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PAST AND FUTURE SOURCES OF GROWTH FOR CHINA

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ABSTRACT

This study develops an analytical framework to account for sources of rapid economic growth in China. The traditional Solow approach includes only two sources, i.e. increased use of inputs and technical change. We expanded the approach to include a third source of economic growth—structural change. The empirical results show that structural change has contributed to growth significantly by reallocating resources from low productivity to high productivity sectors, especially by moving labor from agricultural production to rural enterprises. We also found that the returns to capital investment in both agricultural production and rural enterprises are much higher than those in urban sectors, indicating underinvestment in rural areas. On the other hand, labor productivity in the agricultural sector remains low, a result of the still large surpluses of labor in the sector. Therefore, the further development of rural enterprises and increase in labor flow among sectors and across regions are key to improvements in overall economic efficiency.

CONTENTS

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1. INTRODUCTION

In the past twenty years the Chinese economy has performed spectacularly well. Gross domestic product (GDP) has grown at 9.8 percent per year from 1978 to 1998, with some slowing recently as the impact of the Asian financial crisis has hit China. The economy has also undergone dramatic and continuing structural change. While there have been significant increases in agricultural productivity, the share of agriculture has declined as the manufacturing and services sectors have grown much faster. A large amount of surplus labor has been absorbed by the non-agricultural sectors, especially rural enterprises.

China is the only socialist system that has remained socialist, but it has instituted market reforms that appear to have succeeded in overcoming the economic failures that led to the collapse of the socialist economies of Eastern Europe and the Soviet Union. This success raises a number of questions. Perhaps the most important is whether the performance of the past twenty years can be sustained in the future. To answer this question, we need to understand what have been the driving forces behind past Chinese growth and whether those forces can continue into the future.

In this paper, we analyze the past sources of Chinese growth. The standard economics literature on analyzing the sources of aggregate growth considers two sources: increases in factor inputs (land, labor, and capital) and total factor productivity growth (TFPG) or technical change.[1] To these, we add a third: growth attributed to reallocating resources from low-productivity to high-productivity sectors.[2] We present an empirical analytical framework that supports this analysis and use it to address a number of important issues.

Has China's past rapid economic growth come mainly from capital accumulation (investment), which was a major source of growth in other Asian economies like Taiwan, Hong Kong, South Korea, and Singapore? How important has been total factor productivity growth? Given the rapid rate of structural change in China over this period, what has been the contribution to aggregate growth from efficiency gains achieved through reallocating resources among economic sectors? Accounting for the sources of Chinese economic growth is particularly important as the country searches for the engine of future economic growth. If past rapid growth has been realized predominantly through structural change, which inevitably slows as the structure of the economy (*e.g.,* the shares of agriculture, industry, and services) reaches a new balance, then future growth may be slower. If this is the case, increasing total factor productivity within sectors through investment in technology and infrastructure may be especially important for future growth.

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[1] Technical change in this study is broadly defined to include both changes in technology and improvements in technical efficiency.

[2] There have been numerous studies analyzing the sources of growth in China, but few have considered the role of structural change. See Wang (1999), Maddison (1998), World Bank (1997), Kim and Lau (1996), Wu (1995), and Wu and Wu (1995).

To consider the role of structural change, we divide the economy into four sectors: urban industry, urban services, agriculture, and rural enterprises. In our analysis, we estimate production functions for the four economic sectors using provincial time series data for 1978-95. The rural enterprise sector includes all non-farm activities such as rural industry, construction, transportation, and commerce. The separation of rural enterprises from other sectors is particularly important, as we will show that the development of the rural non-farm sector has been the major engine of growth in the economy since the institutional reforms in 1978.

The paper is organized as follows. We first present data on structural change and the increased use of inputs in the Chinese economy over the past several decades. Next we present a conceptual framework to decompose economic growth into different components. We then describe data sources, followed by the estimation of production functions for the four sectors. Using these estimated production functions and historical data on factor accumulation, we analyze the sources of economic growth. Finally, we conclude by offering some insights into potential sources of future economic growth in China.

2. STRUCTURAL CHANGE IN THE CHINESE ECONOMY

The literature on growth and structural change is extensive.[3] It is often argued that countries pass through phases during the course of development. Kuznets and Chenery focus on the process of industrialization as the driving force of "modern economic growth"—Kuznets' term. Clark (1951) distinguishes between primary, secondary, and tertiary production and describes the process of structural change as "... the most important concomitant of economic progress, namely the movement of working population from agriculture to manufacture and from manufacture to commerce and services."

Although, the development path of the Chinese economy is consistent with the industrialization process described by Chenery *et al.* (1986), the Chinese experience has some unique features. During the last two decades, China underwent both rapid industrialization and dramatic transition from a planned to a market economy. The two processes were complementary. Without a successful transition, the industrialization process would have been much slower. The Chinese national economy grew at 7.7 percent per year from 1952 to 1997 (Table 1), with growth rates accelerating over time. During the pre-reform period 1957-77, the annual growth rate was less than six percent. It accelerated to 9.5 percent during the

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[3] Classics include Clark (1951), Kuznets (1966), and Chenery and Syrquin (1979). Chenery, Robinson, and Syrquin (1986) summarize much of the earlier cross-country comparative work and survey earlier studies on the sources of growth in developing countries. Temple (1999) updated more recent studies on cross-country analysis of sources of economic growth.

reform period of 1978-1989, and to 11 percent in the 1990s.[4] All sectors have grown

rapidly, but at different rates. Agriculture grew at 5.3 percent per year, while urban

industry and urban services grew at 8.6 percent and 7.1 percent, respectively.[5] Rural

enterprises grew at 21.6 percent per year from 1978 to 1997, a rate that few economies

have ever achieved for a sustained period.[6] In 1997, GDP produced by rural industry in

China was larger than the GDP of the entire industrial sector of India.[7]

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[4] There have been several attempts to reconstruct the national GDP figures for China. Maddison (1998) estimated a 7.5 percent annual growth rate for the period of 1978-95, 2.2 percent lower than the official figure. His estimated level of 1987 GDP, however, is 16 percent higher than official SSB data. The major differences come from the weights use in aggregating total output, and the inflation deflators used. Moreover, Maddison's figures were derived from gross production value or net production value, while Chinese official data were constructed using the standard system of national accounts (SNA) in aggregating GDP at the provincial level. Wu and Wu (1994) also constructed GDP figures for China. Their estimated GDP level in 1978 was 12 percent higher than the official released figure, but their growth rate of GDP (8.6 percent per annum) is 0.4 percentage point lower than the SSB rate (9.0 percent) for 1978-91. In this study, we use Chinese official data because of the availability of provincial data recently published by SSB in 1997.

[5] The annual growth rate of agricultural GDP is higher than that of gross production, which was 4.25 percent per year from 1952 to 1995 (Fan 1997). The difference comes mainly from the fact that intermediate inputs in agriculture (such as fertilizers) have grown substantially. The ratio of the value of intermediate inputs to value added has risen, which is characteristic of agriculture in the development process.

[6] The GDP of rural enterprises may have been over-reported, but to what extent, and how it changes over time and across regions, is difficult to judge. In 1997, SSB conducted a comprehensive agricultural census that included more than 1,000 surveyed items. The authors are in the process of getting access to this census and may use the data as a benchmark to adjust both employment and GDP data for rural enterprises. However, rapid growth in rural industry is evidenced all over China, particularly in coastal regions.

[7] Calculated by the authors using data from the *World Development Report*, 1999.

Table 1 Sectoral GDP and input growth by sector

Period	Total	Agriculture	Urban Industry	Urban Service	Rural Enterprise
GDP					
1952-77	5.93	3.66	9.43	5.10	n.a.
1978-89	9.50	8.38	6.47	13.91	19.27
1990-97	11.18	5.27	10.27	7.04	27.86
1978-97	9.81	7.25	7.32	11.00	21.56
1952-97	7.68	5.32	8.66	7.06	n.a.
Labor					
1952-77	2.60	2.13	5.55	3.59	n.a.
1978-89	2.96	1.12	3.67	3.66	15.49
1990-97	1.23	-1.46	1.18	8.25	4.26
1978-97	2.94	0.90	2.86	6.65	11.01
1952-97	2.73	1.56	4.50	4.02	n.a.
Capital Stock					
1978-89	8.54	2.28	9.97	8.90	11.75
1990-95	9.25	6.00	6.69	10.60	18.11
1978-95	8.70	3.40	8.92	9.38	13.20

Note: All the numbers are percent.
Sources: Calculated from various China State Statistical Bureau (SSB) publications.

As a result of differential sectoral growth rates, the Chinese economy has experienced massive structural transformation over the past several decades (Figure 1). In 1952, agriculture accounted for more than half of GDP, while urban industry and services accounted for 21 percent and 29 percent, respectively. The Chinese economy was largely agrarian. But by 1997 the share of agriculture had declined to about 20 percent of GDP—a decline of about two-thirds of a percentage point per year, which is a rapid rate of structural change. The most dramatic change has been the rapid increase of rural enterprises. In 1997, rural enterprises

accounted for more than a quarter of aggregate GDP, while this sector was almost nonexistent even as late as 1978.

Labor shifts among sectors have been phenomenal. In 1952, more than 80 percent of the national labor force was in the agricultural sector, only six percent in urban industry, and ten percent in the urban service sector. By 1997, less than half of the labor force was engaged in agricultural activities. More than 13 percent was in the urban industry sector, and ten percent in the urban service sector. Rural enterprises employed over one-fifth of the total labor in 1997 (Figure 1).

In 1978, agriculture accounted for 20 percent of the total capital stock, while urban industry and services accounted for 38 and 33 percent, respectively, and rural enterprises accounted for only six percent. By 1997, given slow growth in agricultural capital investment, the share of agriculture in the total capital stock declined dramatically to 8.8 percent. Both urban industry and services have increased their shares to 44.5 and 38.7 percent, respectively. Although the total absolute amount of rural enterprise capital stock has grown rapidly (13 percent per year), the growth has been slower than the growth in the sector's GDP over the period 1978-95 (Figure 1).

There was a large difference in labor productivity among sectors in 1952 (table 2). The average productivity of labor in urban industry was 5.8 times larger than in agriculture, indicating a large potential efficiency gain from reallocating labor from

Figure 1 Structural shift of GDP, labor and capital, 1978-95
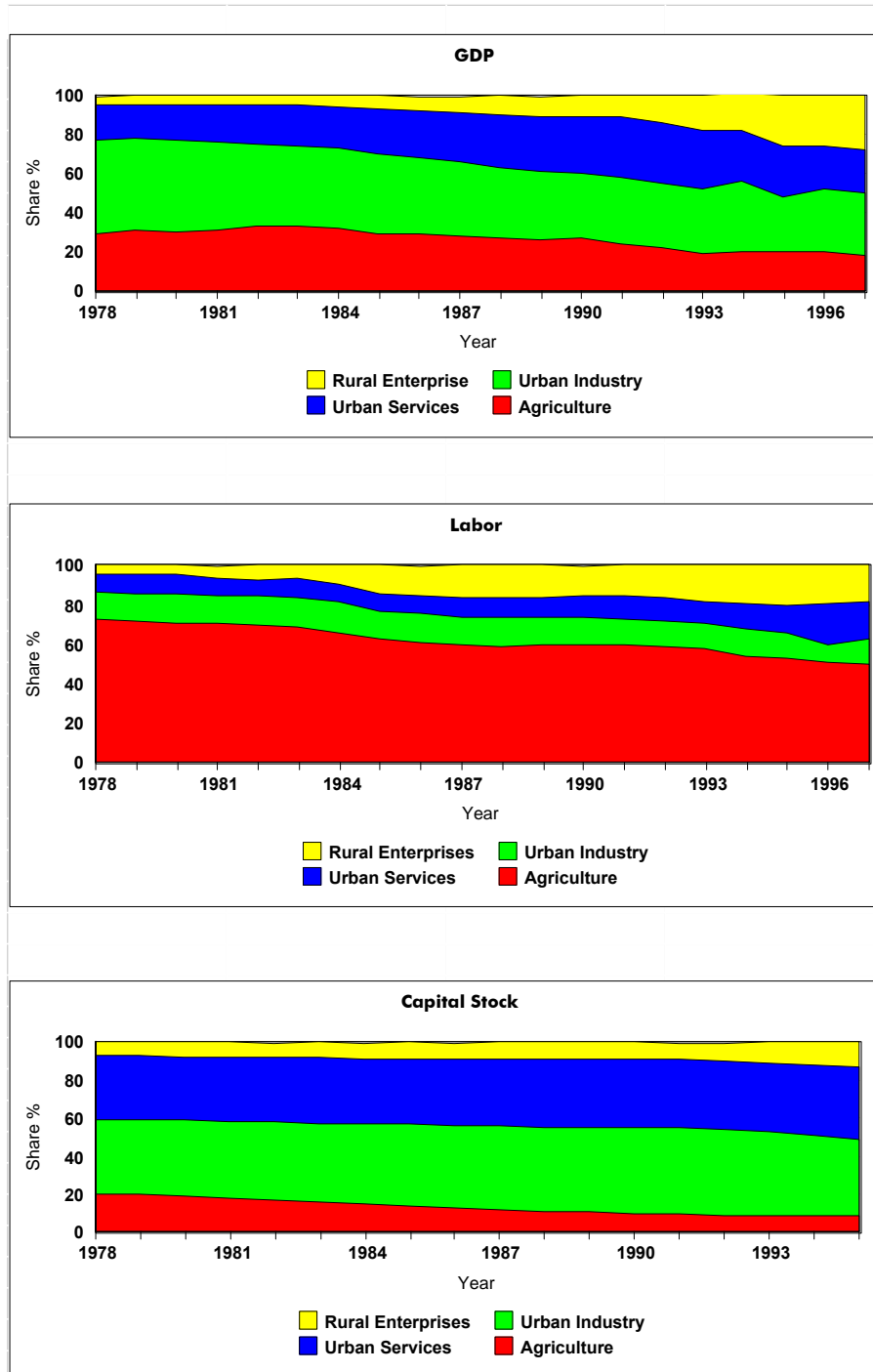
agriculture to industry. Over time, the rise of rural enterprises has absorbed huge amounts of surplus labor in the rural areas, indicating that the efficiency of the whole economy has gained by reallocating these resources to higher productivity sectors. The average labor productivity difference remained large throughout the period, narrowing only to 5.4 by 1995 (Table 2).

In spite of rapid growth of the capital stock, capital productivity in China has actually increased over time (Table 3). For every 100 Yuan of capital stock, 39 Yuan of GDP was produced in 1978, which increased to 46 Yuan in 1995. Over time, rural areas (agriculture and rural enterprises) have shown strongly increasing trends in capital productivity, indicating more investment in rural areas is justified. But the share of capital investment in rural areas has declined, and consequently capital productivity in rural areas (109 for agriculture and 90 for rural enterprises) is two to three times larger than that in urban sectors in 1995.

Table 2 Labor productivity growth by sector

Year	Average	Agriculture	Urban Industry	Urban Services	Rural Enterprise
			1978 constant yuan / worker		
1952	371	224	1,290	1,015	n.a.
1953	416	230	1,515	1,216	n.a.
1954	424	233	1,518	1,266	n.a.
1955	443	246	1,724	1,241	n.a.
1956	495	265	2,261	1,084	n.a.
1957	503	250	2,536	1,176	n.a.
1958	545	319	1,215	626	n.a.
1959	603	259	2,345	686	n.a.
1960	608	216	2,350	858	n.a.
1961	447	210	1,640	1,008	n.a.
1962	417	200	1,981	1,080	n.a.
1963	446	218	2,405	1,044	n.a.
1964	507	237	2,928	1,141	n.a.
1965	574	267	3,160	1,290	n.a.
1966	612	282	3,509	1,259	n.a.
1967	558	275	2,876	1,221	n.a.
1968	516	267	2,458	1,166	n.a.
1969	580	270	2,900	1,359	n.a.
1970	668	291	3,317	1,467	n.a.
1971	692	296	3,215	1,463	n.a.
1972	713	297	3,150	1,505	n.a.
1973	752	319	3,207	1,583	n.a.
1974	755	327	3,087	1,552	n.a.
1975	803	337	3,270	1,516	n.a.
1976	776	336	2,917	1,399	n.a.
1977	824	325	3,178	1,459	n.a.
1978	903	362	3,335	1,738	808
1979	950	419	3,197	1,759	833
1980	992	424	3,201	1,911	873
1981	1,012	459	3,037	2,245	748
1982	1,065	511	2,963	2,720	677
1983	1,152	558	3,109	2,615	844
1984	1,278	627	3,298	3,051	775
1985	1,401	670	3,958	3,510	665
1986	1,484	706	4,021	3,764	767
1987	1,608	758	4,278	4,064	884
1988	1,739	793	4,444	4,641	1,027
1989	1,777	776	4,473	4,904	1,152
1990	1,597	727	4,087	4,024	1,088
1991	1,720	721	4,290	4,471	1,219
1992	1,942	737	4,884	5,193	1,561
1993	2,178	754	5,353	6,051	2,086
1994	2,423	901	6,639	4,867	2,395
1995	2,648	1,026	5,601	5,177	3,276
Annual Growth Rate					
1952-77	3.25	1.50	3.67	1.46	n.a.
1978-89	6.35	7.18	2.70	9.89	3.27
1990-95	10.64	7.13	6.51	5.17	24.67
1978-95	6.54	6.32	3.10	6.63	8.58
1952-95	4.68	3.60	3.47	3.86	n.a.

Sources: Calculated from various SSB publications.

Table 3 Capital productivity growth by sector

Year	Average	Agriculture	Urban Industry	Urban Services	Rural Enterprise
			1978 constant yuan per 100 Yuan Capital Stock		
1978	39	55	48	20	24
1979	39	63	46	20	23
1980	39	63	46	22	23
1981	39	69	42	23	23
1982	40	78	40	24	23
1983	41	85	40	25	25
1984	43	91	41	27	28
1985	43	93	41	28	35
1986	43	97	38	29	39
1987	43	102	38	30	43
1988	44	106	36	33	47
1989	42	105	34	33	48
1990	41	111	30	33	48
1991	42	107	30	36	51
1992	44	106	32	38	59
1993	46	103	34	37	74
1994	47	109	40	33	74
1995	46	109	32	33	90
Annual Growth Rate					
1978-89	0.88	5.97	-3.19	4.60	6.73
1990-95	2.52	-0.30	1.07	-0.27	13.17
1978-95	1.09	4.07	-2.43	2.82	8.15

Sources: Calculated from various China State Statistical Bureau (SSB) publications.

3.   CONCEPTUAL FRAMEWORK

Chinese economic reforms began in the rural sector. Prior to the reforms, most resource allocation was subject to government controls. Labor allocation had long been tightly controlled by the government through the household-registration and food-rationing system in the cities. The agricultural population could only engage in agricultural production. Migration of labor was prohibited between agricultural and nonagricultural sectors, and between rural and urban areas. As the population increased and technology improved, a huge labor surplus developed in rural China. It was estimated that one third of rural labor (about one hundred million workers) was underemployed prior to the reforms.

Beginning in 1979, efforts were made by the government to improve incentives in agriculture and to stimulate output by decentralizing production and increasing the responsibility of household units (the so-called "household production responsibility system") whereby land is still collectively owned, but the use rights were distributed by collectives based on the number of persons and/or laborers in each family. Under the household responsibility system, farm households signed contracts with collectives delineating each other's obligations and responsibilities. The initial contracts were of 15 years' duration. By 1984, more than 99 percent of the country's production teams had adopted the household production responsibility system. Various studies have demonstrated that rural reform during this period substantially increased production efficiency, productivity, and farmer income (McMillian et al. 1989, Fan 1991, Lin 1992).

Rapid growth in agricultural labor productivity and rural income increased rural demand and provided a great opportunity for farmers to develop the non-agricultural rural sector. In addition, rural laborers were finally permitted to leave agricultural production to

work for rural industry and services, and also to migrate to work in urban areas. The percentage of rural laborers engaged in the rural non-farm sector increased from six percent in 1978 to 25 percent in 1997. Similarly, many farmers migrated to urban centers to work in both industry and services. The rapid development of rural industry and services not only provided a demonstration of the potential gains from reform, but also created competitive pressure for urban sectors to reform as well. Without successful reforms in agriculture, which increased agricultural productivity and released resources to work elsewhere, and rapid development of the rural non-farm sector, the reforms and rapid growth in the urban sector since 1984 would have been impossible.

Chinese urban sector reforms did not begin formally until 1984. Various reforms that were enacted piecemeal during 1978-84 were considerably expanded in 1984, but the 1984 reform package was far from the "big bang" programs then being advocated for Eastern Europe and the former Soviet Union. In particular, China's urban-sector reforms emphasized an expansion of enterprise and local autonomy and incentives, and the reduction—but not elimination—of within-plan allocations. The results have been encouraging. Productivity has increased and the returns to factors converged significantly across sectors (Chen *et al.* 1992). Wu (1995) used panel data to decompose growth into technological change and technical efficiency change in three Chinese sectors, and found that productivity in agriculture, rural industry, and state industry all grew very quickly from 1985 to 1991.

There is a vast literature analyzing rapid economic growth in China. To date, few studies have considered the role of structural change as a source of economic growth in China. Chow (1993) estimated production functions and marginal returns to capital and labor for five sectors of the Chinese economy, carefully constructing capital stock data for each sector. He

found that there was a declining difference in returns to capital, and an increasing difference in

returns to labor, among sectors for the period of 1952-85. Borensztein and Ostry (1996) also

suggest that the large gain in total factor productivity (TFP) was caused by labor relocation

from rural to industrial and urban sectors, rather than pure technical progress.

Few economists have tried to quantify the contribution to aggregate growth from

reallocating resources among sectors over time. Robinson (1972) presented a model which

explicitly accounts for the contribution to aggregate growth of resource transfers between

agriculture and non-agriculture, and estimated the model using cross-country data. Feder

(1986) used the same analytic model to estimate, also using cross-country data, the

contribution to aggregate growth of transfers of resources between non-export and export

sectors. Sonobe and Otsuka (1997) demonstrated the significance of changing industrial

structure in economic growth in prewar Japan by decomposing labor productivity. In these

models, the gap in marginal productivity of factors across sectors is assumed to be constant

over time, and they make no assumptions about the form of the sectoral production functions.

In this paper, we present an analytic framework that includes explicit sectoral production

functions, using a flexible functional form that supports econometric estimation and can

incorporate different types of productivity growth, as well as capture the effect of resource

transfers on aggregate growth.

To decompose the impact of resource transfers on growth, start by defining

allocatively efficient GDP as the value of GDP when inputs have been allocated so that the

marginal returns to all inputs are equal across sectors (we will use the term "efficient GDP"

hereafter). The efficiency index, E, is the ratio of actual GDP, Y, to efficient GDP, Y'.

$$E = Y / Y' \qquad\qquad\qquad (1)$$

For many reasons, including policy changes, sectoral allocative efficiency may change over time. Growth in actual GDP can be decomposed into growth in efficient GDP and changes in efficiency.

$$\frac{\partial \ln Y}{\partial t} = \frac{\partial \ln Y'}{\partial t} + \frac{\partial \ln E}{\partial t}. \tag{2}$$

Since $Y' = \sum_i Y'_i$, where the subscript i refers to sectors,

$$\frac{\partial \ln Y'}{\partial t} = \sum_i S'_i \frac{\partial \ln Y'_i}{\partial t}, \tag{3}$$

where $S'_i = Y'_i / Y'$ is the share of i in total GDP.

To perform sources accounting using this equation, we need: (1) to have an explicit specification of sectoral production functions, and then (2) to determine the allocation of factors across sectors so that sectoral marginal products are all equal —the allocation consistent with competitive equilibrium in all factor markets. We start by assuming that real value added (GDP) by sector follows a well-behaved, neoclassical production function:

$$Y_{it} = f_{it}\left(X_{i1t}, \ldots X_{ijt}, \ldots X_{imt}, T\right), \tag{4}$$

where X_{ijt} is input j for sector i in year t. A thornier question is what functional form of the production function should be used. Considering both econometric estimation and theoretical consistency, we specify the following functional form:

$$\ln(Y_{it}) = a_{i0} + a_{it}t + \sum_j b_{ij} \ln(X_{ijt}) + \sum_j b_{ijt} \ln(X_{ijt})t + a_{itt}t^2. \tag{5}$$

or

$$\ln(Y_{it}) = A_{it} + \sum_j B_{ijt} \ln(X_{ijt}). \tag{6}$$

where $A_{it} = a_{i0} + a_{it}\,t + a_{itt}\,t^2$, and $B_{ijt} = b_{ij} + b_{ijt}\,t$. Within each time period (fixed t), the production function is Cobb-Douglas in form. The marginal product of each factor is given by:

$$\frac{\partial Y_{it}}{\partial X_{ijt}} = B_{ijt} \frac{Y_{it}}{X_{ijt}}. \tag{7}$$

Over time, both neutral and biased technical changes are allowed in every sector, since all the coefficients potentially vary over time.

For any given year, the efficient allocation of resources can be determined by computing the allocation of resources such that the marginal product of each factor j is the same across all sectors i. The computational problem is equivalent to solving a small computable general equilibrium model of the factor markets assuming that product prices are fixed.[8] The result is a set of efficient resource allocations, X'_{ijt} and outputs Y'_{it}. Taking the first derivative of (6) with respect to time t, the growth of efficient production in sector i can be decomposed as:

$$\frac{\partial \ln Y'_{it}}{\partial t} = \frac{\partial A_{it}}{\partial t} + \sum_j \frac{\partial B_{ijt}}{\partial t} \ln X'_{ijt} + \sum_j B_{ijt} \frac{\partial \ln X'_{ijt}}{\partial t}. \tag{8}$$

The first term of equation (8) represents the effect of neutral technical change while the second term measures the effect of biased technical change for sector i. The final term is the effects of increased use of inputs. For simplicity, we aggregate the first and second terms as measuring the total impact of sectoral technical change (or productivity growth) on sectoral output growth.[9]

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[8] We solve for the efficient allocation using the GAMS software. See Brooke, Kendrick, and Meeraus (1992) for a description of the software.

[9] Since even within a sector, productivity can also increase by reallocating resources, the first and second terms may reflect within-sector allocative changes. The two terms together measure growth in sectoral total factor productivity (*i.e.*, total output growth minus aggregate input growth).

4.   DATA

GDP

Both nominal GDP and real GDP growth indices for various sectors are available

from SSB's *The Gross Domestic Product of China* (SSB, 1997a). The data sources and

construction of national GDP estimates was published by the State Statistical Bureau (SSB,

1997b). This publication indicates that the SSB has used the U.N. standard SNA (system of

national accounts) definitions to estimate GDP for 29 provinces by three economic sectors

(primary, secondary, and tertiary) in mainland China for the period of 1952-95. Since 1995,

the *China Statistical Yearbook* has published GDP data every year for each province by the

same three sectors. Both nominal and real growth rates are available from SSB official

publications.

We use four sectors in our analysis: agriculture, urban industry, urban services, and

rural enterprises. The agriculture sector is equivalent to the primary sector used by SSB. The

following procedures were used to construct GDP for the other three sectors. Until 1996,

China published annual gross production value for rural industry and services. In 1996, they

began to publish value added figures. The definition of value added is GDP originating in the

sector, the data we need. The Ministry of Agriculture published data on both gross production

value and value added for rural industry (including construction) and services in *China's*

Agricultural Yearbook, 1996. The data on nominal value added for rural industry and services

prior to 1995 were estimated using the growth rate of gross production value and 1995 value-

added figures, assuming no change in the ratio of value added to gross production value.

GDP for rural industry was subtracted from GDP for industry as a whole (or the

secondary sector as classified by SSB) to obtain GDP for urban industry. Similarly, GDP for

rural services was subtracted from aggregate service sector GDP (or the tertiary sector as classified by SSB) to obtain GDP for the urban service sector. GDP for rural enterprises is the sum of GDP for rural industry and rural services.

The implicit GDP deflators by province for the three sectors are estimated by dividing nominal GDP by real GDP. These deflators are then used to deflate nominal GDP for rural industry and services to obtain their GDP in real terms.

LABOR

Labor input data for the primary, secondary, and tertiary sectors at the provincial level after 1989 can be found in SSB's *Statistical Yearbooks* (various issues), while provincial labor data prior to 1989 are available in SSB (1990). Labor is measured in stock terms as the number of persons at the end of each year. For rural industry and services, prior to 1984, labor input data at the township and village level, but not at the individual household level, are available in SSB's *Rural Statistical Yearbooks*. The omission of individual-household, non-farm employment data will not cause serious problems as the share of this category in rural employment was minimal prior to 1984. Urban industry labor is estimated by subtracting rural industry labor from total industry labor, and urban service labor is similarly estimated as total service labor net of rural service labor.

CAPITAL STOCK

Capital stocks for the four sectors are calculated from data on gross capital formation

and annual fixed asset investment. For the three sectors classified by SSB, the data on gross

capital formation by province after 1978 was published by SSB (1997). Gross capital

formation is defined as the value of fixed assets and inventory acquired minus the value of

fixed assets and inventory disposed. To construct a capital stock series from data on capital

formation, we used the following procedure. Define the capital stock in time *t* as the stock in

time *t-1* plus investment minus depreciation:

$$K_t = I_t + (1 - \ddot{a}) K_{t-1}. \tag{9}$$

where K_t is the capital stock in year *t*, I_t is gross capital formation in year *t*, and δ is the

depreciation rate. *China Statistical Yearbook* (SSB, 1995) reports the depreciation rate of

fixed assets of state owned enterprises for industry, railway, communications, commerce, and

grain for the years 1952 to 1992. We use the rates for grain and commerce for agriculture and

services, respectively. Since 1992, SSB has ceased to report official depreciation rates. For the

years after 1992, we used the 1992 depreciation rates.

To obtain initial values for the capital stock, we used a similar procedure to Kohli

(1982). That is, we assume that prior to 1978, real investment has grown at a steady rate (*r*)

which is assumed to be the same as the rate of growth of real GDP from 1952 to 1977. Thus,

$$K_{1978} = \frac{I_{1978}}{(\ddot{a} + r)}. \tag{10}$$

This approach ensures that the 1978 value of the capital stock is independent of the

1978-95 data used in our analysis. Moreover, given the relatively small capital stock in 1978

and the high levels of investment, the estimates for later years are not sensitive to the 1978 benchmark value of the capital stock.

Estimates of capital stocks for rural industry and services are constructed using the annual fixed asset investment by province from 1978 to 1995, which are available in the annual *China Statistical Yearbooks* and the *China Fixed Asset Investment Statistical Materials, 1950-95*. Initial values are calculated using equation (10), but the growth rate of real investment prior to 1978 is assumed to be four percent. Again, the initial capital stock is low, so that the estimated series is not sensitive to the benchmark starting value.

Capital stock for rural industry was subtracted from that of total industry (or secondary industry as classified by SSB) to obtain capital stock for the urban industry sector. Similarly, capital stock for rural services was subtracted from the aggregate service sector (or tertiary sector as classified by SSB) to obtain the capital stock for the urban service sector. Finally, capital stock for rural enterprises is the sum of capital stocks for both rural industry and services.

Prior to constructing capital stocks for each sector, annual data on capital formation and fixed asset investment was deflated by a capital investment deflator. The SSB began to publish provincial price indices for fixed asset investment in 1987. Prior to 1987, we use the national price index of construction materials to proxy the capital investment deflator.

LAND

Land in agriculture is taken to be arable land, and data are available in various issues of *China's Agricultural Yearbook, China's Statistical Yearbook,* and *China's Rural Statistical Yearbook*. The official data on arable land areas are known to be inaccurate. Various new

estimates indicate that official figures under report actual acreage by as much as 30-40%.

However, it is difficult to judge how this under-reporting varies over time and across regions.

In this study, we simply use the official data. We also use the sown areas as the land input

variable in the estimation of the agricultural production function. The coefficient of the land

variable was sensitive to changes in the definition of the land variable, but using different land

data had almost no impact on the coefficients of labor and capital.

5. ESTIMATION OF PRODUCTION FUNCTIONS

We have data for eighteen years (1978-95) for 28 provinces, which represents a panel of 504 observations. Tibet is excluded mainly because of lack of data. Hainan province, which was separated from Guangdong as a separate province after 1987, is still included in Guangdong province.

In order to avoid the heteroscedasticity problem due to large regional differences, regional dummies were added to the production functions. The division of the seven regions are as follows: (1) Northeast (NE): Heilongjiang, Liaoning, and Jilin provinces; (2) North (N): Municipalities of Beijing and Tianjin; Hebei, Henan, Shangdong, Shanxi, Shaanxi, and Gansu provinces; (3) Northwest (NW): autonomous regions of Nei Monggol, Ningxia, Xinjiang, and Tibet; Qinghai province; (4) Central (C): Jiangxi, Hunan, and Hubei provinces; (5) Southeast (SE): Shanghai municipality, Jiangsu, Zhejiang, and Anhui provinces; (6) Southwest (SW): Sichuan, Guizhou, and Yunan provinces; and (7) South (S): Guangxi autonomous region; Fujian and Guangdong provinces.[10]

The results of the estimated production functions are presented in Table 4. Regressions R1, R2, R3, and R4 present the results of different specifications of the production functions for agriculture. Regressions R1 and R2 include land as a separate input, in addition to labor and capital, because land is treated differently from agricultural

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[10] One could also use provincial dummies. Adding provincial dummies would not significantly change the results but only reduce degrees of freedom.

Table 4 Production functions estimates by sector

	Agriculture				Urban Industry		Urban Services		Rural Enterprise	
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}
Labor	0.367	0.543	0.627	0.805	0.581	0.634	0.428	0.337	0.249	0.314
	(9.24)*	(9.26)*	(29.63)*	(19.01)*	(16.07)*	(10.02)*	(17.25)*	(8.25)*	(6.20)*	(4.75)*
Capital	0.227	0.136	0.285	0.155	0.386	0.330	0.374	0.398	0.719	0.482
	(8.14)*	(2.82)*	(10.04)*	(13.06)*	(8.81)*	(4.41)*	(19.95)*	(11.03)*	(18.33)*	(6.56)*
Land	0.317	0.268								
	(7.55)*	(5.39)*								
Time Trend	0.046	0.121	0.041	0.141	0.041	-0.091	0.059	0.079	0.101	-0.091
	(18.22)*	(5.16)*	(16.02)*	(7.91)*	(9.26)*	(-5.00)*	(22.05)*	(5.25)*	(19.67)*	(-5.00)*
Labor*t		-0.016		-0.017		-0.009		0.013		0.009
		(-3.66)*		(-4.86)*		(-0.94)		(2.95)*		(1.60)
Capital*t		0.009		0.013		0.009		-0.004		0.012
		(2.17)*		(2.89)*		(0.96)		(-6.92)		(1.99)*
Land*t		0.003								
		(0.76)								
Time Trend^2		-0.0019		-0.002		0.0007				0.005
		(-3.76)*		(-3.96)*		(0.85)				(6.25)*
R^2	0.920	0.924	0.910	0.918	0.891	0.891	0.925	0.933	0.923	0.939

Notes: Estimates of regional dummies are not reported.   *Asterisk indicates that estimates are at the 5% significance level
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capital (buildings, machinery, and livestock) in the SSB data (SSB 1997b). The SSB only

includes capital formation from net increased land areas due to reclamation, but reclaimed

land usually is of lower quality than the current stock of land. Using the Kohli approach would

underestimate the initial capital stock embodied in land. We exclude land area as an input in

regressions R3 and R4 for comparison. Fertilizer could also be included in the agricultural

production functions, but agricultural output is measured as value-added, so intermediate

inputs such as fertilizer are excluded from output measures by definition. Including fertilizer

and other intermediate inputs is more appropriate in estimating a production function for gross

output.

Results from regression R1 indicate that, over the period of 1978-95, labor still played

an important role in Chinese agricultural production with an elasticity of 0.367. The elasticity

of the land input is slightly smaller than that of labor at 0.317, while that of capital is the

smallest. The strong, positive coefficients of the time-trend variables imply that technical

change played a vital role in promoting Chinese agricultural production during the study

period.

Results from Regression 2 show that the importance of labor in agricultural production

has declined, while the role of capital has increased. The declining role of labor is particularly

significant, with its production elasticity declining from 0.53 to 0.26. The elasticity of capital

increased from 0.15 to 0.30. There was, however, no significant change in the role of land in

agricultural production (the estimated elasticity went from 0.443 in 1978 to 0.409 in 1995).

Without land as an input, the coefficient of labor in the regressions is greater and that of

capital changes very little in 1978, while both coefficients would be overestimated in 1995

(regressions R3 and R4).

The labor elasticity for urban industry was large in 1978, at 0.63, but declined rapidly to 0.50 in 1995 (comparing regressions R5 and R6 and taking account of the time trend on the labor coefficient). Capital elasticity was low at 0.34 in 1978, but increased to 0.49 in 1995. These results indicate that a rapid transformation occurred in the sector—it has become increasingly more capital intensive and less labor intensive. The urban service sector followed a different path. The labor elasticity increased over time from 0.35 in 1978 to 0.58 in 1995, while the capital elasticity changed very little (regressions R7 and R8). In contrast to urban industry, the urban service sector has become increasingly labor intensive.

The most striking phenomenon in the rural enterprise sector is that both labor and capital elasticities have increased over time (regressions R9 and R10), implying increasing returns to scale in the industry. In particular, the labor elasticity increased from 0.32 in 1978 to 0.47 in 1995; and the capital elasticity became the highest of all sectors, increasing from 0.49 in 1978 to 0.70 in 1995.

These estimates of sectoral production functions yield results that differ sharply from some previous estimates. Chow (1993), for example, found that there was technical regression in all sectors in China during 1952-80. He used national time-series data. Time series data on labor, capital, land, and the time-trend variable are highly correlated, leading to unreliable parameter estimates. Our results are very similar to those of Wu (1995), who estimated production functions for three sectors, with the exception that he reports smaller estimates for the labor elasticity for agriculture and the capital elasticity for state industry. However, in Wu's specification, parameters do not change over time, while the more flexible form in our regressions supports estimation of biased technical change, which was found to be significant.

Differences in estimated elasticities for the same input across sectors reflect differences in technology, but do not provide any indication of how efficiently resources are allocated. Efficiency of resource allocation depends on differences in the marginal productivity of inputs across sectors. Given the estimated parameters, the marginal product of each factor can be computed from equation 8. The results are shown in Figure 2. Over the study period, the marginal return to labor in agriculture increased very little, while that of rural enterprises rose sharply. In 1978, labor productivity in rural enterprises was over 50 percent larger than that in agriculture, implying the existence of large potential gains from reallocating labor from agriculture to rural industry.[11] From 1978 to 1995, more than 130 million rural labor workers were shifted from agricultural production to rural non-farm activities. This shift is perhaps the major source of efficiency gain since the reform. In the urban areas, the marginal returns to labor in urban industry were highest among all sectors in 1978, but increased rapidly in the urban service sector, rising to a level 33 percent higher than in industry by 1995.

Capital in the urban industry sector had the highest marginal return in 1978. But the return in rural enterprises, although slightly lower than the value in urban industry in 1978, rose dramatically. In 1995, the return in rural enterprises was 3.6 times that in urban industry. The marginal return in agriculture was low and similar to the level in the urban service sector, but over time it increased more than three fold, and in 1995 its return was 2.0 and 2.9 times those in urban industry and service sectors, respectively, but only 51 percent of the value in rural enterprises.

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[11] The low level and stagnation of returns to labor in agriculture was also found by Chow (1993).

Figure 2 Marginal returns to labor and capital stock
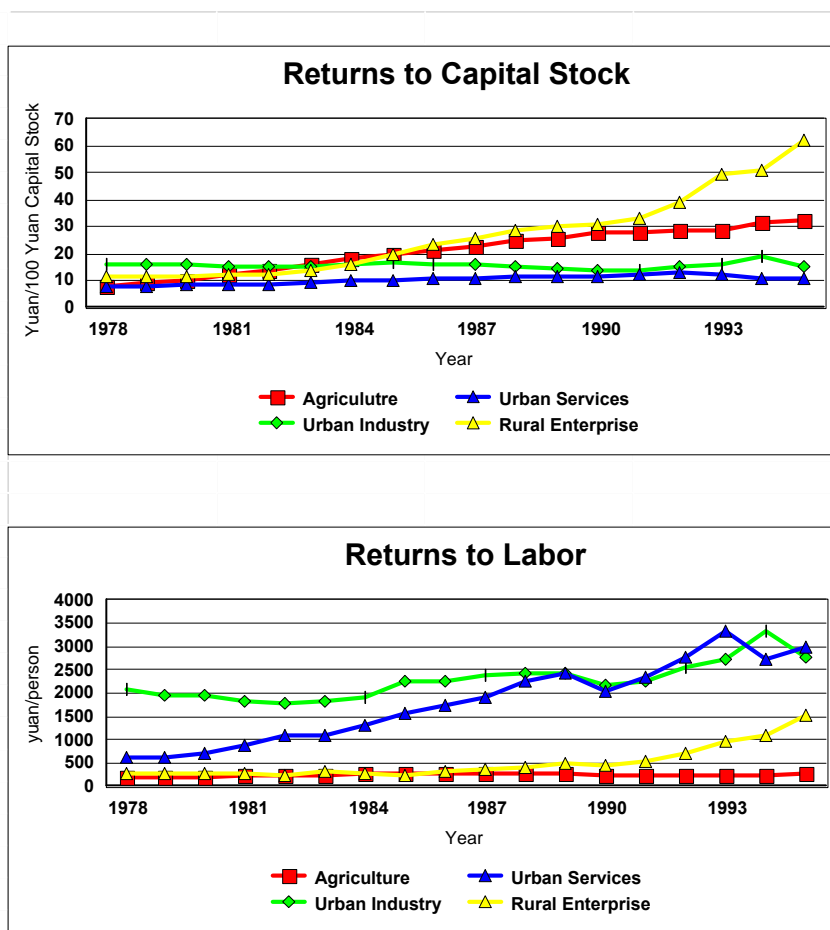
Table 5 presents the estimates of returns to scale for each sector. Returns to scale are less than one in agriculture, urban industry, and urban services. Returns to scale in agriculture have declined over time, while rising in urban industry and urban services. The returns to scale in rural enterprises were smaller than one in 1978, but have increased since, and in 1995 reached a value of 1.2. The finding of significant increasing returns to scale in rural enterprises is consistent with findings from earlier studies (1.1 by Wu 1995, and 1.2 by Svejnar 1990).

Table 5: Returns to scale by sector

Year	Agriculture	Urban Industry	Urban Services	Rural Enterprises
1978	0.94	0.88	0.74	0.80
1979	0.94	0.88	0.75	0.83
1980	0.94	0.88	0.76	0.85
1981	0.93	0.88	0.77	0.87
1982	0.93	0.89	0.78	0.90
1983	0.93	0.89	0.79	0.92
1984	0.92	0.89	0.80	0.94
1985	0.92	0.89	0.81	0.97
1986	0.91	0.89	0.82	0.99
1987	0.91	0.90	0.83	1.01
1988	0.91	0.90	0.84	1.04
1989	0.90	0.90	0.85	1.06
1990	0.90	0.90	0.86	1.08
1991	0.90	0.90	0.87	1.11
1992	0.89	0.91	0.88	1.13
1993	0.89	0.91	0.89	1.15
1994	0.89	0.91	0.90	1.18
1995	0.88	0.91	0.91	1.20

Sources: Calculated by authors from Table 4.

Having discussed the trends of marginal returns for each sector, we want to evaluate the overall divergence of marginal returns to capital and labor using the Gini coefficient. The Gini coefficient of the marginal returns to labor decreased from 0.47 in 1985 to 0.33 in 1995, while the Gini coefficient of the marginal returns to capital declined from 0.16 in 1978 to 0.11 in 1985, and thereafter went up to 0.21 in 1995. In terms of the magnitude, the disequilibria for labor market is more serious than for the capital market, indicating that there still exist institutional barriers for labor flow. However, the trend of the Gini coefficients is very different—the marginal returns to labor narrowed, but the marginal returns to capital widened.

The fragmentation of the labor market is mainly caused by by the Hukou system (household registration system). The Hukou system pretty much confined people to the village or city of their birth (Solinger, 1993). With the success of rural reform, which freed labor from agricultural production, migration from rural areas to nearby towns and cities became easier,

narrowing the gap in the marginal returns to labor. However, cross-regional migration remained difficult and there are still large barriers that prevent labor from moving freely among sectors (Kanbur and Zhang, 1999). For example, urban centers often impose certain restrictions for a non resident to live and work for "security reasons" or to protect job markets for their own residents, particularly those laid off by state-own enterprises.

The initial decline in the variations in marginal returns to capital prior to 1985 is consistent with Chow's finding. However, the trend reversed after 1985, indicating that the capital market in China is still embryonic and needs to be further developed. The government still controls a large share of investment resources through its budget allocation and five major state banks.[12] Continued flows of financial resources to inefficient state-owned enterprises are a major source of inefficient capital allocation. Poor regulation of the semi-government financial institutions such as the Guangdong International Trust and Investment Corp may also have contributed to inefficient capital allocation.

Overall, in spite of movements of factors, there are indications of continuing disequilibrium in factor markets. Continuing inter-sectoral variations in marginal factor returns and in scale economies indicates significant opportunities for achieving efficiency gains by reallocating factors across sectors.

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[12] People's Bank of China (central bank), Industrial and Commercial Bank of China, Bank of China (specialized bank for foreign currency), Agricultural Bank of China, and Construction Bank of China.

6.   ACCOUNTING FOR SOURCES OF ECONOMIC GROWTH

Using equations 2, 3, and 7, the sources of growth of GDP can be decomposed as shown in Table 6. To calculate the source of growth due to structural change, we used the following procedure. We first simulate allocatively efficient GDP for 1978 by solving for the allocation of labor and capital such that the marginal returns to each factor are equal across all four sectors. The efficiency index was then calculated as the ratio of actual GDP to efficient GDP. We used the same method to calculate the efficiency index for 1995. The contribution of structural change is then calculated as the change in the efficiency index as a percentage of the change in GDP (equation 2).[13]

Figure 3 presents estimates of the allocative efficiency index for the period 1978-95. The index was about 0.57 in 1978, indicating there was large inefficiency in allocating resources among sectors. After 1978, the index rose steadily to 0.68 in 1985. During this period, agricultural productivity improved sharply due to rural reforms and surplus labor was shifted to non-farm activities, leading to the rapid development of rural enterprises. Allocative efficiency improved very little from 1985 to 1991, the period when the effects of the first phase of rural reforms were largely exhausted, and urban sectors were struggling with gradual reforms. Since 1991, the index has begun to rise steadily, probably reflecting aggressive government policy reforms in the urban sectors which have resulted in increased productivity growth and widened the gap between marginal factor returns across sectors. During this period, both urban industry and rural enterprises experienced rapid growth.

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[13] In this study, we ignore the effects of demand and price changes on structural change. One could take shifts in demand into account by using a full CGE model, if the demand side could be fully specified.

Table 6 Sources of growth, 1978-95

Sources	Whole Economy	Agriculture	Urban Industry	Urban Services	Rural Enterprises
GDP Growth	100.00	100.00	100.00	100.00	100.00
Input	40.91	20.68	61.88	49.52	47.06
Labor	15.44	10.72	23.07	16.51	18.01
Capital	25.73	9.96	38.81	33.01	29.04
Sectoral Productivity	41.63	79.32	38.12	50.48	52.94
Structural Change	17.47				

Figure 3 Sectoral allocative efficiency
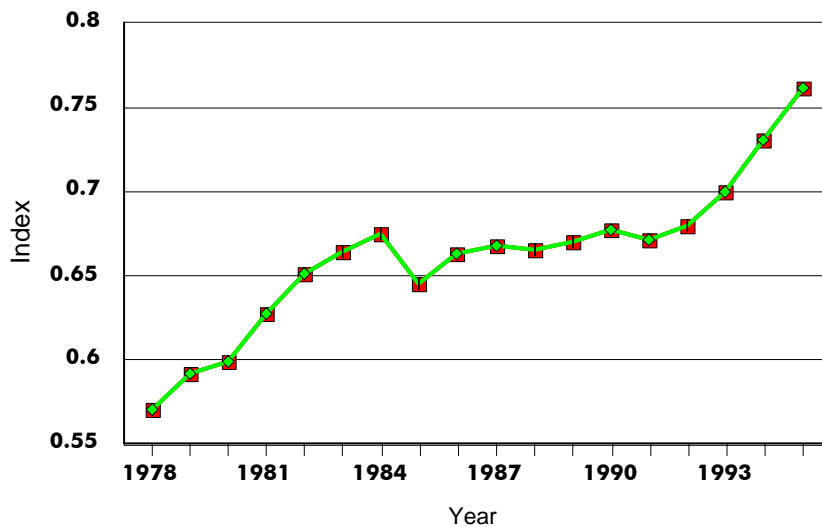
Large amounts of rural labor were shifted out of agriculture. For the first time, employment in agriculture began to decline absolutely (-1.46% per year).

To calculate the contribution of growth in productivity within a particular sector, we first calculate the contribution of increased use of each input by multiplying input growth by

its production elasticity. Productivity growth in the sector is then calculated as the residual, the growth in GDP minus contribution of the growth in inputs. Contributions of sectoral productivity growth and increased use of inputs in the entire economy are calculated as a weighted (by GDP shares) average of their respective contributions in each sector.

Structural change contributed 1.7 percentage points to aggregate GDP growth, and accounted for 17 percent of the total GDP growth rate of 9.9 percent per year from 1978 to 1995. This share seems comparable to those reported by Maddison (1998), World Bank (1997) and Wang (1999).[14]

For the economy as a whole, 41.6 percent of total GDP growth was from sectoral productivity growth, while 41 percent was from the increased use of inputs. Total factor productivity growth (total growth in output minus aggregate input growth, or the sum of the

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[14] Maddison (1998) provided a crude measure of the impact of labor reallocation on GDP growth. He attributed 0.92 percentage point of the annual GDP growth (or 21 percent) to labor reallocation from 1952 to 1978, and 1.44 percentage points (or 19 percent) from 1978 to 1995. However, the average (instead of marginal) productivity of labor was used in calculating the impact. He recognized that his approach was very rough and pointed out that there is a need for more sophisticated analysis of structural-shift effects that require disaggregated information on the physical and human capital stock, which is the approach used in the present study.

World Bank (1997) estimates that the contribution from labor reallocation was about 1.0 percentage points to GDP growth (or about ten percent of the total growth) between 1985 to 1994. However, the methodology used is not clear to the authors. The footnote on the methodology (pp. 107) was missing in the study. In the exercise of projecting the future growth of the Chinese economy in the same study, A simple CGE model was applied to simulate the impact of resources reallocation on GDP growth. The model assumes no changes in sectoral technologies, and assumes a perfect capital allocation in the base year and a declining friction of distortion during projection period. These assumptions are largely ad hoc, and are proved to be inappropriate by the evidence obtained from the present study.

Wang (1999) claimed that from 1979 to 1997, the increased TFP due to labor shifts contributed about eight percent of total GDP growth (7.7 percent between 1979 to 1990 and nine percent between 1991 to 1997). But the methodology used is not clear to us.

contributions of sectoral productivity growth and structural change) for the economy as a

whole accounts for 59% of total GDP growth. This share is much higher than Maddison's

estimate of 30 percent, and slightly higher than the World Bank estimate of 43-46 percent.[15]

Within the agriculture sector, growth in productivity explains nearly 80 percent of

sectoral GDP growth. This figure seems very high when compared with previous studies. Fan

(1991) attributes 16 percent of total output growth in agriculture to technical change and 27

percent to institutional reforms for the period of 1965-85. But Fan's study covers the period in

which agricultural production was institutionally constrained (e.g., the cultural revolution

period from 1966 to 1976). Moreover, the contribution of both institutional and technical

change (43 percent) in Fan's study can be regarded as growth in productivity in the current

study. In Fan and Pardey's study, these two effects plus a residual accounted for 75.8 percent

during 1979-84 and 79.9 percent from 1985 to 1993. Thus, considering all these factors, the

estimated contribution of productivity growth to output growth differs little from other

studies.[16]

In urban industry, sectoral productivity growth accounts for 38 percent of sectoral

GDP growth from 1978 to 1995, while increased input use accounts for 62 percent. Increased

capital input alone accounts for more than 49 percent of total growth, while labor growth

accounts for only 23 percent. Jefferson *et al.* (1992) also concluded that a large share (or more

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[15] Other TFP contribution estimates include 41.6 percent from 1979 to 1994 (Hu and Khan, 1996), 39.9 percent from 1979 to 1995 (Li *et al.*, 1996), and 29.3 percent from 1980 to 1986 (Bosworth *et al.*, 1995). Kim and Lau, however, estimated a technical regress (or negative productivity growth) in the pre-1990 Chinese economy. We believe that the data they used, particularly for GDP and capital stock, are not appropriately constructed.

[16] Other studies on the topic include Huang and Rozelle (1996) and Zhang and Carter (1997).

than 70 percent) of output growth from 1980 to 1988 was from increased use of inputs, particularly capital. They also concluded that the difference in input contributions between state and collective industries and between the periods 1980-84 and 1984-88 was insignificant, although collective industry grew much faster than state industry.

The annual growth rate of urban services was nearly 50% higher than that of urban industry. Growth in sectoral productivity accounts for 51 percent of the total growth, and the remainder is accounted for by increased use of inputs. Growth in capital explains about 33 percent, while growth in labor accounts for 17 percent. There have been no studies of the urban service sectors, so it is impossible to compare our estimates with others.

The rapid growth in rural enterprises is explained equally by the increased use of inputs (47 percent) and improvement in total factor productivity (53 percent). In terms of percentage of contribution to GDP growth, productivity growth is in the same range as for the urban industry and service sectors, but in terms of absolute contribution to GDP growth it is the highest among all sectors. Growth in productivity contributed more than 12 of the total of 22 percentage points of GDP growth in rural enterprises over 1978-95. The contributions are 3.9 percent, 3.0 percent, and 5.6 percent for agriculture, urban industry, and urban services, respectively.

Our initial reaction to these results was that we may have overestimated productivity growth in the rural enterprise sector, considering its lower technology level, but several prior studies also reach the same conclusion. Svejnar (1990) suggests that Chinese rural enterprises have experienced rapid technical progress, and that they seem to operate under mildly increasing returns to scale. Jefferson (1993) and Jefferson *et al* (1996) found that rural enterprises outpaced state-owned enterprises in growth of TFP during the 1980s, surpassing

them in absolute level of TFP by the end of the period. Dong and Putterman (1997) concluded

that productivity of rural enterprises increased at between six and nine percent per year during

1984-89, using time-series, firm-level data and an analytical framework of a frontier

production function.

7.   CONCLUSION

In this paper, we develop a conceptual framework that explicitly incorporates the contribution to aggregate growth of reallocation of resources across sectors. We used new data on GDP by sectors at the provincial level for 1978-1995 to estimate sectoral production functions that incorporate the possibility of biased technical change. Using the estimated parameters and a computational procedure for calculating the "allocatively efficient" level of GDP, we found that about 17 percent of aggregate growth in China over this period is due to structural change—shifting resources from lower to higher productivity sectors. This efficiency gain is attributed mainly to intersectoral labor movements. There were severe policy constraints on capital mobility, and capital reallocation appears to have actually hindered efficiency.

Sectoral productivity growth accounts for 42 percent of aggregate growth, which is relatively low when compared with the experience of developed countries.[17] However, in absolute terms, TFP growth contributed 4.2 percentage points to the aggregate annual growth rate, which is very high by any international standard. The increased use of inputs accounts for 41 percent of growth. Growth in labor input explains only a small part of China's rapid economic growth (15%), while capital growth explains more than 26 percent.

The results of this study support an optimistic view of prospects for future economic growth in China. The continuing large differences in both labor and capital productivity across

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[17] For many developed countries, increased productivity often accounts for more than half of the total economic growth (Chenery *et al.* 1986).

sectors suggests that China still has great potential for further efficiency gains through continued structural change. To realize this potential, however, many restrictions on the intersectoral movement of resources need to be removed. For example, higher capital returns in rural areas (in both rural enterprises and agriculture) suggest that more aggressive government policies should be sought to increase investment there, or at least not hinder their movement. Such policies will not only improve overall economic performance, but also narrow the development gap and inequality between the rural and urban sectors. Similarly, the government should also encourage labor movement from agriculture to rural enterprises, urban industry, and service sectors as labor productivity in these sectors continues to be much higher than in the agriculture sector.

The results indicate that intersectoral differences in marginal returns to capital have grown during the reform period. The puzzle is why there has not been more investment in higher productivity sectors such as rural enterprises and agriculture. One plausible explanation is the sluggish reform of the financial sector in China. Efficient capital markets that can funnel new investment to sectors with higher returns still need to be developed.

The results also show the dramatic role of technical change in fostering rapid growth in China. It may well be that serious reform efforts allowed the economy to exploit opportunities that had long been present but could not be pursued in the earlier system of command planning. The results concerning the continuing role for structural change indicate that such opportunities are not exhausted. However, possibilities for "easy" increases in productivity may well be more difficult to find in the future. To maintain the historically high rates of aggregate growth in the future undoubtedly requires increased investment in R&D, infrastructure, and human capital, as well as continuing policy reform.

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