{i\,t-1} = \lambda_1 (AY_{it}^{*} - AY_{i\,t-1})$$

where

i	=	index for provinces in China, I = 1,2, , , ,30.
t	=	index for time, t = 1988, 1989, , , , 1992.
AY^{*}	=	desired gross national income in the Chinese agricultural sectors
λ_1	=	a dynamic adjustment coefficient ranged between 0 and 1

All other variables are defined previously.

Combining equations (3) and (4) yields

$$(5)\ AY_{it} = \lambda_1\beta_0 + \lambda_1\beta_1 AL_{it} + \lambda_1\beta_2 AN_{it} + \lambda_1\beta_3 L_{it} + \lambda_1\beta_4 TD_{it} + \lambda_1\beta_5 IY_{it} + (1-\lambda_1) AY_{i\,t-1}$$

Similarly, the equation for China's industrial sector (Equation 2) can be expressed as follows:

$$(6)\ IY_{it}^{*} = \alpha_0 + \alpha_1 IL_{it} + \alpha_2 IN_{it} + \alpha_3 TD_{it} + \alpha_4 AY_{it} + e_{it}$$

$$(7)\ IY_{it} - IY_{i\,t-1} = \lambda_2 (IY_{it}^{*} - IY_{i\,t-1})$$

where

IY_{it}^{*}	=	desired or optimal gross national income in the Chinese industrial sector
$\lambda 2$	=	a dynamic adjustment coefficient ranged between 0 and 1

Combining equations (6) and (7) yields

$$(8)\ IY_{it} = \lambda_2\alpha_0 + \lambda_2\alpha_1 IL_{it} + \lambda_2\alpha_2 IN_{it} + \lambda_2\alpha_3 TD_{it} + \lambda_2\alpha_4 AY_{it} + (1-\lambda_2) IY_{i\,t-1} + e_{it}$$

Equations (5) and (8) are used to examine the interdependency between the Chinese agricultural and industrial sectors. It is hypothesized that these two sectors of the Chinese

economy influence each other in the process of economic development. It also is hypothesized that all the independent variables in Equations (5) and (8) are positively correlated with the income growth in the corresponding sectors.

Data Collection and Estimation Procedure

The dynamic models of the Chinese agricultural and industrial sectors (Equations 5 and 8) were estimated simultaneously by using the three stage least square estimator. In this estimation, IY and AY are treated as endogenous variables and other variables as exogenous. The panel data of 30 provinces, municipalities, and autonomous regions from 1988 to 1992 were used to estimate the equations. The data used for this study are summarized in Table 2.

Gross national income data for the agricultural and industrial sectors were used to measure growth rates. The data were obtained from *China Statistics Yearbook.* Input factors used in the study are arable land, the total number of labor employed in the agricultural and industrial sectors, and the total amount of capital invested in the agricultural and industrial sectors. These input data were obtained from *China Rural Economy Statistics Yearbook* and *China Statistics Yearbook.*

The sum of total import and export value serves as our measurement of foreign trade. The trade data were obtained from *China Foreign Trade Statistics Yearbook.*

A dummy variable representing the coastal provinces was used to represent the disparity of economic growth between the coastal and inland regions. In addition, the equations include four time dummy variables to capture the changes in economic growth over years.

Empirical Results

Estimated equations are presented in Table 3. R^2 s are 0.9369 for the growth model of the agricultural sector and 0.9471 for the growth model of the industrial sector, indicating that over 90 percent of the Chinese economic growth in both the agricultural and industrial sectors can be explained by variables used in the models.

In the agricultural growth model, the industrial income variable is significant at the 5 percent level of significance, but the agricultural income variable is not significant in the industrial growth model. This implies that industrial growth contributes to agricultural growth, but agricultural growth does not contribute to industrial growth. This result is contrary to the study by Lin and Koo. The reason for the different results may be due to the diminishing role of the Chinese agricultural sector as the Chinese economy makes major progress in its economic development.

Table 2. Summary of the Data (Means and Standard Deviations) Over Cross Sections

Variables	Units	1988	1989	1990	1991	1992
National Income of Agriculture	100 Mil. Yuan	128.19 (95.87)	140.79 (105.67)	166.57 (121.24)	175.30 (132.29)	193.26 (142.73)
Agricultural Labor	1,000 Person	10485.2 (9129.4)	10813.5 (9423.1)	11112.1 (9656.7)	11395.4 (9920.0)	11345.7 (9885.3)
Agricultural Investment	Bil. Yuan	1.49 (0.85)	1.65 (0.99)	2.17 (1.14)	2.65 (1.62)	3.61 (2.30)
Arable Land	1,000 Hectares	3190.70 (2237.98)	3190.90 (2237.96)	3188.53 (2234.76)	3189.13 (2233.91)	3188.53 (2233.33)
National Income of Industry	100 Mil. Yuan	182.73 (137.55)	211.59 (157.89)	223.29 (167.23)	257.55 (196.88)	330.52 (268.63)
Industry Labor	1,000 Person	3770.4 (2557.9)	4003.8 (2935.5)	4053.1 (2945.0)	4156.2 (2989.1)	4299.4 (3119.2)
Industrial Investment	Bil. Yuan	26.21 (17.71)	26.99 (18.81)	31.05 (22.49)	36.89 (24.04)	47.58 (29.50)
Foreign Trade	Mil. Yuan	1717.78 (2430.13)	1879.12 (2669.11)	1780.47 (1982.42)	2368.99 (4062.26)	3338.46 (5437.65)

Note: ( ) is standard deviation for the corresponding mean.

Table 3. Estimated Coefficients of the Chinese Agricultural and Industrial Growth Models

Variables	Agriculture	Industry
Constant	-6.5483	17.7028
	(8.952)	(12.726)
Labor	0.0052	0.0303
	(0.0001)	(0.004)
Investment	1.1492	0.7083
	(2.439)	(0.276)
Land	0.0043	--
	(0.002)	
Trade	0.0660	0.1411
	(0.023)	(0.032)
Agricultural National Income	--	-0.0997
		(0.087)
Industrial National Income	0.0609	--
	(0.032)	
Lagged Agricultural National Income	0.4900	--
	(0.047)	
Lagged Industrial National Income	--	0.4984
		(0.051)
Coastal Dummy	14.9438	22.8668
	(7.918)	(11.876)
Dummy for 1988	-16.3578	-51.9169
	(9.450)	(13.561)
Dummy for 1989	-12.0683	-44.5948
	(9.251)	(13.341)
Dummy for 1990	3.7529	-52.9934
	(8.839)	(12.871)
Dummy for 1991	-6.5312	-36.7544
	(8.572)	(12.522)

Note: ( ) represents standard error.

In the earlier period, the Chinese agricultural sector was larger than the industrial sector in terms of national income and population. The agricultural sector was the main market for the goods and services produced by the Chinese industrial sector. However, this relationship has gradually changed. The government's supports for the agricultural sector have been reduced and incentives for the production responsibility system had already reached its limit. Lack of capital investment has also hindered the growth of Chinese agricultural sector (Zhang). In addition, the industrial sector has grown faster than the agricultural sector since 1985. The growth of the industrial sector has been fueled by the increased domestic and foreign demand for China's industrial output rather than by demand from the agricultural sector.

The labor variable has a positive sign in the agricultural and industrial growth model and is statistically significant at the 5 percent level, indicating that labor has been a significant factor in the growth of the agricultural and industrial sectors. The coefficient of the labor variable represents marginal productivity of labor in 100,000 yuan, which represents an additional increase in gross income in each sector resulting from one additional unit of labor. Marginal productivity (MP) of labor in the agricultural sector is 520 yuan, and that in the industrial sector is 3,000 yuan.

Average productivity (AP) of labor in each sector is calculated by dividing aggregate income in the sector by the number of laborers in the sector. The average labor productivity in 1992 was 1700 yuan in the agricultural sector and 7700 yuan in the industrial sector based on data in Table 2. The low productivity in the agricultural sector is due mainly to surplus labor in the agricultural sector. Labor productivity in the industrial sector has been increasing as China's market-oriented reform moves forward.

Labor elasticities can be calculated from marginal and average productivity of labor by making use of the relationship; MP = elasticity*AP. The calculated elasticities are shown in Table 4. The elasticities represent the contribution of labor to income growth in the agricultural and industrial sectors. The labor elasticities are 0.308 for the agricultural growth model and 0.394 for the industrial growth model, indicating that labor has made a greater contribution to industrial growth than to agricultural growth.

Table 4. Estimated Elasticities in Agricultural and Industrial Growth Models

Variables	Agricultural Growth Model	Industrial Growth Model
Labor	0.308	0.394
Investment	0.021	0.043
Land	0.071	--
Trade	1.141	1.427

The investment variable is positively related to agricultural income growth, but is statistically insignificant at the 5 percent level, indicating that agricultural investment does not play a significant role in agricultural growth in China. This is mainly because of the limited investment in the agricultural sector during the period. For the industrial sector, the investment variable is positively related to its income growth and is significant at the 5 percent level. Investment elasticities are low in both the agricultural and industrial growth models, more inelastic in the agricultural growth model than in the industrial growth model. This implies that capital investment has not made a major contribution to income growth in the industrial and agricultural sectors.

The trade variable has a positive sign and is significantly different from zero at the 5 percent significant level in the agricultural and industrial sector model. This implies that China's foreign trade has had a positive impacts on the growth of the agricultural and industrial sectors, suggesting that China's "open door" policy has achieved some success. Opening to the outside world has enabled China to use foreign funds, advanced technology, and efficient management methods for agricultural and industrial production.

The open door policy also compelled Chinese enterprises to face international competition and to further economic reforms to maintain their competitiveness. At the same time, continuing domestic economic reform has improved the country's investment environment. The creation of favorable business conditions through the open door policy has attracted more foreign investment and technology. Foreign trade elasticities are 1.141 and 1.427 for agricultural and industrial sectors, respectively, indicating that foreign trade has made significant contribution to both agricultural and industrial growth. However, its contribution to industrial growth is greater than that to agricultural growth.

The land variable carries a positive sign and is significant at the 5 percent level in the agricultural sector growth model, implying that increasing arable land has made a positive contribution to China's total agricultural output and vice versa. Arable land in China has been declining in recent years and likely will continue to decline mainly because of increasing uses of arable land for other purposes, such as industrial development, transportation, and recreation (Koo, Lou, and Johnson). Decreased arable land will reduce China's agricultural output.

China's coastal area started economic reform earlier than did the inland area and has received more favorable policy treatment. The dummy variable representing coastal provinces is positive and significantly different from zero at the 5 percent significant level, indicating that China's coastal area contributed more to economic growth than the inland area. The time dummy variables are negative because 1992 is used as the base year. The magnitudes of the variables decline toward more recent years except for 1990 (agricultural sector), indicating that China has achieved significant economic growth from 1988 to 1991.

Conclusions

This study examined economic growth in the Chinese agricultural and industrial sectors from 1988 to 1992. The results indicate that a traditional input such as labor is still important to China's economy. Land is known to be an important factor in agricultural sector, but this study reveals that its contribution to the agricultural growth is low compared to other factors. In addition, arable land in China is declining, mainly because of increasing uses of the land for other purposes, such as industrial development, transportation, and recreation. Capital investment has made the smallest contribution to China's agricultural and industrial sectors. Results also indicate that international trade has made the most significant contribution to Chinese economic growth. As China's economic reform moves forward, the agricultural sector's growth depends on the growth of the industrial sector, while growth of industrial sector does not rely on agricultural growth.

To improve agricultural productivity in China, a significant increase in agricultural investment is needed. The agricultural growth will depend more on improved technology and production efficiency. Limited investment in the agricultural sector has caused poor rural infrastructure and insufficient agricultural research. The "open door" policy is another important factor in China's economic growth. China should continue to emphasize its open door policy to attract more technology and investment.

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