Some Aspects of the Chinese Industrialization*

Murat Üngör†

August 15, 2011

Abstract

I study the industrialization of China documenting some facts and developing a sectoral growth accounting exercise that links changes in sectoral productivity to the institutional reforms since 1978. I also examine the liberalization process of the Chinese foreign trade focusing on the changes in dynamic comparative advantage using both aggregated and disaggregated data.

JEL Classification: C82, F13, F14, O11, O14.
Key Words: China, industrialization, sectoral productivities, trade.

*This is a revised version of the first chapter of my dissertation submitted to the University of Southern California. I am very grateful to Caroline M. Betts and Ayşe İmrohoroğlu for their criticism and encouragement. I thank Robert Dekle, Rahul Giri, Yong Kim, John Strauss, and Rubina Verma. The views expressed herein are those of the author and not necessarily those of the Central Bank of the Republic of Turkey.

†Research and Monetary Policy Department, Central Bank of the Republic of Turkey, İstiklal Caddesi 10, Ulus, 06100 Ankara, Turkey. E-mail address: murat.ungor@tcmb.gov.tr

1 Introduction

The dramatic emergence of China's role in the world economy is one of the central topics of the current research in international economics. This paper reviews the three aspects of this phenomenon since 1978. First, it is characterized by very high growth rates of GDP per capita. Second, there is an association of long-run economic growth with a significant shift in the composition of economic activity. Third, the transformation of the Chinese economy has been accompanied by a huge increase in international trade.

Beginning in 1978, China adopted a series of economic reforms leading to rapid economic growth and structural transformation with significant and persistent shifts in the proportions of the labor force employed, and of income originating in the major sectors of the economy. China's economic reforms, initiated in the rural areas, succeeded remarkably in boosting rapid growth rates in the rural economy. Changes in the structure of employment have been set in motion by an increase in the productivity of the agricultural sector, especially until 1984. Market reforms were extended to urban areas and state-owned enterprises in 1984. China began further economic reforms, which focused on the manufacturing sector in urban areas. Along with the reform of the centralized planned allocation mechanism, prices for products and production factors were gradually readjusted or partially liberalized.

For many years, the development of China remained largely indigenous, mainly because of China's isolation from other countries. However, China has become an increasingly important part of the global trading system, especially over the last two decades. In 2009, China, accounting for nearly 10 percent of the world merchandise exports, overtook Germany as the lead exporter of merchandise. China's share in world merchandise imports increased to 7.9 percent in 2009, resulting in China becoming the second largest importer while the United States remained the world's leading importer.[1]

The paper is organized as follows. Section 2 provides historical patterns of aggregate growth and productivity. Section 3 examines the structural transformation of the Chinese economy between 1978 and 2005. Section 4 lays out a sectoral growth accounting exercise and links changes in sectoral productivity to the institutional reforms. Section 5 examines the liberalization process of the Chinese foreign trade focusing on the changes in dynamic comparative advantage using both aggregated and disaggregated data. Section 6 concludes.

[1] http://www.wto.org/english/res_e/statis_e/its2010_e/its2010_e.pdf

2 Aggregate Growth and Productivity

Figure 1 plots annual average growth rates of GDP per capita (in 1990 Geary-Khamis dollars) over the period 1978-2008 against annual average growth rates over the period 1950-1977 for one hundred and one countries (see Appendix). China grows at an annual average rate of 2.6 percent during 1950-1977 and then at a rate of 7.1 percent during 1978-2008. China, the world's most populous country, is also the fastest growing country since 1978 and sustains an annual average rate of growth of GDP per capita more than 5 percentage points higher than that of the United States.[2]

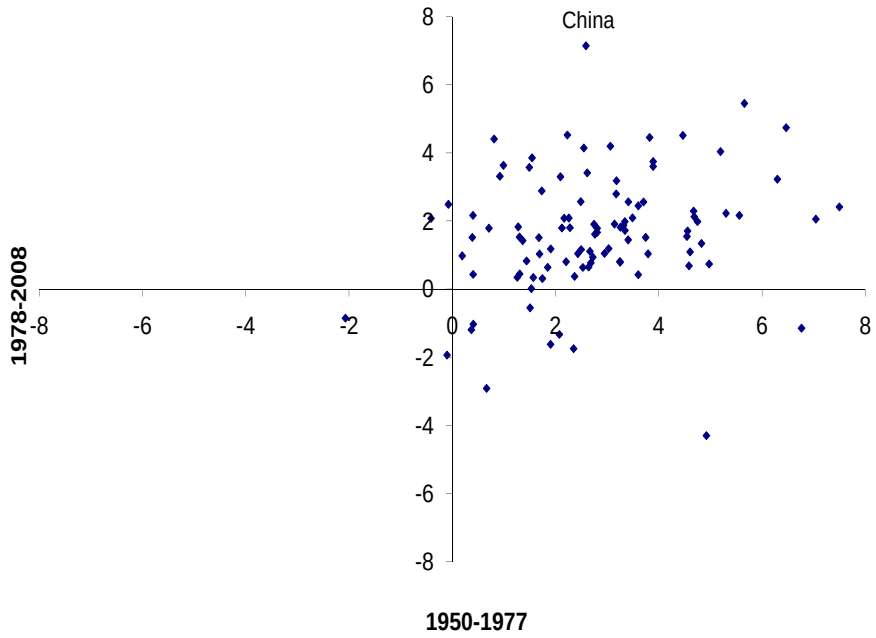

Figure 1: Growth Rates of GDP per Capita (%)

Figure 2 displays the GDP per capita relative to the United States in a set of countries between 1950 and 2008.[3] In 1950 Chinese GDP per capita is 3.6 percent of that in the United States. By 2008, it increases to 19.1 percent. Relative income in Japan starts about 20 percent of the U.S. level, increases to above 84 percent in 1991, and declines to

[2]Perkins and Rawski (2008) anticipate that China's economy can achieve real GDP growth at average rates of 6-8 percent per annum between 2005 and 2025.

[3]For all countries, data for the years 1950-2008 are from the Conference Board, Total Economy Database, January 2009. Western Europe consists of Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, and the United Kingdom. Latin America consists of Argentina, Bolivia, Brazil, Chile, Colombia, Mexico, Peru, Uruguay, and Venezuela. Asian countries are Hong Kong, Singapore, South Korea, and Taiwan.

74 percent in 2008. During the 1990s Japan's rapid growth is replaced by protracted economic stagnation.[4] Asian Dragons start at a GDP per capita level that is about 10 percent of that in the United States in 1950 and they reach to about 70 percent of the U.S. level by 2008. Latin American countries, on the other hand, show relative stagnation, if not deterioration.

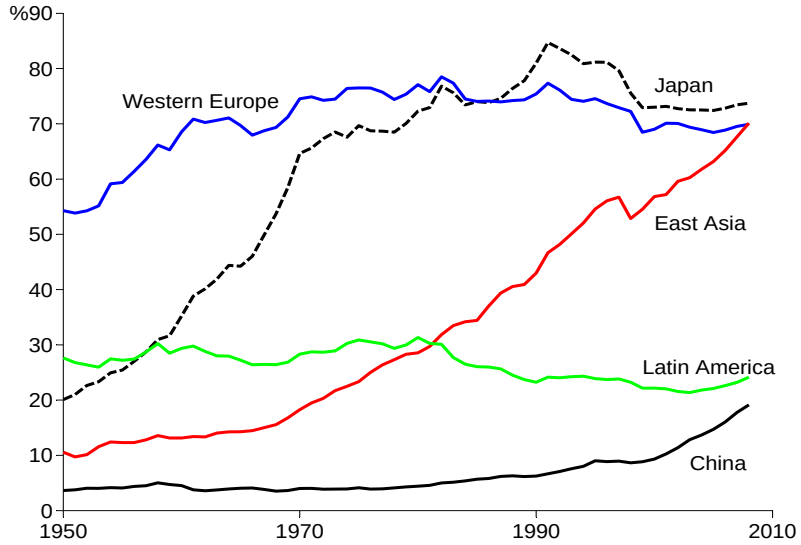

Figure 2: GDP per Capita as a Percentage of the U.S.

When the People's Republic of China was founded in 1949, more than 80 percent of the population was in agriculture. China, under the socialist government, chose the heavy-industry oriented development strategy as the so-called "engine" of economic development with distorted factor and product prices to "leap forward" the nation. China started industrialization within a socialist camp with the leaning-on-one-side policy, which placed a heavy reliance upon trade with and the assistance from the U.S.S.R and industrialization was virtually synonymous with economic development. Great emphasis was put on investment and the rapid development of heavy industry.[5]

[4]Japan was the first country in Asia which responded successfully to the Western economic growth and began to catch-up after the Meiji restoration, in 1868, while China in the same period failed to do so. However, since 1978, China's macroeconomic performance has rivaled that of Japan. Maddison (2005, p.8) notes that the experience of China, particularly since the 1978 economic reforms, shows that China's economic growth has involved a very significant element of catch-up.

[5]According to the Chinese Statistical Yearbooks heavy industry refers to the industry which produces capital goods, and provides various sectors of the national economy with necessary material and technical basis. It consists of the following three branches according to the purpose of production or the use of products: (1) Mining, quarrying and logging industry refers to the industry that extracts natural resources, including extract ion of petroleum, coal, metal and non-metal ores and logging. (2) Raw materials indus-

Naughton (2007, p. 55) labels this development strategy "big push industrialization". Heavy industry makes intensive use of capital, yet capital was very scarce in the beginning of the leap-forward development strategy. To generate and allocate resources for heavy industrial development, China relied on mechanisms such as investment licenses and import quotas rather than a price mechanism working through markets.

Lin (1994, pp. 28-29) summarizes the key characteristics of this heavy-industry development strategy as consisting of low interest rates, an overvalued exchange rate, low wage rates, and low prices for raw materials and living necessities. Under the central plan raw material prices were kept low, and final good prices high, generating substantial surpluses in manufacturing and processing industries, which funded the government budget (Young, 2000).

The resulting misallocation of resources through government planning, from 1949 to 1978, did not bring sustainable economic development to China, i.e., low aggregate total factor productivity (TFP) growth. Chow (1993) finds that growth is almost entirely capital accumulation driven during 1952-1980 and TFP growth is absent. Borensztein and Ostry (1996) estimate the TFP growth is negative at about -0.7 percent average rate during 1953-1978.

Rosenberg (1994, pp. 105-106) argues that the Chinese government before 1978 did not give importance to the role of technological innovation in the attainment of an efficient industrial society and the preoccupation with "big-ness" in industry was hostile to technological innovation. Brandt and Sutton (2008) discuss that noneconomic policy objectives, weak institutions, and poor incentives are the underlying causes of productivity stagnation.

A simple aggregate growth accounting exercise suggests that the aggregate TFP is the single most important factor behind the aggregate output growth in the Chinese economy since 1978. This exercise decomposes the factors that contribute to GDP per working-age population as follows:

$$Y_t/N_t = TFP_t^{1/(1-\alpha)}(K_t/Y_t)^{\alpha/(1-\alpha)}(E_t/N_t), \tag{1}$$

where Y_t is the aggregate GDP, N_t is the economically active population, K_t and E_t are the quantities of capital and labor employed at time t and the capital share is given by α. TFP

try refers to the industry that provides various sectors of the national economy with raw materials, fuels and power. It includes smelting and processing of metals, coking and coke chemistry, chemical materials and building materials such as cement, plywood, and power, petroleum refining and coal dressing. (3) Manufacturing industry refers to the industry that processes raw materials. It includes machine building industry which equips sectors of the national economy, industries of metal structure and cement products, industries producing means of agricultural production, such as chemical fertilizers and pesticides.

represents total factor productivity and the power $1/(1-\alpha)$ represents the magnification effect of TFP. An increase in TFP generates a proportionate increase in the capital stock, so the capital intensity factor, $(K_t/Y_t)^{\alpha/(1-\alpha)}$, represents only the part of capital accumulation not induced by TFP growth.

According to the results in Table 1, over the period 1978-2005, GDP per economically active person grows at 7.45 percent per year, which is completely accounted for by a 9.67 percent growth rate in TFP factor, which implies that the average annual growth in TFP between 1978 and 2005 is 4.85 percent.[6] These results suggest that most of the fluctuations in output per working-age person are due to changes in the TFP factor, rather than to changes in the capital-output ratio or in the employment rate.[7]

Table 1: Growth Accounting

	Average annual rate of growth in percents		
Sources of Growth	1978-1984	1984-2005	1978-2005
GDP per economically active person, Y_t/N_t	6.05	7.85	7.45
TFP Factor, $TFP_t^{1/(1-\alpha)}$	8.92	9.89	9.67
Capital Intensity Factor, $(K_t/Y_t)^{\alpha/(1-\alpha)}$	-2.65	-1.06	-1.42
Employment Rate, E_t/N_t	0.01	-0.80	-0.62

Several previous studies find that TFP growth ranges around or above 3 percent per year since the beginning of the economic reforms and my findings are consistent with these studies.[8] Blanchard and Giavazzi (2006, Table 4) and Cao, Ho, Jorgenson, Ren, Sun, and Yue (2009, Table 1) report the estimates of TFP growth computed by various studies. These studies cover different periods and employ different methods, and a complete account of their differences and a reconciliation of their results with my findings are beyond the scope of this paper.

[6] Aggregate labor, capital, and output are obtained as the summation of the sectoral figures that I discuss in the related sections. I set the capital share as $\alpha = 0.487$ following Bai, Hsieh, and Qian (2006). They discuss the changing nature of the importance of capital and labor in the aggregate economy, and argue that the average labor share between 1978 and 2005 is 51.3 percent. I measure population as those who are aged 16 and over who are capable to work, rather than the total population based on the definitions of *CSY*.

[7] These results do not reflect any adjustments for the contribution of human capital and other such factors (Heston and Sicular, 2008). Lee and Malin (2010) find that about 13 percent of aggregate growth in output per worker from 1978 to 2004 is accounted for by an increased education, with 11 percent coming from through the labor-reallocation channel and 2 percent attributable to increased within-sector human capital.

[8] For example, Perkins and Rawski (2008) obtain TFP growth of 3.8 percent per year for 1978 - 2005 net of the contribution of rising education levels.

3 Structural Transformation

The Chinese economy is divided into three broad sectors: agriculture, industry, and services. They are also known as primary, secondary, and tertiary, respectively. *Primary* refers to agriculture, forestry, animal husbandry and fishery. *Secondary* refers to mining and quarrying, manufacturing, production and supply of electricity, water and gas, and construction. *Tertiary* refers to all other economic activities not included in primary or secondary industry.

Reallocation of Labor from Agriculture. The most striking feature of the structural transformation of the Chinese economy is seen on shifts in the pattern of employment. I use two sources for employment data: the Chinese Statistical Yearbook of the National Bureau of Statistics of China (CSY) and Holz (2006). Holz (2006, p. 57) and Brandt, Hsieh, and Zhu (2008) discuss the problems regarding the total and sectoral employment series reported in CSY. Brandt, Hsieh, and Zhu follow Holz's method to get the revised sectoral employment data. Holz (2006, Appendix 13) reports the revised employment values (end-year), where he revises the period 1978-1989.[9]

Figure 3 displays the evolution of sectoral employment shares based on revised employment data in China between 1978 and 2005. Agricultural employment share falls rapidly in the early stages of economic reforms, at low levels of income, giving rise to rapid increases in the share of non-agricultural sector in total employment. Even though the importance of agriculture in China's economy falls, it is still a large sector, accounting for more than 40 percent of employment in 2005.[10]

The employment share of the service sector climbs from 12.2 percent in 1978 to 31.3 percent in 2005. The employment share of the industrial sector does not rise as fast as that of the service sector during the period 1978-2005. Banister (2005) argues that manufacturing employment in China increases during the 1980s and early 1990s, peaks in about 1995-1996, declines during the late 1990s until 2000-1, and increases again 2002. Brandt, Rawski, and Sutton (2008) argue that the stagnation of employment in the secondary sector is due to the result of the massive state-owned enterprise (SOE) layoffs since the

[9]Prior to 1990, the published economy-wide number of laborers constituted the sum of laborers across industrial sectors. Since 1990, the economy-wide number of laborers exceeds the sum across industrial sectors significantly in each year, but continues to, as in all reform years, equal the sum across economic sectors. Since the economy-wide number following the new time series for the years after 1990 is the one compiled according to international definitions of employment, the economy-wide number of laborers in the years prior to 1990 was adjusted following the population censuses of 1982 and 1990 (later-year official values rely on population census data).

[10]De-agriculturalization fosters the urbanization and off-farm migration facilitates the development of the nonagricultural sectors in the Chinese economy. The share of rural population in the total is falling, but remains high at 57.0 percent in 2005.

mid-1990s.

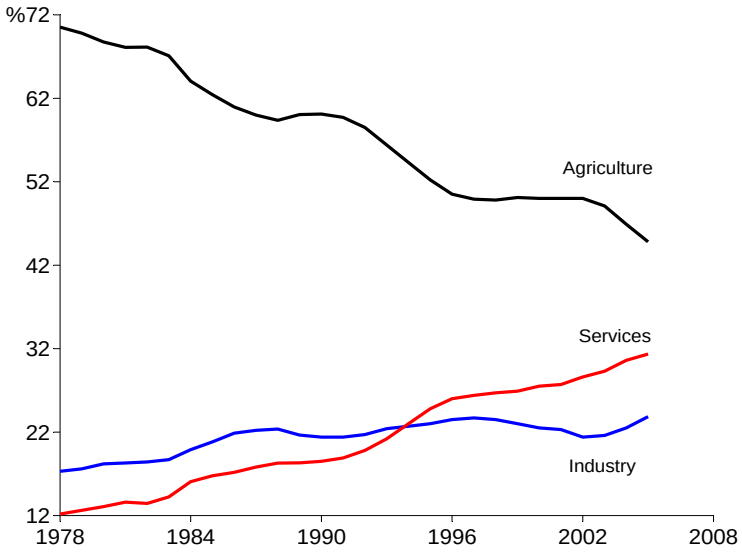

Figure 3: Employment Shares

The Measurement of Sectoral Output. The primary sector's share of GDP (at current prices) declines from 27.9 percent in 1978 to 12.6 percent in 2005. On the other hand, GDP share of the tertiary sector increases from 24.2 percent in 1978 to 39.9 percent in 2005. The secondary sector dominates the production structure with the average share of this sector in total GDP is 45.3 percent over the sample period.

For output statistics in China, the deflators used to measure sectoral real output are the major points of the discussion.[11] Holz (2006) offers the following approach: The output series rely on the post-economic census benchmark revision data as far as the revisions reach back. Holz uses real growth rates calculated from the first published implicit deflator and nominal values whenever feasible. First, nominal values are post-economic

[11]Ruoen (1997, p.122) and Young (2003) compare the sectoral implicit GDP deflators with the independent survey based price indices and they suggest alternative price indices instead of the implicit deflators. They choose the index for "overall farm and sideline products purchasing price" as an alternative for a primary industry index. Ruoen chooses "industrial products producer index" to serve as the deflator for the secondary industry. Young compares Ruoen's choice with two other possible alternatives: the industrial products rural retail price index and the retail price index. Young argues that the Ruoen's choice is a superior deflator. For tertiary industry, Ruoen uses the index for services from the overall residents' consumer price indices. Young has a similar approach and combines urban service price index and the overall service price index. Chow (2004) argues that Young's method leads to serious errors, and that his findings contradict the alternative estimates of the rates of growth for the periods 1978-1998 and 1988-1989 provided by Young. Dekle and Vandenbroucke (2009) follow Young's methodology to choose the sectoral deflators. On the other hand, Bosworth and Collins (2007) prefer to use the official output data for the primary and tertiary sectors and the alternative (the ex-factory industrial price index) only for the secondary industry.

census values across all sectors after 1993, all other nominal values are not revised, and the earlier published nominal values are used in those instances. Second, the output values are in constant year 2000 prices, which imply applying real growth rates to year 2000 (post-economic census) nominal value added in order to obtain time series of constant price output. First published implicit deflators are available for the primary, secondary, and tertiary sector after 1987.

Figure 4 displays the evolution of value added shares at constant 2000 prices (yuan) between 1978 and 2005. In 1978, agriculture captures 40.0 percent of the Chinese value added, while in 2005 it has the lowest contribution to Chinese total value added, with 11.5 percent. The value added share of the secondary (tertiary) sector increases from 31.8 (28.1) percent in 1978 to 46.0 (42.5) percent in 2005. China's real output in the secondary (tertiary) sector grows at an average annual rate of 11.6 (11.8) percent since 1978.

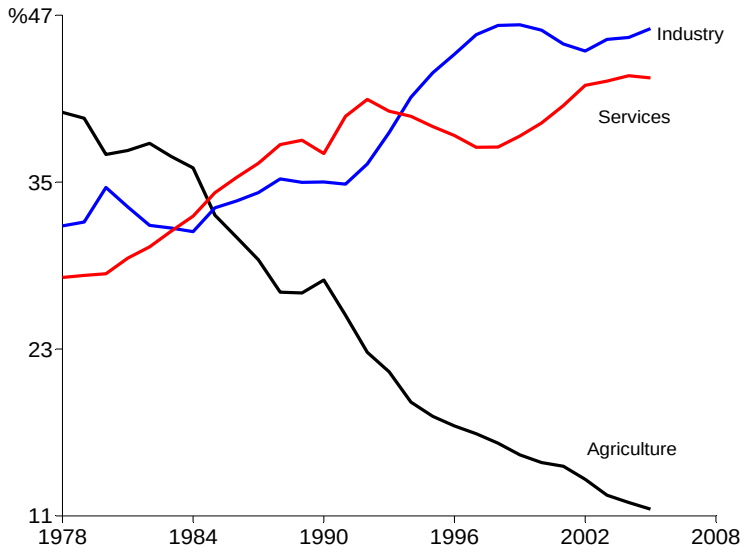

Figure 4: Real GDP Shares

Capital by Sector. The Chinese official statistics provide no standard estimation of the capital stock at any industry level or by any category. The sectoral gross fixed capital formation (GFCF) data are available only at the provincial level and only for 1978-95, where the total sectoral provincial GFCF accounts for an average of 78.86 percent of the annual value of national GFCF.

I follow Holz (2006) to construct the sectoral GFCF data for the period 1978-95. GFCF is divided into the three main economic sectors using sectoral share values available for the individual provinces in GFCF 1978-95. Provincial sectoral shares are shares in the

provincial sum-across sector-GFCF value. Holz (2006) uses GDP shares of the three sectors to allocate the nation-wide GFCF into these sectors. However, these shares seem to overstate investment in agriculture, since agriculture's share in production is very high compared to the capital formation rate. To avoid such a bias, I use the shares of the year 1995 that I compute from Hsueh and Li (1999) for the remaining years, 1996-2005.[12,13]

The ideal index to deflate nominal investment figures is the price index of investment in fixed assets. The CSY, however, began to provide this index only after 1993. Jefferson, Rawski and Zheng (1996) estimate China's price index of investment in fixed assets between 1979 and 1992. Zhang (2006, p. 290) argues that the estimates of Jefferson, Rawski and Zheng are consistent with the official figures since both sources estimate their indices by averaging the deflators of construction/installation and machinery/equipment purchases; and constructs China's price index of investment in fixed assets between 1978 and 2000. Using the CSY, I extend this index to the year 2005. Zhang (2006) does not report the value of the index for the year 1978. I take the value in 1979 as the corresponding observation for the year 1978.

Sectoral capital stock series are calculated using the perpetual inventory approach with 10 percent depreciation rate.[14] The initial capital stock series in each sector is calculated by the formula $I_{j0}/(g_j + \delta)$, where I_{j0} is the first year of the sectoral real investment series, g_j is the average growth of the sectoral investment in the first five years of the sectoral real GFCF series, and δ is depreciation rate. This approach ensures that the 1978 values of the capital stocks are independent of the 1978-2005 data used in our analysis. Moreover, given the relatively small capital stocks in 1978 and the high levels of investment, the estimates for later years are not sensitive to the 1978 benchmark values of the capital stocks. All real series are valued at 2000 prices.

Figure 5 plots the (real) capital-output ratios for the whole economy, and by sector. The average capital-output ratio for the entire economy is 1.96 for the sample period.[15] The

[12]Hsueh and Li (1999, p.137) define their methodology as follows: "According to the type of industry, gross fixed capital formation can be divided into the investment by the primary, secondary and tertiary industrial sectors. The principle behind this division according to industrial sectors is the nature of the production activities undertaken after the construction units have completed the projects or have handed them to be put into production, or the particular nature of production that other social economic activities take in the process of production."

[13]An alternative methodology described in Dekle and Vandenbroucke (2009), following Young (2003), is to construct the sectoral GFCF data as follows: they pursue a similar approach for the period of 1978-95, except that they use the sum of provincial total GFCF value for the nation-wide GFCF. For the years after 1995, they obtain the distributional GFCF data from the individual Provincial Statistical Yearbooks, and aggregate across the provinces. They use the sectoral distribution reported in Hsueh and Li (1999) to allocate overall national GFCF between the three sectors.

[14]Bai, Hsieh, and Qian (2006) argue that 10 percent is a plausible number for the period 1978-2005.

[15]Bai, Hsieh, and Qian (2006) estimate that the average nominal capital-output ratio between 1978 and

capital-output ratios in agriculture and services demonstrate U-shape patterns since 1978. The capital-output ratio in agriculture (services) increases after 1995 (1993). In contrast, there is a reduction in the capital-output ratio in industry, starting with value of 4.91 in 1978 and falling to about 1.63 in 2005, reflecting the higher efficiency of capital in industry.

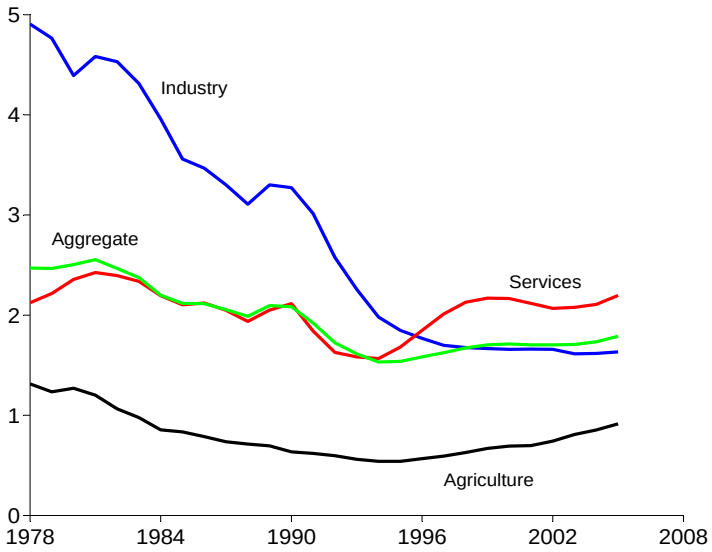

Figure 5: Capital-Output Ratios

The capital intensity and the investment rate increase after 1997 consistent with the fact that the capital share of aggregate income increases steadily. The investment rate increases from 31.80 percent in 1997 to 41.49 percent in 2005, whereas the period average is 31.68 percent during 1978-2005.[16] Capital formation increases the capital stock which, in turn, expands production capacity. Bai, Hsieh, and Qian (2006) interpret this observation as a gradual restructuring of China's industrial sector, in favor of more capital-intensive industries, requiring higher aggregate investment rates in the steady state.

4 Sectoral Growth Accounting and Economic Reforms

Framework. I assume that capital and labor are the two primary production factors for each sector. Moreover, land is the third input in the production of the agricultural goods,

2005 is 1.46.

[16] I use the expenditure components of GDP as investment rate and follow Young (2003) by expressing it as the ratio of gross fixed capital formation to nominal GDP (see CSY, Table 3.12).

it is a nonreproducible factor, constant and also it does not depreciate.[17] Since it is constant, its contribution is submerged in the TFP of the agricultural sector. I specify the technologies at the sector level and employ the Cobb-Douglas functional form. The production function for the agricultural sector is:

$$Y_{At} = TFP_{At} K_{At}^{\upsilon} E_{At}^{\theta}. \tag{2}$$

K_{At} and E_{At} are the quantities of capital and labor employed in agriculture at time t. Y_{At} is the sectoral output produced in this sector and TFP_{At} is the agricultural TFP at time t. The share parameters for capital and labor in are given by υ and θ, respectively ($\upsilon + \theta < 1$). The agricultural production function is consistent with a literature on cross-country agricultural production functions (Vollrath 2009).

Non-agricultural goods are produced using two factors of production, capital and labor, combined in constant returns to scale technology in secondary and tertiary sectors:

$$Y_{jt} = TFP_{jt} K_{jt}^{\alpha_j} E_{jt}^{1-\alpha_j}, \quad j \in \{industry, services\}. \tag{3}$$

K_{jt} and E_{jt} are the quantities of capital and labor employed in sector j at time t. Y_{jt} is sectoral output, TFP_{jt} is sectoral TFP at time t, and α_j denotes the capital share of sector j.

Sectoral TFPs and Growth Accounting. Data for labor, capital, and output are discussed in the previous sections.[18] I need to determine the sectoral factor shares to conduct sectoral growth accounting exercises. Holz (2006) reports the time series for the sectoral labor shares in the primary, secondary, and tertiary sectors in the Chinese economy during 1978-2002; and calculates the labor share by sector as the share of labor remuneration in the sum of labor remuneration, depreciation, and operating surplus.[19] Holz calculates

[17] Agricultural land has been almost a fixed quantity since 1952 in China. The average annual growth rates of cultivated land area and total sown land area were 0.35 and 0.18 percent during 1952-2005, respectively. (China Data Online, Production condition for agriculture of China, http://chinadataonline.org/)

[18] Note that labor input is measured in stock terms as the number of persons employed in a sector at the end of each year. This measure, changes in labor input measured by persons employed, does not reflect changes in hours worked per full-time and part-time worker, or changes in the shares by sector of total employment. However, I do not have time-series data on hours worked as the labor input measure. A better measure would be total number of hours worked, broken down by type of labor input. Data on the number of persons employed or number of jobs, by sector can generate biased measures of productivity if hours per person change (OECD, 2001).

[19] Net taxes on production are split proportionally between labor and capital, where capital's share is measured by the sum of depreciation and the operating surplus. Since there is no national data on these sources of renumeration, all shares are based on the sum of provincial values. Holz also notes that all values are pre-economic census values; revised values have so far not been released, and are unlikely to be forthcoming. Since the sum provincial pre-economic census value added comes very close to the post-economic census national value added, these provincial pre-economic census values may be quite accurate

that the average labor income shares in the primary, secondary, and tertiary sectors are 0.884, 0.475, and 0.502, respectively between 1978 and 2002.[20] I use these figures as the sectoral labor shares for the entire period. I assume identical capital and land shares in agriculture following Dekle and Vandenbroucke (2009). Turning to sectoral capital input in the secondary and tertiary sectors I take the share of capital by sector to be simply one minus the share of labor.

Figure 6 shows the actual path of sectoral TFPs in China between 1978 and 2005.[21] TFP growth in Chinese agriculture averages 4.55 percent per annum between 1978 and 2005. The average growth rate of TFP in the secondary sector is the highest of the three sectors. TFP growth in the secondary sector averages 6.11 percent per annum and TFP growth in the tertiary sector averages 2.91 percent per annum between 1978 and 2005.

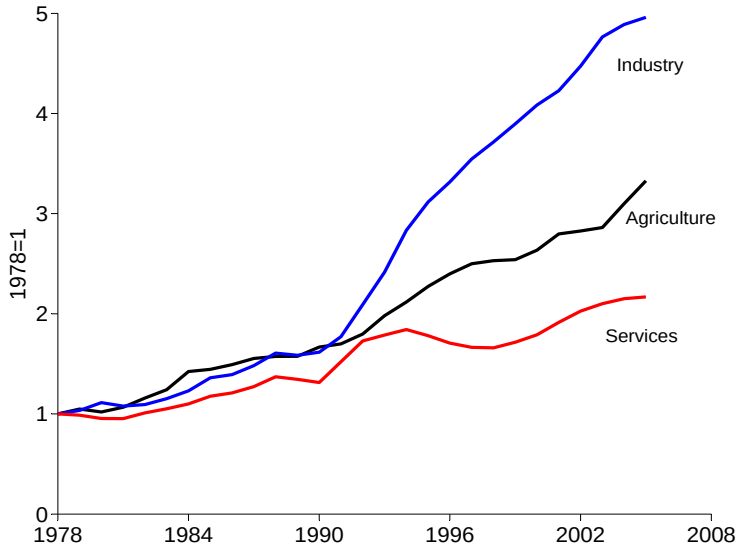

Figure 6: TFP by Sector

All sectors experience declines in TFP growth rates during the late 80s. This coincides with the violent repression of the student movement at Tiananmen Square in June of 1989, which puts a temporary end to the steady liberalization of the Chinese economy and leads to temporary re-centralization of many economic activities (Naughton 1995, p. 4).

(Holz, 2006, Appendices 32 and 33).

[20] Young (2003) argues that the labor share in the non-agricultural sector increases steadily between 1978 and 1995 and is slightly below 0.5.

[21] I observe that agricultural TFP growth is not affected significantly in the presence of land. That's why I exclude the land, for the rest of the analysis, from the production function so that the agricultural production function looks like the other two sectors' production functions.

In order to measure the contribution made by factors of production relative to that made by TFP, I conduct a growth accounting exercise at the sectoral level.

$$Y_{jt}/E_{jt} = TFP_{jt}^{1/(1-\alpha_j)}(K_{jt}/Y_{jt})^{\alpha_j/(1-\alpha_j)}, \quad j \in \{primary, secondary, tertiary\}. \tag{4}$$

The first term on the right of (4) is the sectoral TFP factor in sector j. The second term measures the sectoral capital intensity factor. The power $1/(1-\alpha_j)$ represents the magnification effect of sectoral TFP that an increase in TFP generates a proportionate increase in the sectoral capital stock, so the capital intensity factor represents only the part of sectoral capital accumulation.

Table 2 reports the average annual growth rate of sectoral GDP per worker and its factors shown for post-reform China.

Table 2: Sectoral Growth Accounting

	Average annual rate of growth in percents		
Economic Activity / Sources of Growth	1978-1984	1984-2005	1978-2005
Agriculture			
Output per Worker	5.88	4.73	4.98
Capital Intensity Factor	-0.94	0.04	-0.18
TFP Factor	6.88	4.68	5.17
Industry			
Output per Worker	3.37	9.76	8.31
Capital Intensity Factor	-3.87	-4.55	-4.40
TFP Factor	7.53	14.99	13.29
Services			
Output per Worker	3.75	6.66	6.00
Capital Intensity Factor	0.54	0.00	0.12
TFP Factor	3.19	6.65	5.87

Real GDP per worker of the primary sector grows by 5.88 percent average annual growth rate during 1978-1984. Rapid growth rate in the wake of the early post-1978 reforms then falls to an annual average rate of 4.73 percent for the years between 1984 and 2005. For the primary sector, there is no increase in capital intensity: between 1978 and

1984, the capital-output ratio declines. A high per-worker GDP growth rate is brought by a very high TFP growth. This observation is consistent with earlier findings. For example, Stavis (1991) views that technological change is the engine of agricultural growth for the period 1978-1984.

What caused the high TFP growth rate in agriculture in the early reform period? China adopted a strategy of gradual economic transformation that maintained the existing system and created new economic activities on top of it. Between 1978 and 1984 significant developments took place agriculture. In the early reform period (1978-1984), the household responsibility system (HRS), which replaced the production team system as the unit of production and income distribution, significantly increased agricultural productivity transferring the collective agricultural production system to individual farms by contracting land-use rights to individual rural households, price and marketing reforms improving the peasants' work incentives (see, for example, Lin 1988, 1994; Lin, Cai, and Li 2003, Chapter 5; and Naughton 1995, Chapter 4 for details of the HRS).

Lin (1988) argues that the failure of the collectivization period is not due to its socialist nature but it is because of the difficulties inherent in supervising agricultural work. Farmers are residual claimants in the HRS. Since the end of the year 1978 the HRS has gradually replaced the commune system. By the end of 1983 less than 3 percent of households had not adopted the responsibility system. This suggests that the institutional transformation from a collective to the HRS of farm management was essentially completed by the mid 1980s. The decline in the growth rate, according to this view, has been associated with the completion of one-off effects of the HRS since the institutional reforms were one time only events. Huang and Rozelle (1996) argue that earlier studies may have over-estimated the impact of decollectivization.

There are important reforms in the non-agricultural sectors: gradual reduction of centralized controls on prices, inputs and outputs, and the rising share of production outside of the state enterprise sector; and the freedom of townships and villages to establish industrial enterprises outside of the central plan (Jian, Sachs, and Warner, 1996).[22]

China's real output per worker in the secondary sector grows at an average annual rate of 8.31 percent since 1978. Brandt, Rawski, and Sutton (2008) divide reforms in the

[22]One of the major institutional features of the Chinese economy is the coexistence of state-owned enterprises (hereafter, SOEs) and non-state sector. The non-state sector, including private enterprises, joint ventures, urban collectives, and township and village enterprises (TVEs), has crowded out SOEs in many markets. TVEs are economic units which are either collectively owned by local residents in the rural areas of China or mainly owned and controlled by the peasants (Fu and Balasubramanyam, 2003). Brandt and Zhu (2001) make clarification for the definition of the non-state sector: although it does include private enterprises and joint ventures, until recently the non-state sector was primarily made up of urban collectives and TVEs.

secondary sector into two periods: reforms concentrated on incentives and market mechanism to prevent resource misallocation problem. Beginning in the mid-1990s, the privatization and subsequent stock market listing of SOEs have been integral parts of China's state enterprise reforms. In the beginning of the reform period, SOEs dominated the industrial structure.

In the secondary sector, policies were introduced to increase the autonomy of enterprise managers, to reduce the dominance of planned quotas, and to allow enterprises to produce and sell goods in the market. More market-oriented polices have emerged with the growing importance of the urban private sector, as SOEs are being downsized and the real sector of the economy has been liberalized substantially and goods and factor markets have become increasingly competitive.

Huang and Duncan (1997) discuss that studies of TFP in the state sector have different results: some studies find no TFP growth during the post-1978 period; some other studies argue that state sector has positive TFP growth during the reform period. Liu and Otsuka (2004) show statistically that in order for SOEs to compete with TVEs, a major ownership reform of SOEs is essential.

Real GDP per worker of the tertiary sector grew by 6.00 percent average annual growth rate during 1978-2005. The production of services is likely to become increasingly important to China's overall economic development over the coming decades. Being a World Trade Organization (WTO) member since 2001, increased market access has opened new economic opportunities for China, with an expected favorable impact on trade and investment for years to come. Services created 27.15 million new jobs, which was 85 percent of all employment creation, during the 9th Five-Year Plan, 1995-2000 (OECD 2003).

5 Foreign Trade

From 1949 to 1978, China was a planned economy and trade flows were entirely controlled by the state. Since 1978, China has been moving toward a market economy and, thus, a more liberal trade system. In 1980-81 four special economic zones (Shantou, Shenzhen, Xiamen, and Zhuhai) were established. These zones were new areas created in localities far away from the power center and concentrated on the southern coast of China. Some argue that China's rapidly growing coastal provinces have benefited from the proximity to the Chinese-speaking economies of Hong Kong and Taiwan (see, for example, Goodfriend and McDermott 1998 and Naughton 1996).

China has attempted different reforms in three broad areas to liberalize foreign trade: the gradual elimination of central plans and the introduction of market competition in

the tradable sectors; the reduction of barriers to trade including both tariff and non-tariff restrictions; and the reform of the foreign exchange regime. The rate of decreases in trade barriers has increased especially in the 1990s.[23]

Figure 7 shows the evolution of the effective tariff rates in China between 1952 and 2005. The effective tariff rate is defined as the ratio of tariff revenue to total imports.[24]

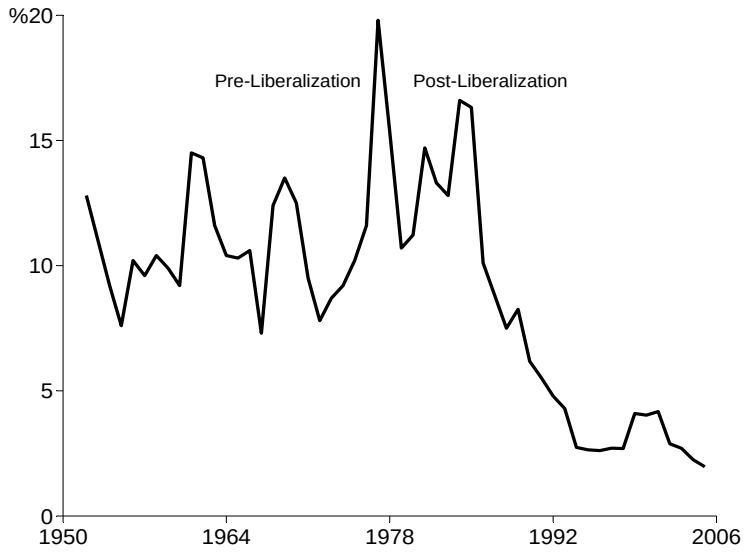

Figure 7: Effective Tariff Rates

The effective tariff rate was 12.8 percent in 1952 and 2.0 percent in 2005. The figure is divided into two parts indicating pre-and post-liberalization episodes and it makes a peak in 1977, just before the reforms that were started in 1978 towards a transition from rigid central planning toward a market-based economy. The effective tariff rate has been always less that 10 percent after the year 1986.

The second phase of liberalization started in 1992. It was not until 1992 when China declared its intention to establish a so-called socialist market economy that it began to lower tariffs. Many major changes started in 1992, i.e., preferential policies, such as generous tax holidays and credit matching, were given to foreign investors. Foreign direct

[23]The government reduced the number of export goods subject to quota-license regulation from 212 to 183 in 1992 and eliminated import-quota license requirements for 16 classes of goods. Import license requirements for 9 classes of goods that comprise 283 goods were eliminated in 1993. Next, the government stopped issuing mandatory plans for imports and exports in 1994 as well as the elimination import license requirements for 195 goods. It was followed by another elimination of import license requirements for 120 goods in 1995. Lastly, in 1996, 30 percent of the remaining quotas were eliminated (see Shuguang, Yansheng, and Zhongxin 1998, Table 2.1 for the details in tariff and non-tariff changes).

[24]The data are from Kanbur and Zhang (2005) for the period 1952-77 and the CSY (2006, Tables 8.3 and 18.3) for the period 1978-2005.

investments surged to US$ 11.3 billion in 1992 from US$ 4.6 billion the year before (Bao, Chang, Sachs, and Woo 2002). China officially started its WTO membership application in 1986 and she formally became a member of the WTO on 11 December 2001. WTO accession gives China greater access to the world's markets. As a result of the negotiations, China has agreed to undertake a series of important commitments to open and liberalize its regime in order to better integrate in the world economy and offer a more predictable environment for trade and foreign investment in accordance with WTO rules.

Dynamic Changes in Comparative Advantage. The composition of international trade has changed considerably in the post-1978 period. The declining role of agriculture in total employment and output is accompanied by a declining share of primary goods' trade in China's total commodity trade.[25] In 1980, primary goods' share in total commodity trade was 42.15 percent. By 2005, it declined to 13.84 percent (CSY 2006, Tables 18.5 and 18.6). On the other hand, the share of manufactures in total exports increased. Table 3 breaks down the Chinese nominal trade balance (in current billion U.S. dollars) in 1984 and in 2005 into industries using one-digit SITC codes.

Table 3 shows that China imports raw materials and chemicals (SITC industries 2, 3 and 5) and exports manufactured goods (SITC industries 6, 7 and 8). Similarly, decomposing China's real export growth since 1992, Amiti and Freund (forthcoming) find that there has been a significant decline in the share of agriculture and soft manufactures, such as textiles and apparel, with growing shares in hard manufactures, such as consumer electronics, appliances, and computers.

Dean and Lovely (forthcoming) study the trends in the composition of China's trade and find significant changes in the sectoral composition of Chinese trade between 1995 and 2005. For example, in 1995, textiles and apparel accounted for the largest shares of Chinese exports to the world. These shares fell by about a third by 2004, while the export share of office and computing machinery grew by a factor of five, and that of communications equipment more than doubled. The largest shares of Chinese imports in 1995 were attributable to textiles and machinery. These shares fell by about 70 percent and 40 percent, respectively, by 2004, while import shares in office and computing machinery and in communications equipment more than doubled. Dean and Lovely aggregate the Chinese trade data to HS (6-digit) and then convert to ISIC Rev. 3 using the official Chinese concordance.

SITC industries at the one-digit level are rather broad, and some important details about changes in the structure of Chinese trade are likely to be obscured. In a compan-

[25]Primary goods include food and live animals used chiefly for food; beverages and tobacco; non-edible raw materials; mineral fuels, lubricants and related materials; animal and vegetable oils, fats and wax.

Table 3: Chinese Trade Balance in current billion US$

SITC Code	Industry	1984	2005
0	Food and Live Animals	0.9	13.1
1	Beverages and Tobacco	-0.01	0.4
2	Crude Materials, Except Fuels	-0.1	-62.7
3	Mineral Fuels, Lubricants and Related Materials	5.6	-46.7
4	Animal and Vegetable Oils, Fats and Waxes	0.1	-3.1
5	Chemicals and Related Products	-2.7	-41.2
6	Manufactured Goods Chiefly by Materials	-2.1	49.2
7	Machinery and Transport Equipment	-5.7	61.6
8	Miscellaneous Manufactured Article	3.3	132.0
9	Commodities Not Classified Elsewhere	-0.6	-0.4

Source: United Nations Statistics Division, Commodity Trade Statistics Database

ion to the analysis of Table 3, I conduct an exercise in which I compute the specialization indices of China using one-digit SITC codes. Kwan (2002, pp. 15-17) argues that the revealed comparative advantage of a country can be shown by calculating the specialization indices for its major industries. For a particular industry, the specialization index is defined as its trade balance divided by the volume of two-way trade, with a higher value implying stronger international competitiveness for the industry concerned.

Following Kwan (1994), a country's comparative advantage structure (as revealed by its trade structure) can be classified into one of four categories based on the relative magnitude of the specialization indices of the country's primary commodities (SITC Rev. 2, sections 0 - 4), machinery (SITC Rev. 2, section 7, a proxy for capital-and-technology-intensive products), and other manufactures (SITC Rev. 2, sections 5, 6, 8, 9, a proxy for labor-intensive products).

A country typically passes from one category to another in the following sequence: (i) the developing country stage, with primary commodities more competitive than other manufactures and machinery; (ii) the young NIE (newly industrialized economy) stage, with other manufactures becoming more competitive than primary commodities, which maintains its lead over machinery; (iii) the mature NIE stage, with machinery overtaking primary commodities while other manufactures maintain their overall lead; and (iv) the industrial country stage, with machinery overtaking other manufactures, which maintain

their lead over primary commodities.

Figure 8 shows the development of China's trade structure between 1984 and 2005 in terms of broad sectors of merchandise trade.

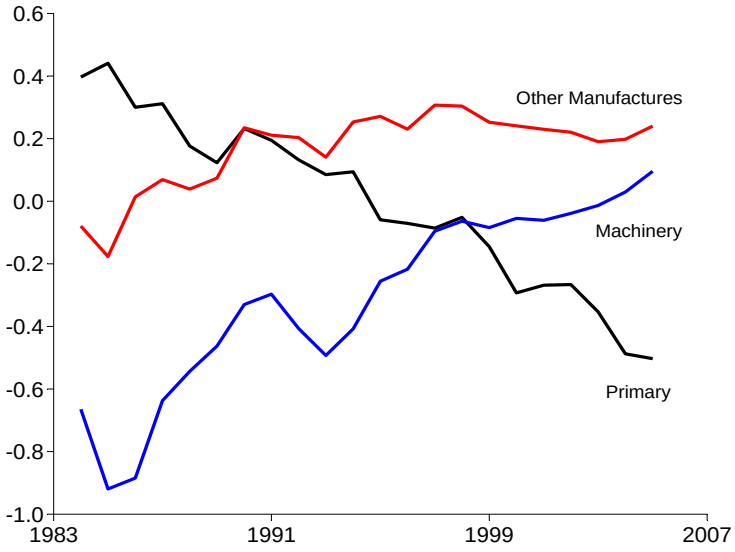

Figure 8: Stages of China's Trade Structure

Figure 8 exhibits that China became a young NIE in 1991, when the specialization index of other manufactures surpassed that of primary commodities. Subsequently, it attained the mature NIE stage in 1999, when the specialization index of machinery also overtook that of primary commodities. In 1984, the specialization indices for China indicated that machinery and transport equipment (SITC 7) were the lowest, while the highest was for the miscellaneous manufactured articles (SITC 8). If the current trend in the sectoral specialization indices continues, the specialization index of machinery may overtake that of other manufactures in the near future.

Trade in New Products. Another dimension of the changing nature of China's comparative advantage is the observation of the emergence of previously non-exported products. Hummels and Klenow (2005) and Kehoe and Ruhl (2009) decompose the growth of individual countries' trade into that part due to countries exporting new products - what they call the "extensive margin" - and that part due to countries exporting more of the same products - the "intensive margin".

I perform the following new goods in trade exercise based on Kehoe and Ruhl (2009). I take four-digit SITC (Rev. 2) bilateral trade data obtained from United Nations Commodity Trade Statistics Database for the years between 1985 and 2005. There are 786 cat-

egories of goods in these data. First, I rank categories in order of base-year exports, from categories with the smallest amount of trade to the categories with the largest amount. Second, I form ten sets of "10 percentile" export groups by cumulating export product categories - the first 677.08 categories account for 10 percent of exports, for example; the next 50.56 categories account for 10 percent of exports; the next 15.72 categories account for 10 percent of exports; and so on. Third, I calculate the share of exports in subsequent years accounted for by each set of categories.

Figure 9 shows the values of the 10 sets of codes in 1985 for Chinese exports to the rest of the world.

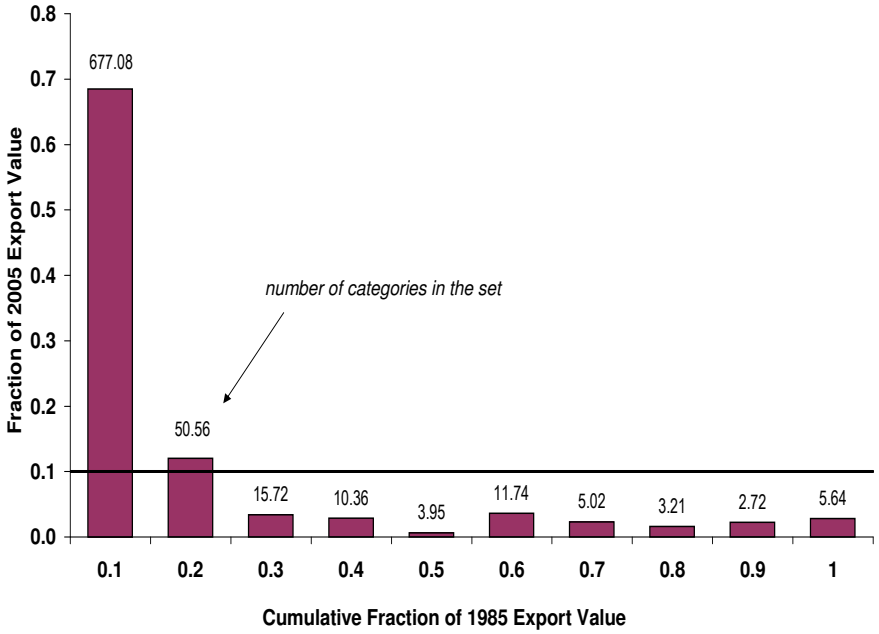

Figure 9: Composition of Exports: China to the Rest of the World

The numbers above each bar in the figure are the number of SITC codes needed to account for 10 percent of the trade flow and the bars are the fractions of trade in 2005. The trade data do have the very large positive spike in share of trade accounted for by the least traded goods even though the movements in the shares of the trade shares of the highest nine sets of goods are not uniform.

Figure 9 shows that the largest increases in the share of exports occur for those sets of categories that accounted for the smallest amount of trade in 1985. The 677.08 smallest categories of exports from China to the rest of the world accounted for 10 percent of exports in 1985, but in 2005 these same 677.08 categories accounted for 68.50 percent of

exports.

Figure 10 depicts the evolution, over the period 1985-2005, of the export shares of the set of categories least traded in 1985. The share of the least-traded goods in total exports has increased gradually and continuously over time. The goods exported from China that were the least traded in 1985 account for a disproportionate portion of growth in trade.[26]

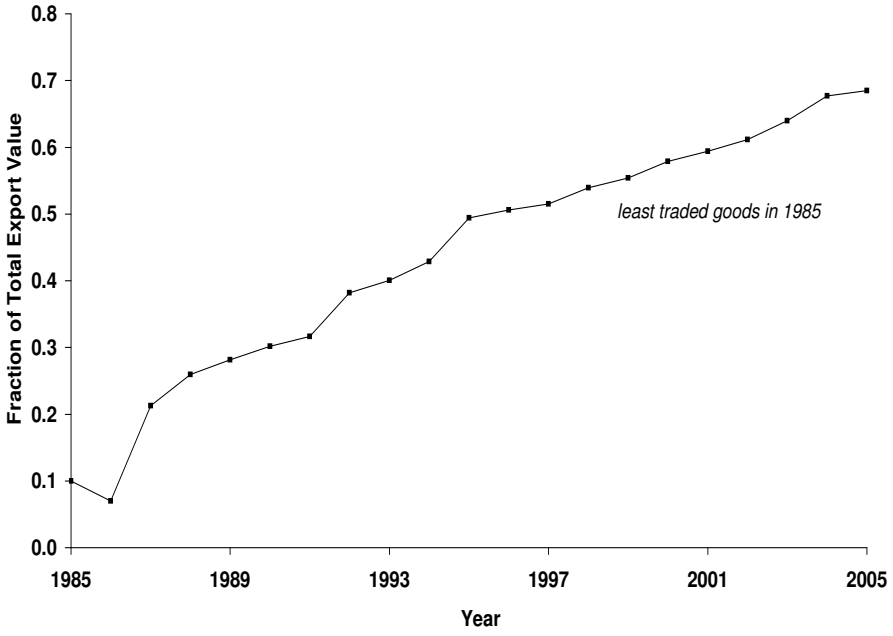

Figure 10: Export Shares of the Set of Categories Least Traded in 1985

The findings suggest that the goods exported from China that were the least traded in 1985 account for a disproportionate portion of growth in trade, and document the expansion in export varieties from China due to the acceptance into the World Trade Organization after the year 2001 (see, also, Kehoe and Ruhl 2009 for similar findings).

Exchange Rate. Figure 11 shows the nominal exchange rate of the RMB in Japanese yen and in U.S. dollars between 1981 and 2005.[27] I observe a stable parity around 8.3 Yuan / US$ after a major devaluation of the RMB in 1994. On 21 July 2005, the government of China revalued the RMB against the dollar-though by only 2.1 percent-and announced the implementation of a new managed floating system (Frankel 2006).

[26]Broda and Weinstein (2006) note that China exported 710 different goods to the United States in 1972 as opposed to 10,315 in 2001.

[27]The name of the Chinese currency is the renminbi (RMB) and its unit is the yuan. I use them interchangeable.

During most of the period between 1994 to the present day, the U.S. has had a substantial trade deficit in Sino-American trade. McKinnon and Schnabl (2006) argue that this common presumption of RMB undervaluation is wrong, and its appreciation need not reduce China's trade surplus but would cause serious deflation in China. Groenewold and He (2007) estimate the effect on the US - China trade balance of a revaluation of the RMB and present a range of computations but, likely, changes in the value of the RMB are not predicted to make much inroad into the trade imbalance between the US and China - a 10 percent revaluation is likely to improve the trade balance by less than 10 percent.

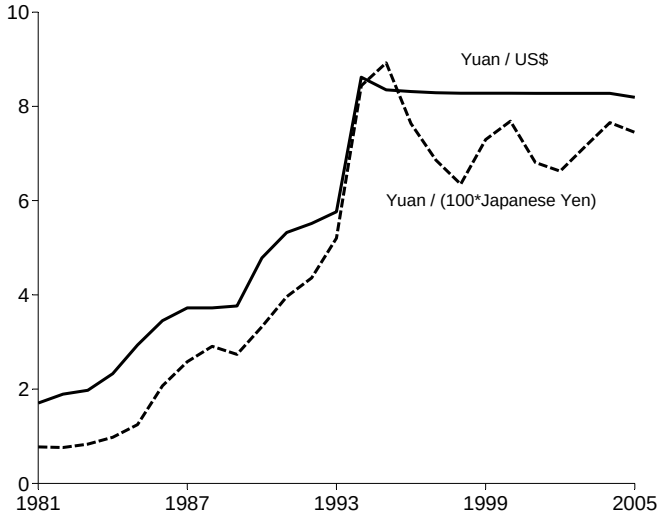

Figure 11: Nominal Exchange Rate of the RMB

Some argue that China's exchange rate policy artificially holds down the value of the yuan to the detriment of U.S. manufacturing output and employment in both import-competing and exporting industries (see, for example, Goldstein 2004; Holtz-Eakin 2003; and Hua 2007).[28] Schott (2008) argues that manufacturing in industrialized countries is more exposed to direct competition from China and industrialized countries should compete with China by raising the quality of their exports.

[28]There is some empirical evidence that changes in exchange rate, in terms of appreciation and depreciation of and volatility in exchange rates, have an important influence on domestic employment. Gourinchas (1999) finds that traded sectors' job creation and destruction are very responsive to real exchange rate movements studying firm level data in France between 1984 and 1992. Klein, Schuh, and Triest (2003) find strong evidence that movements in real exchange rates significantly affect gross job flows in U.S. manufacturing.

6 Concluding Remarks

In the last decade or so, a considerable amount of interest in Chinese economic development has been generated outside China. China has been following a pattern of industrialization characterized by very rapid growth of industrial sector and increasing participation in the international economy.[29]

This paper has studied data, combining information from different sources, that include sectoral variables regarding the economic growth and international trade. The main policy message is that a deeper analysis of the productivity-enhancing economic reforms at the sector level is crucial to develop a comprehensive understanding of the Chinese economic development.[30]

Appendix

Countries in Figure 1 are selected such that there is no missing observation in the sample. GDP per capita for a given country is measured in millions of U.S. dollars (converted at Geary-Khamis PPPs). Data are from the Conference Board, Total Economy Database, January 2009. Countries are Albania, Algeria, Angola, Argentina, Australia, Austria, Bahrain, Bangladesh, Barbados, Belgium, Bolivia, Brazil, Bulgaria, Burkina Faso, Cambodia, Cameroon, Canada, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Cyprus, Denmark, Dominican Republic, DR Congo, Ecuador, Egypt, Ethiopia, Finland, France, Ghana, Greece, Guatemala, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kuwait, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mexico, Morocco, Mozambique, Myanmar, Netherlands, New Zealand, Niger, Nigeria, Norway, Oman, Pakistan, Peru, Philippines, Poland, Portugal, Qatar, Romania, Saudi Arabia, Senegal, Singapore, South Africa, South Korea, Spain, Sri Lanka, St. Lucia, Sudan, Sweden, Switzerland, Syria, Taiwan, Tanzania, Thailand, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom, United States, Uruguay, Venezuela, Vietnam, West Germany, Yemen, Zambia, and Zimbabwe.

[29] Parente and Prescott (2005) state that the recent catching up done by China is primarily a result of it becoming a free trade club.

[30] Sectoral heterogeneity matters for economic development. There is quite a large literature on convergence at the sectoral level. For example, see, Bernard and Jones 1996; Caselli and Tenreyro 2004; Duarte and Restuccia 2010; Herrendorf and Valentinyi *forthcoming*; and Sørensen 2001.

References

[1] **Amiti, Mary, and Caroline Freund.** Forthcoming. "The Anatomy of China's Export Growth." In *China's Growing Role in World Trade*, ed. Robert Feenstra and Shang-Jin Wei, The University of Chicago Press.

[2] **Bai, Chong-En, Chang-Tai Hsieh, and Yingyi Qian.** 2006. "The Return to Capital in China." *Brookings Papers on Economic Activity*, 2: 61-88.

[3] **Banister, Judith.** 2005. "Manufacturing Employment and Compensation in China." The U.S. Department of Labor, Bureau of Labor Statistics Research Report. http://www.bls.gov/fls/chinareport.pdf

[4] **Bao, Shuming, Gene H. Chang, Jeffrey D. Sachs, and Wing T. Woo.** 2002. "Geographic Factors and China's Regional Development under Market Reforms, 1978-1998." *China Economic Review*, 13(1): 89-111.

[5] **Bernard, Andrew B., and Charles I. Jones.** 1996. "Productivity Across Industries and Countries: Time Series Theory and Evidence." *The Review of Economics and Statistics*, 78(1): 135-46.

[6] **Blanchard, Olivier, and Francesco Giavazzi.** 2006. "Rebalancing Growth in China: A Three-Handed Approach." *China & World Economy*, 14(4): 1-20.

[7] **Borensztein, Eduardo, and Jonathan D. Ostry.** 1996. "Accounting for China's Growth Performance." *American Economic Review Papers and Proceedings*, 86(2): 224-28.

[8] **Bosworth, Barry, and Susan. Collins.** 2007. "Accounting for Growth: Comparing China and India." National Bureau of Economic Research Working Paper 12943.

[9] **Brandt, Loren, and John Sutton.** 2008. "China's Great Economic Transformation." In *China's Great Economic Transformation*, ed. Loren Brandt and Thomas G. Rawski, 1-26. Cambridge: Cambridge University Press.

[10] **Brandt, Loren, and Xiadong Zhu.** 2001. "Soft Budget Constraint and Inflation Cycles: A Positive Model of the Macro-Dynamics in China during Transition." *Journal of Development Economics*, 64(2): 437-57.

[11] **Brandt, Loren, Thomas G. Rawski, and John Sutton.** 2008. "China's Industrial Development." In *China's Great Economic Transformation*, ed. Loren Brandt and Thomas G. Rawski, 569-632. Cambridge: Cambridge University Press.

[12] **Brandt, Loren, Chang-Tai Hsieh, and Xiaodong Zhu.** 2008. "Growth and Structural Transformation in China." In *China's Great Economic Transformation*, ed. Loren Brandt and Thomas G. Rawski, 683-728. Cambridge: Cambridge University Press.

[13] **Broda, Christian, and David E. Weinstein.** 2006. "Globalization and the Gains from Variety." *Quarterly Journal of Economics*, 121(2): 541-85.

[14] **Cao, Jing, Mun S. Ho, Dale W. Jorgenson, Ruoen Ren, Linlin Sun, and Ximing Yue** 2009. "Industrial and Aggregate Measures of Productivity Growth in China, 1982-2000." *Review of Income and Wealth*, 55(1): 485-513.

[15] **Caselli, Francesco, and Silvana Tenreyro.** 2004. "Is Poland the Next Spain?" In *NBER International Seminar on Macroeconomics 2004*, ed. Richard H. Clarida, Jeffrey Frankel, Francesco Giavazzi, and Kenneth D. West, 459-524, The MIT Press.

[16] **Chow, Gregory C.** 1993. "Capital Formation and Economic Growth in China." *Quarterly Journal of Economics*, 108(3): 809-42.

[17] **Chow, Gregory C.** 2004. "Another Look at the Growth of Output in China." http://www.princeton.edu/~gchow/Chinaoutputgrowth.htm.

[18] **Dean, Judith M, and Mary E. Lovely.** Forthcoming. "Trade Growth, Production Fragmentation, and China's Environment." In *China's Growing Role in World Trade*, ed. Robert Feenstra and Shang-Jin Wei, The University of Chicago Press.

[19] **Dekle, Robert and Vandenbroucke, Guillaume.** 2009. "A Quantitative Analysis of China's Structural Transformation." http://guillaumevdb.net/China_Paper.pdf

[20] **Duarte, Margarida, and Diego Restuccia.** 2010. "The Role of the Structural Transformation in Aggregate Productivity." *Quarterly Journal of Economics*, 125(1): 129-73.

[21] **Frankel, Jeffrey.** 2006. "On the Yuan: The Choice between Adjustment under a Fixed Exchange Rate and Adjustment under a Flexible Rate." *CESifo Economic Studies*, 52(2): 246-75.

[22] **Fu, Xiaolan, and V. N. Balasubramanyam.** 2003. "Township and Village Enterprises in China." *Journal of Development Studies*, 39(4): 27-46.

[23] **Goldstein, Morris.** 2004. "Adjusting China's Exchange Rate Policies." http://www.iie.com/publications/wp/wp04-1.pdf

[24] **Goodfriend, Marvin, and John McDermott.** 1998. "Industrial Development and the Convergence Question." *American Economic Review*, 88(5): 1277-89.

[25] **Gourinchas, Pierre-Olivier.** 1999. "Exchange Rates Do Matter: French Job Allocation and Exchange Rate Turbulence, 1984-1992." *European Economic Review*, 43(7): 1279-1316.

[26] **Groenewold, Nicolaas, and Lei He.** 2007. "The US - China Trade Imbalance: Will Revaluing the RMB Help (Much)?" *Economic Letters*, 96(1): 127-32.

[27] **Groningen Growth and Development Centre.** 2009. *The Conference Board, Total Economy Database.* Groningen: Groningen Growth and Development Centre.

[28] **Herrendorf, Berthold, and Ákos Valentinyi.** Forthcoming. "Which Sectors Make Poor Countries So Unproductive?" *Journal of the European Economic Association*.

[29] **Heston, Alan, and Terry Sicular.** 2008. "China and Development Economics. " In *China's Great Economic Transformation*, ed. Loren Brandt and Thomas G. Rawski, 27-67. Cambridge: Cambridge University Press.

[30] **Holtz-Eakin, Douglas.** 2003. "The Chinese Exchange Rate and U.S. Manufacturing." Congressional Budget Office Testimony.

[31] **Holz, Carsten A.** 2006. "Measuring Chinese Productivity Growth, 1952-2005." Unpublished.

[32] **Hsueh, Tien-tung, and Xiaochao Li.** 1999. "Chinese National Economic Accounting System." In *Chinas National Income, 1952-1995*, ed. TientungHsueh and Qiang Li , 65-152. Boulder, Colorado: Westview Press.

[33] **Hua, Ping.** 2007. "Real Exchange Rate and Manufacturing Employment in China." *China Economic Review*, 18(3): 335-53.

[34] **Huang, Jikun, and Scott Rozelle.** 1996. "Technological Change: Rediscovering the Engine of Productivity Growth in China's Rural Economy." *Journal of Development Economics*, 49(2): 337-69.

[35] **Huang, Yiping, and Ron Duncan.** 1997. "How Successful Were China's State Sector Reforms?" *Journal of Comparative Economics*, 24(1): 65-78.

[36] **Hummels, David, and Peter J. Klenow.** 2005. "The Variety and Quality of a Nation's Exports." *American Economic Review*, 95(3): 704-23.

[37] **Jefferson, Gary H., Thomas G. Rawski, and Yuxin Zheng.** 1996."Chinese Industrial Productivity: Trends, Measurement Issues, and Recent Developments." *Journal of Comparative Economics*, 23(2): 146-80.

[38] **Jian, Tianlun, Jeffrey D. Sachs, and Andrew M. Warner.** 1996."Trends in Regional Inequality in China." *China Economic Review* , 7(1): 1-21.

[39] **Johnston, Bruce F.** 1970. "Agriculture and Structural Transformation in Developing Countries: A Survey of Research." *Journal of Economic Literature*, 8(2): 369-404.

[40] **Kanbur, Ravi, and Xiaobo Zhang.** 2005. "Fifty Years of Regional Inequality in China: A Journey through Central Planning, Reform, and Openness." *Review of Development Economics*, 9(1): 87-106.

[41] **Kehoe, Timothy J., and Kim J. Ruhl.** 2009. "How Important is the New Goods Margin in International Trade." Federal Reserve Bank of Minneapolis Research Department Staff Report 324.

[42] **Klein, Michael W., Scott Schuh, and Robert K. Triest.** 2003. "Job Creation, Job Destruction, and the Real Exchange Rate." *Journal of International Economics*, 59(2): 239-65.

[43] **Kwan, C. H.** 1994. *Economic Interdependence in the Asia-Pacific Region: Towards a Yen Bloc*. New York: Routledge.

[44] **Kwan, C. H.** 2002 "The Rise of China as an Economic Power: Implications for Asia and Japan." In *Japan and China: cooperation, competition, and conflict*,ed. Hanns Gunther Hilpert and Rene Haak, 12-31. New York: Palgrave.

[45] **Lee, Soohyung, and Benjamin A. Malin.** 2010. "Education's Role in China's Stuctural Transformation." http://www.soohyunglee.com/research

[46] **Lin, Justin Yifu.** 1988. "The Household Responsibility System in China's Agricultural Reform: A Theoretical and Empirical Study." *Economic Development and Cultural Change*, Supplement: Why Does Overcrowded, Resource-Poor East Asia Succeed: Lessons for the LDCs, 36(3): S199-S224.

[47] **Lin, Justin Yifu.** 1994. "Chinese Agriculture: Institutional Changes and Performance.." In *Agriculture and Trade in China and India: Policies and Performance since 1950*, ed. T. N Srinivasan, 23-72. California: An International Center for Economic Growth Publication.

[48] **Lin, Justin Yifu, Fang Cai, and Zhou Li.** 2003. *The China Miracle: Development Strategy and Economic Reform*. 2nd ed. Hong Kong: The Chinese University Press.

[49] **Liu, Deqiang, and Keijiro Otsuka.** 2004. "A Comparison of Management Incentives, Abilities and Efficiency between SOEs and TVEs: The Case of the Iron and Steel Industry in China." *Economic Development and Cultural Change*, 52(4): 759-80.

[50] **Maddison, Angus.** 2005. *Growth and Interaction in the World Economy: The Roots of Modernity*. Washington, D.C.: The American Enterprise Institute Press.

[51] **McKinnon, Ronald, and Gunther Schnabl.** 2006. "China's Exchange Rate and International Adjustment in Wages, Prices and Interest Rates: Japan Dj Vu?" *CESifo Economic Studies*, 52(2): 276-303.

[52] **National Bureau of Statistics of China.** 2006. *China Statistical Yearbook*, Beijing: China Statistics Press.

[53] **Naughton, Barry.** 1995. *Growing out of the Plan: Chinese Economic Reform, 1978-1993.* New York, NY: Cambridge University Press.

[54] **Naughton, Barry.** 1996. "China's Emergence and Prospects as a Trading Nation." *Brookings Papers on Economic Activity*, 2: 273-337.

[55] **Naughton, Barry.** 2007. *The Chinese Economy : Transitions and Growth.* Cambridge: MIT Press.

[56] **Organization for Economic Cooperation and Development (OECD).** 2001. *Measuring Productivity: Measurement of Aggregate and Industry-Level Productivity Growth.* Paris: OECD.

[57] **Organization for Economic Cooperation and Development (OECD).** 2003. *Asia and Europe: Services Liberalization.* Paris: OECD.

[58] **Parente, Stephen, and Edward C. Prescott.** 2005. "A Unified Theory of the Evolution of International Income Levels." In *Handbook of Economic Growth*, ed. Philippe Aghion and Steven N. Durlauf, 1371-1416. Elsevier Science: North Holland

[59] **Perkins, Dwight H., and Thomas G. Rawski.** 2008. "Forecasting China's Economic Growth to 2025." In *China's Great Economic Transformation*, ed. Loren Brandt and Thomas G. Rawski, 829-886. Cambridge: Cambridge University Press.

[60] **Rosenberg, Nathan.** 1994. *Exploring the Black Box: Technology, Economics, and History.* Cambridge: Cambridge University Press.

[61] **Ruoen, Ren.** 1997. *China's Economic Performance in an International Perspective.* Paris: OECD.

[62] **Schott, Peter K.** 2008. "The Relative Sophistication of Chinese Exports." *Economic Policy*, 23(53): 1-49.

[63] **Shuguang, Zhang, Zhang Yansheng, and Wan Zhongxin.** 1998. *Measuring the Costs of Protection.* Washington, D.C.: Institute for International Economics.

[64] **Sørensen, Anders.** 2001. "Comparing Apples to Oranges: Productivity Convergence and Measurement across Industries and Countries: Comment." *American Economic Review*, 91(4): 1160-67.

[65] **Stavis, Benedict.** 1991. "Market Reforms and Changes in Crop Productivity: Insights from China." *Pacific Affairs*, 64(3): 373-83.

[66] **Young, Alwyn.** 2000. "The Razor's Edge: Distortions and Incremental Reform in the People's Republic of China."*Quarterly Journal of Economics*, 115(4): 1091-1135.

[67] **Young, Alwyn.** 2003. "Gold into Base Metals: Productivity Growth in the People's Republic of China during the Reform Period." *Journal of Political Economy*, 111(6): 1220-61.

[68] **Zhang, Jun.** 2006. "Investment, Investment Efficiency and Economic Growth in China." In *China, Hong Kong and the World Economy*, ed. Lok Sang Ho and Robert Ash, 273-96. New York: Palgrave Macmillan.