De-industrialization of the Riches and the Rise of China: Online Appendix

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1 The Structural Transformation of China, 1978-2005

1.1 Aggregate Growth and Productivity

Using the new PPP estimates of GDP, the United States remains the largest economy in the world by 2005, with a world share of 22.5 percent, followed by China with 9.7.[1] 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.[2] China grew 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 in the sample during 1978-2008. China has sustained an annual average rate of growth of GDP per capita more than 5 percentage points higher than that of the United States.[3]

Figure 2 displays the GDP per capita relative to the United States in a set of countries between 1950 and 2008. My country group consists of Western Europe, Latin America, Japan, and a set of Asian countries.[4] In 1950 Chinese GDP per capita was 3.6 percent of that in the United States. By 2008, it had increased 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 74 percent in 2008.[5] Asian Dragons in 1950 start at a GDP per capita level that

[1] http://siteresources.worldbank.org/ICPINT/Resources/icp-final.pdf

[2] The countries are selected such that there is no missing observation in the sample. GDP per capita for a given country are measured in millions of U.S. dollars (converted at Geary-Khamis PPPs). For all countries, data for the years 1950-2008 are from the Conference Board, Total Economy Database, January 2009. The sample used in Figure 1 consists of 101 countries: 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.

[3] 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.

[4] 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.

[5] During the 1990s Japan's rapid growth was replaced by protracted economic stagnation. As Hayashi and Prescott (2002) note, Japan in the 90s, after steady catch-up for more than three decades, not only stopped catching up but lost ground relative to the industrial leader of the 20th century, the United States and have faced a prolonged recession.

is about 10 percent of the United States 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.[6]

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.[7] For the purpose of mobilizing resources for heavy industries, the Stalinist planned system was implemented in the Chinese economy. Great emphasis was put on investment and the rapid development of heavy industry.[8] Naughton (2007, p. 55) labels this development strategy "big push industrialization". 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 TFP growth. Chow (1993) finds that growth was almost entirely capital accumulation driven during 1952-1980 and TFP growth was absent. Borensztein and Ostry (1996) estimate the TFP growth was 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 Rawski (2008) discuss that noneconomic policy objectives, weak institutions, and poor incentives are the underlying causes of productivity stagnation.

[6]Cole, Ohanian, Riascos, and Schmitz (2005) argue that Latin America is a "development outlier" since it is the only group of Western countries that have not gained significant ground on U.S. income levels in the last 50 years. The failure to attain higher levels of relative income represents what Restuccia (2008) calls the development problem of Latin America.

[7]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. Soviet aid to China ceased in 1961.

[8]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.

On the other hand, the aggregate TFP is the single most important factor behind the aggregate output growth in the Chinese economy for the sample period between 1978 and 2005. To show this I perform a simple aggregate growth accounting framework. I decompose 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_A and E_t are the quantities of capital and labor employed at time *t* and the capital share is given by α. TFP 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.[9]

According to the results in Table 1, over the period 1978-2005, GDP per economically active person has grown 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. 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.

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 observations are beyond the scope of this paper. Most of the 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. Heston and Sicular (2008) argue that the studies with higher estimates of China's TFP growth do not make adjustments for the contribution of human capital and other such factors. On the other hand, Perkins and Rawski (2008) obtain TFP growth of 3.8 percent per year for 1978 -2005 net of the contribution of rising education levels.

[9] Aggregate labor, capital, and output are obtained as the summation of the sectoral figures that I discuss in the related sections. Bai, Hsieh, and Qian (2006) 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*.

1.2 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. As China becomes more developed, there is a steady transfer of labor from rural to urban areas, and the percentage of the labor force engaged in agriculture falls dramatically. However, agriculture is still the dominant sector in China in terms of employment. I use two sources for employment data: CSY and Holz (2006).

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.

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. He adjusts pre-1990 sectoral employment values for 1978-1989 are obtained by applying the shares of the individual sectors in official total employment to the adjusted pre-1990 total employment values.

Holz's method is explained as follows. 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). Table 2 presents the discrepancies between the official statistics and the revision made by Holz. Holz's data set for the period 1990-2005 coincides with that of the CSY. In addition, sectoral employment shares are the same both in official statistics and in revised data.

Figure 3 displays the evolution of sectoral employment shares based on revised employment data in China between 1978 and 2005. Agricultural employment share has fallen 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 primary industry in China's economy has fallen, it is still a large sector, accounting for more than 40 percent of employment in 2005.

De-agriculturalization has fostered the urbanization and off-farm migration has facilitated the development of the nonagricultural sectors in the Chinese economy. Analyzing the percentage of the Chinese population in urban and rural areas, the share of rural population in the total is falling, but remains high at 57.0 percent in 2005. In 1978, the country's rural population was 82.1 percent. Between 1978 and 2005, China's urban population increased, on average, by 4.5 percent by annum; the corresponding figure for the rural population was -0.2 percent.[10]

Between 1978 and 2005, 17.3 percent of the employment was in industry in 1978 and the share was 23.8 percent in the year 2005. The employment share of the service sector climbed from 12.2 percent in 1978 to 31.3 percent in 2005. The employment share of the industrial sector did not rise as fast as that of the service sector during the period 1978-2005. 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 mid-1990s.

Today, the majority of world manufacturing employment is located in the developing countries of Asia, especially in China. In terms of employment, China's manufacturing industry is the largest in the world, employing more manufacturing workers than the G-7 countries combined. Banister (2005) shows that manufacturing employment in China increased during the 1980s and early 1990s, peaked in about 1995-1996, declined during the late 1990s until 2000-1, and increased again 2002.

1.3 The Measurement of Sectoral Output

I start with the analysis of the composition of GDP at current prices (yuan) during the period 1978 through 2005 based on the official statistics. According to this data, the production structure of the economic activity in China has changed significantly for the years 1978-2005. The primary sector's share of GDP declined from 27.9 percent in 1978 to 12.6 percent in 2005. On the other hand, GDP share of the tertiary sector has increased from 24.2 percent in 1978 to 39.9 percent in 2005. The secondary sector dominate the production structure with the average share of this sector in total GDP was 45.3 percent over the sample period.

There has been a recent discussion on the reliability of the official Chinese GDP num-

[10]On the other hand, employed persons by urban areas increased, on average, by 4.0 percent by annum; the corresponding figure by the rural areas was 1.7 percent.

bers as well as the implicit sectoral deflators.[11] For output statistics in China, the deflators used to measure sectoral real output are the major points of the discussion.[12] Other things being equal, an overstatement (or an understatement) of sectoral output growth could invalidate any productivity estimate based on the official data.

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 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) during the period 1978 through 2005. In the year 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 has increased 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 has grown at an average annual rate of 11.6 (11.8) percent since 1978.

1.4 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

[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.

[12]Xianchun (2002) studies the estimates of GDP at current prices and argues that there are five main problems in China's GDP estimates: the measurement of housing services; fiscal subsidies; welfare services provided within enterprises; rural industrial statistics; and livestock products.

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.[13] [14]

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 Zhang 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.[15]

Sectoral capital stock series are calculated using the perpetual inventory approach with 10 percent depreciation rate following Bai, Hsieh, and Qian (2006), who argue that 10 percent is a plausible number for the period 1978-2005. 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. All real series are valued at 2000 prices. This approach ensures that the 1978 values of the capital stocks

[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]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."

[15]Zhang (2006) does not report the value of the index for the year 1978. I take the 1979's value as the corresponding observation for the year 1978.

are independent of the 1978-2005 data used in our analysis.

Figure 5 plots the capital-output ratios for the whole economy, and by sector. The average capital-output ratio for the entire economy is 1.40 for the sample period. Bai, Hsieh, and Qian (2006) estimate that the average nominal capital-output ratio between 1978 and 2005 is 1.46. The real capital stock of the primary sector grew by 3.69 percent per annum on average during 1978-2005. The corresponding figures for the secondary and the tertiary sectors are 7.12 percent and 11.90 percent, respectively.

The capital-output ratios of the primary and the tertiary sectors have demonstrated a U-shape pattern since 1978. The capital-output ratio of the primary sector (the tertiary sector) has risen after 1995 (1993). In contrast, there has been a reduction in the capital-output ratio in the secondary sector, starting with value of 2.28 in 1978 and falling to about 0.81 in 2005, reflecting the higher efficiency of capital in secondary industry.

The capital intensity and the investment rate have increased after 1997, consistent with the fact that the capital share of aggregate income has increased steadily. The investment rate has increased 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 has increased the capital stock which, in turn, has expanded 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.

2 Sectoral Growth Accounting and Economic Reforms

2.1 Framework

I assume that capital and labor are the two primary production factors in the generation of final output. Moreover, land is the third input in the production of the agricultural goods, 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

[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).

[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/).

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 the primary sector 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,

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

Here 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.

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. 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 (Holz, 2006, Appendices 32 and 33). Holz calculates 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. I use these figures as the sectoral labor shares for the entire period.[18] I use 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.

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

2.2 Sectoral TFPs and Growth Accounting

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. Figure 6 shows the actual path of sectoral TFPs in China between 1978 and 2005. TFP growth in Chinese agriculture averaged 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 averaged 6.11 percent per annum and TFP growth in the tertiary sector averaged 2.91 percent per annum between 1978 and 2005. All sectors experienced 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 put a temporary end to the steady liberalization of the Chinese economy and led to temporary recentralization of many economic activities (Naughton 1995, p. 4).

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 3 reports the average annual growth rate of sectoral GDP per worker and its factors shown for post-reform China. Real GDP per worker of the primary sector grew by 5.88 percent average annual growth rate during 1978-1984. Rapid growth rate in the wake of the early post-1978 reforms then fell to an annual average rate of 4.73 percent for the years between 1984 and 2005. For the primary sector, there was no increase in capital intensity: between 1978 and 1984, the capital-output ratio declined. A high per-worker GDP growth rate of 5.88 percent was brought completely by a very high TFP (more than 6.88 percent growth in TFP factor). This observation is consistent with earlier findings. For example, Stavis (1991) views that technological change was the engine of agricultural growth for the period 1978-1984. What caused the high TFP growth rate, including the early reform period, in the primary sector?

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.[19]

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.[20]

There were 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). China's real output per worker in the secondary sector has grown at an average annual rate of 8.31 percent since 1978. For the secondary sector, there was no increase in capital intensity: between 1978 and 2005, the capital-output ratio declined significantly.

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.[21] 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.

Brandt, Rawski, and Sutton (2008) divide reforms in the secondary sector into two periods: reforms concentrated on incentives and market mechanism to prevent resource

[19]See, for example, Lin (1988, 1994), Lin, Cai, and Li (2003, Chapter 5), and Naughton (1995, Chapter 4) for details of the HRS.

[20]Huang and Rozelle (1996) argue that earlier studies may have over-estimated the impact of decollectivization.

[21]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).

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.[22]

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 is 85 percent of all employment creation, during the 9th Five-Year Plan, 1995-2000 (OECD 2003).

3 China's Foreign Trade after 1978

Figure 7 shows that China has grown from having a negligible role in world trade to being one of the world's exporting powers accounting for 11 percent of global export share in manufactured goods in 2006 (WTO Statistics). 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.[23] 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

[22]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.

[23]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).

foreign exchange regime. The rate of decreases in trade barriers has increased especially in the 1990s.

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.[24] There were significant reductions starting from 1992 in tariff rates and the removal of nontariff barriers. 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.[25]

Figure 8 shows the evolution of the effective tariff ratio in China during 1952-2005. The effective tariff rate is defined as the ratio of tariff revenue to total imports.[26] 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.

3.1 China's Changing 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.[27] In 1980, primary goods' share in total commodity trade was 42.15 percent. By 2005, it had declined to 13.84 percent (CSY 2006, Tables 18.5 and 18.6). On the other hand, an increase in the relative importance of manufactures in total exports has taken place.

Table 4 breaks down the Chinese nominal trade balance (in current billion U.S. dol-

[24] 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 investments surged to US$ 11.3 billion in 1992 from US$ 4.6 billion the year before (Bao, Chang, Sachs, and Woo 2002).

[25] See Shuguang, Yansheng, and Zhongxin (1998, Table 2.1) for the details in tariff and nontariff changes.

[26] 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.

[27] 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.

lars) in 1984 and in 2005 into industries using one-digit SITC codes. Certainly, 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. I investigate this issue below. The table shows that China imports raw materials and 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) finds 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.[28]

In a companion to the analysis of Table 4, 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). Each stage can be characterized by a typology, to which the countries in that stage are alleged to conform. A country typically passes from one category to another in the following sequence:

- The developing country stage, with primary commodities more competitive than

[28]Dean and Lovely (forthcoming) aggregate the Chinese trade data to HS (6-digit) and then converted to ISIC Revision 3 using the official Chinese concordance.

other manufactures and machinery;

- The young NIE (newly industrialized economy) stage, with other manufactures becoming more competitive than primary commodities, which maintains its lead over machinery;
- The mature NIE stage, with machinery overtaking primary commodities while other manufactures maintain their overall lead; and
- The industrial country stage, with machinery overtaking other manufactures, which maintain their lead over primary commodities.

Figure 9 shows the development of China's trade structure between 1984 and 2005 in terms of broad sectors of merchandise trade. The figure 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). It is clear from the figure that, if the current trend in the sectoral specialization indices continues, the specialization index of machinery will overtake that of other manufactures in the near future, when China will be classified as an industrial country.

3.2 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". Kehoe and Ruhl argue that extensive margin is important in explaining trade growth after liberalizations presenting evidence of growth in extensive margin following a decrease in trade barriers, while Hummels and Klenow discuss that larger countries trade more at both margins.

I find substantial extensive margin growth in China as the country has begun exporting and importing new kinds of goods following the methodology of Kehoe and Ruhl (2009). I take four-digit SITC (Revision 2) bilateral trade data obtained from United Nations Commodity Trade Statistics Database for the years between 1985 and 2005. There are 786 categories 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 10 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 11 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. In other words, the goods exported from China that were the least traded in 1985 account for a disproportionate portion of growth in trade. Broda and Weinstein (2006) note that China exported 710 different goods to the United States in 1972 as opposed to 10,315 in 2001.

I find similar results for the Chinese imports from the rest of the world as presented in Figure 12 and Figure 13. 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). I replicate the Figure 10 - Figure 13 to analyze China-Japan and China-U.S. bilateral trade relations and find similar results. The results are presented in Figure 14 - Figure 21. Amiti and Freund (forthcoming) examine the relative contribution of intensive and extenive margins to China’s export growth and their analysis of China’s export growth patterns between 1997 and 2005 shows that most of China’s export growth was actually in the intensive margin.

3.3 Exchange Rate Issues

Figure 22 shows the nominal exchange rate of the RMB in Japanese yen and in U.S. dollars between 1981 and 2005. This figure reflects the purchasing power of RMB relative to the main convertible currencies.[29] I observe a stable parity around 8.3 Yuan / US$ after

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

a major devaluation of the RMB in 1994. During most of the period between 1994 to the present day, the U.S. has had a substantial trade deficit in Sino-American trade. The large trade imbalance in Sino-American bilateral trade has been blamed on the undervalued RMB. On the other hand, 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.[30]

During a time of economic catch-up and rapid financial transformation, fixing the exchange rate is the preferred way of anchoring the domestic price level. 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.

Another related argument is that the RMB's undervaluation and its peg to the dollar prevent other countries' currencies from rising against the dollar, since appreciation would damage their competitive power relative to China.[31] 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 (Goldstein 2004, Holtz-Eakin 2003, Hua 2007).[32] Corden (2007) calls this "exchange rate protection", i.e., industries producing tradables are protected at the expense of producers of nontradables. Trefler (2005) argues that China cannot forever keep the yuan undervalued, and the Chinese currency will rise to the point where China's low yuan denominated wages are eradicated by the currency conversion by the logic of comparative advantage. Trefler also asserts that the weakness of institutions in China will retard the rate

[30]On 21 July 2005, the government of China finally revalued the RMB against the dollar-though by only 2.1 percent-and announced the implementation of a new managed floating system (Frankel 2006).

[31]Zhang (2001) argues that exchange rate reform is a vital supply-side factor in China's export growth for the period between 1978 and 1993, the period that most major events of China's exchange rate reforms happened.

[32]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) investigates empirically the pattern of job creation and destruction in response to real exchange movements in France between 1984 and 1992, using firm level data and finds that traded sectors are very responsive to real exchange rate movements. Klein, Schuh, and Triest (2003) find strong evidence that movements in real exchange rates significantly affect gross job flows in U.S. manufacturing. They also find that movements in trend real exchange rates significantly affect both job creation and destruction, thus they have large job allocative effects.

4 A Three-Sector Closed Economy Model

Table 5 shows the sectoral changes of the civilian employment and the value added shares (measured at current prices in national currencies) of the G7 countries between 1970 and 2006 and establishes three broad categories and one subordinate category (manufacturing, which is the most dominant component of the industrial activities) to show the extent of the employment and the output composition of the sectoral changes in G7 countries.

I analyze the relationship between productivity change and industrial employment using a closed economy general economy model for each of the G7 economies and argue that domestic differential productivity gains in industrial sector do not necessarily explain declines in industrial employment. My findings provide quantitative evidence to the intuitive perspective of Obstfeld and Rogoff (2002, Chapter 4) and Matsuyama (2009), who presents a simple example demonstrating how misleading writing down a closed economy model can be in the context of productivity-based theory of manufacturing employment decline.

4.1 Economic Environment

At each date there are three goods produced: agriculture, industry, and services.[33] The production function for sector *j* is given by

$$Y_j = \theta_j N_j, \tag{5}$$

where Y_j is output of sector *j*, N_j is labor allocated to production, and θ_j is sector *j*'s labor productivity. I assume that labor is fully mobile across sectors and the wage rate in the economy is given by

$$\omega = \theta_j p_j, \tag{6}$$

where p_j is the price of good-*j* output and ω is the wage-rate in the economy. Without loss of generality, I normalize the wage rate to 1. Since I abstract from capital and fixed factors in production, differences in labor productivity implicitly incorporates differences due to capital as well as due to technology adoption, regulation, etc. across sectors (Rogerson 2008).

The economy is populated by an infinitely-lived representative household of constant size over time. The population size is normalized to one, without loss of generality. I assume that the household is endowed with one unit of productive time that it supplies

[33] Time subscripts are omitted and I focus on the resource allocation problem solved in a particular period.

inelastically to the market and consumption is the only determinant of the instantaneous utility function, which is given by:

$$U(\bar{A}, C) = \bar{A} + \log(C) \tag{7}$$

The instantaneous utility is defined over the agricultural good $(\bar{A})$ and the composite consumption good (C), which is derived from the industry and services::

$$C = (\gamma^{1/\eta} I^{(\eta-1)/\eta} + (1-\gamma)^{1/\eta} S^{(\eta-1)/\eta})^{\eta/(\eta-1)}. \tag{8}$$

I is the consumption of the industrial good, and S is the consumption of the services. The weight γ influences how non-agricultural consumption expenditure is allocated between industry and services. The parameter η is the (constant) elasticity of substitution between industrial goods and the services and it underlies the magnitudes of price responses to quantity adjustments: lower substitution elasticity implies that sharper price changes are needed to accommodate a given change in quantities consumed. If η approaches 1, preferences over the non-agricultural goods approach a Cobb-Douglas so that the substitution effect vanishes regardless of the magnitude of the differences between sectoral productivity differences.

The utility function belongs to the following general type of utility function:

$$U(A, C) = \begin{cases} \bar{A}, & \text{if } A < \bar{A}, \\ \log(C) + \bar{A}, & \text{if } A \geq \bar{A}. \end{cases} \tag{9}$$

This specification of preferences implies that the economy specializes in agriculture until the subsistence level $\bar{A}$ is reached. Moreover, the economy will never produce more agricultural good than $\bar{A}$. Once $\bar{A}$ is reached, the representative household will supply labor to the other five sectors. In other words, the representative agent's preferences over agricultural goods and non-agricultural goods (and services) reflect Engel's law. The idea is that consumers care mainly about food up to a satiation point; beyond that point their attention focuses exclusively on non-agricultural goods. As Laitner (2000) and Stokey (2001) note, technological progress and such a specification of preferences eventually would cause structural change, with the economy endogenously shifting from a preponderance of agricultural production to marginalization of the same sector.[34]

At each date, and given prices, the household chooses consumption of each good to

[34] See, also, Gollin, Parente, and Rogerson (2002, 2004, 2007).

maximize his lifetime utility subject to the budget constraint,

$$p_A \bar{A} + p_I I + p_S S = 1. \tag{10}$$

I assume that the household is endowed with one unit of productive time that supplies inelastically to the market. Therefore, the demand of labor from firms must equal this exogenous supply at every date:

$$N_A + N_I + N_S = 1. \tag{11}$$

Since there is no international trade or capital accumulation the following conditions hold at each date implying that the market must clear for each goods and services produced:

$$\bar{A} = Y_A, \quad I = Y_I, \quad S = Y_S. \tag{12}$$

Given a set of prices, a competitive equilibrium consists of consumption decisions that are the household's allocations $\{\bar{A}, I, S\}$, and factor allocations for the firms, $\{N_A, N_I, N_S\}$ such that given prices, the firm's allocations solve its profit maximization problem, the household's allocations solve the household's utility maximization problem, and all product and factor markets clear.

Employment share in agriculture is determined solely by the subsistence constraint and labor productivity in agriculture:

$$N_A = \bar{A}/\theta_A. \tag{13}$$

High agricultural productivity is a necessary condition for industrialization and economic development since poor countries have a much larger fraction of their employment in the agricultural sector than rich countries to be able to produce enough food to satisfy their subsistence requirements. This is consistent with the view in the literature that the agricultural revolution preceded the industrial revolution. For example, Nurkse (1961, p. 52) argues that the introduction of the turnip and other improvements in agriculture led the rise in agricultural productivity and then caused the expansion of the industrial sector.[35]

Employment share in industrial sector is given by:

$$N_I = \frac{\Delta(1 - (\bar{A}/\theta_A))}{1 + \Delta}, \tag{14}$$

[35] See Johnston and Mellor (1961) and Johnston (1970) and the references therein.

where

$$\Delta \equiv (\gamma/(1-\gamma))(\theta_I/\theta_S)^{\eta-1} = N_I/N_S. \tag{15}$$

Notice that the predicted sectoral nominal shares of output are exactly equal to the predicted sectoral employment shares.

4.2 Quantitative Analysis

I calibrate the model economy for each of the G7 economy between 1978 and 2007. I use GDP by kind of economic activity at constant prices (measured in national currencies) and employment by kind of economic activity to derive labor productivity (value added per worker) series for each economy between 1978 and 2007.[36] All time series are detrended using the Hodrick-Prescott filter with a smoothing parameter of 6.25 before any ratios are computed.[37]

First, I normalize productivity levels across sectors in each country to one in 1978. Notice that the employment share in agriculture is determined independently of the state of the non-agricultural sectors. I use data on sectoral labor productivity growth in each of G7 economies to obtain the time paths of sectoral productivity between 1978 and 2007. Second, I calibrate subsistence in agriculture so that the equilibrium of the model matches the share of employment in agriculture for 1978 in each economy. Third, I calibrate γ to match the industrial (or service sector) employment share in 1978 for each economy.

Since η determines the amount of substitution between industrial goods and services this parameter determines how much labor will be reallocated between the industry and service sector in response to uneven changes in productivity growth. The recent literature provides a range of estimates for η. Bah (2008) reports an elasticity of 0.45 studying the data for the United States for the period 1950-2000. Similarly, Rogerson (2008) uses the data for the U.S. economy in 1950 and 2003 and sets η equal to 0.44. Ngai and Pissarides (2004, 2008) cite the empirical literature and argue that the elasticity of substitution lies between 0.1 and 0.3. I study three values of η: 0.1, 0.3, and 0.45. The parameters for each country are reported in Table 6.

Figure 23 shows that, given the calibrated value for subsistence level of consumption in agriculture, labor productivity growth in agriculture implies a share of employment

[36]Sectoral value added data are from the United Nations Statistics Division, National Accounts Main Aggregates Database. Sectoral Employment data are from the OECD Employment and Labor Market Statistics, Summary Tables Volume 2008, Release 1.

[37]I am interested in long-term trends, not in yearly fluctuations. I follow Ravn and Uhlig (2002) for choosing 6.25 as a smoothing parameter. The features that I emphasize also hold for other smoothing parameter values for annual data such as 100 and 400. See, also, Jaimovich and Siu (2009) for a very similar discussion of the Hodrick-Prescott filter for annual data.

in this sector in the model that turns out to be remarkably close to the time series data for each of the G7 economies. Under this calibration, the model generates a transition of the labor force out of the agriculture and the figures generated by the model economy matches well the level and the pace of their empirical counterpart.

The results for the industrial employment shares in each economy are displayed in Figure 24. The model fails to match the industrial employment share in the G7 economies. A major problem is that labor productivity growth in industry relative to services is not high enough to move the labor out of the industrial sector. This problem is robust under different values of the elasticity of substitution between industry and services. I observe that the model gets close to match the data as the elasticity of substitution decreases, i.e., the model with $\eta = 0.1$ fits better, relatively, compared to the other two cases. The fit of the model does not improve substantially with the values of η smaller than 0.1.

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Table 1: Growth Accounting, China, 1978-2005

	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

Table 2: Total Employed Persons, Official versus Revised, million persons

	CSY (2006)			Holz (2006)		
Year	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
1978	283.2	69.5	48.9	330.4	81.0	57.1
1979	286.3	72.1	51.8	334.8	84.4	60.5
1980	291.2	77.1	55.3	339.6	89.9	64.5
1981	297.8	80.0	59.5	347.6	93.4	69.4
1982	308.6	83.5	60.9	358.5	97.0	70.8
1983	311.5	86.8	66.1	363.0	101.2	77.0
1984	308.7	95.9	77.4	357.4	111.1	89.6
1985	311.3	103.8	83.6	359.2	119.8	96.5
1986	312.5	112.2	88.1	360.5	129.4	101.6
1987	316.6	117.3	94.0	364.4	134.9	108.1
1988	322.5	121.5	99.3	369.4	139.2	113.8
1989	332.3	119.8	101.3	381.7	137.6	116.4

Table 3: Sectoral Growth Accounting, China, 1978-2005

	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

Table 4: 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

Table 5: Sectoral Shares of Employment and Value Added, G7 Countries

	Employment Shares (%)							
	Agriculture		Manufacturing		Industry		Services	
Country/Year	1970	2006	1970	2006	1970	2006	1970	2006
Canada	7.6	2.6	22.3	12.8	29.8	20.8	62.6	76.6
France	13.5	3.4	27.5	15.0	38.4	22.0	48.0	74.6
Germany	8.5	2.3	39.5	22.0	48.7	29.0	42.8	68.8
Italy	20.1	4.3	27.7	21.2	38.8	29.8	41.1	65.9
Japan	16.9	4.1	27.4	18.3	35.7	27.1	47.4	68.8
United Kingdom	3.2	1.3	34.7	13.0	43.2	21.5	53.6	77.2
United States	4.5	1.5	26.4	11.3	33.1	19.9	62.3	78.5

	Value Added Shares (%)							
	Agriculture		Manufacturing		Industry		Services	
Country/Year	1970	2006	1970	2006	1970	2006	1970	2006
Canada	4.5	2.2	21.7	18.0	36.1	31.7	59.4	66.1
France	7.7	2.4	24.9	13.7	35.6	21.1	56.7	76.5
Germany	3.7	1.0	35.1	23.7	47.9	30.0	48.5	69.1
Italy	8.8	2.4	27.6	18.8	39.3	27.1	52.0	70.5
Japan	6.3	1.6	34.0	20.2	45.6	28.9	48.1	69.5
United Kingdom	2.9	0.9	31.7	14.0	42.6	24.0	54.6	75.1
United States	3.4	0.9	22.9	13.1	34.1	22.0	62.5	77.1

Sources: U.S. Department of Labor, *Bureau of Labor Statistics* and United Nations Statistics Division, *National Accounts Main Aggregates Database.*

Table 6: Calibration

Country	$\bar{A}$	γ
Canada	0.0546	0.3091
France	0.0916	0.4048
Germany	0.0569	0.4718
Italy	0.1548	0.4544
Japan	0.1162	0.3969
United Kingdom	0.0272	0.4027
United States	0.0367	0.3265

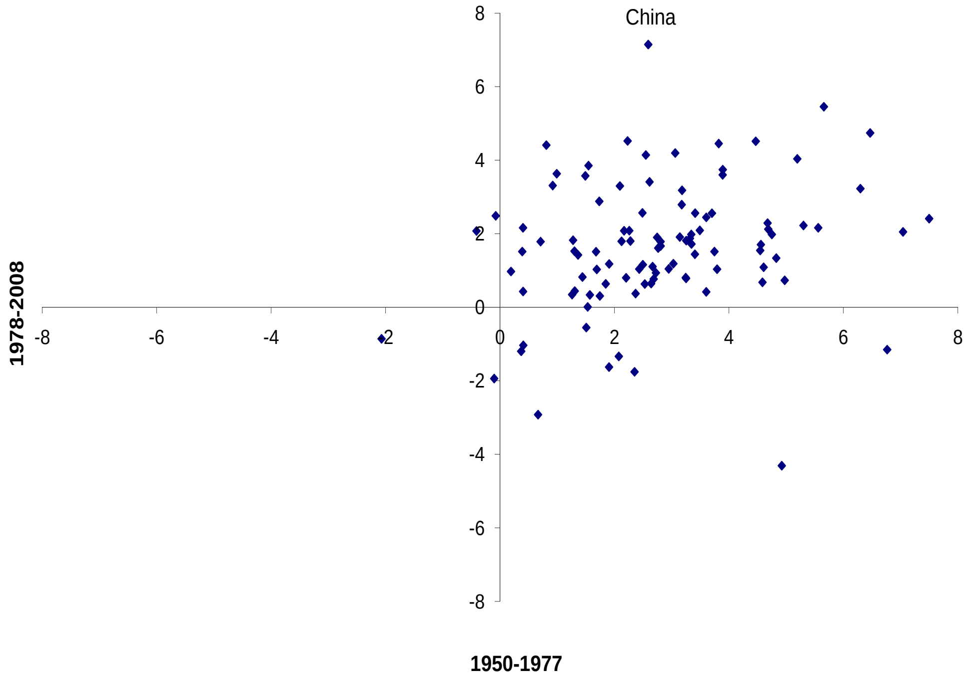

Figure 1: Growth Rates of GDP per Capita (%), 1950-2008

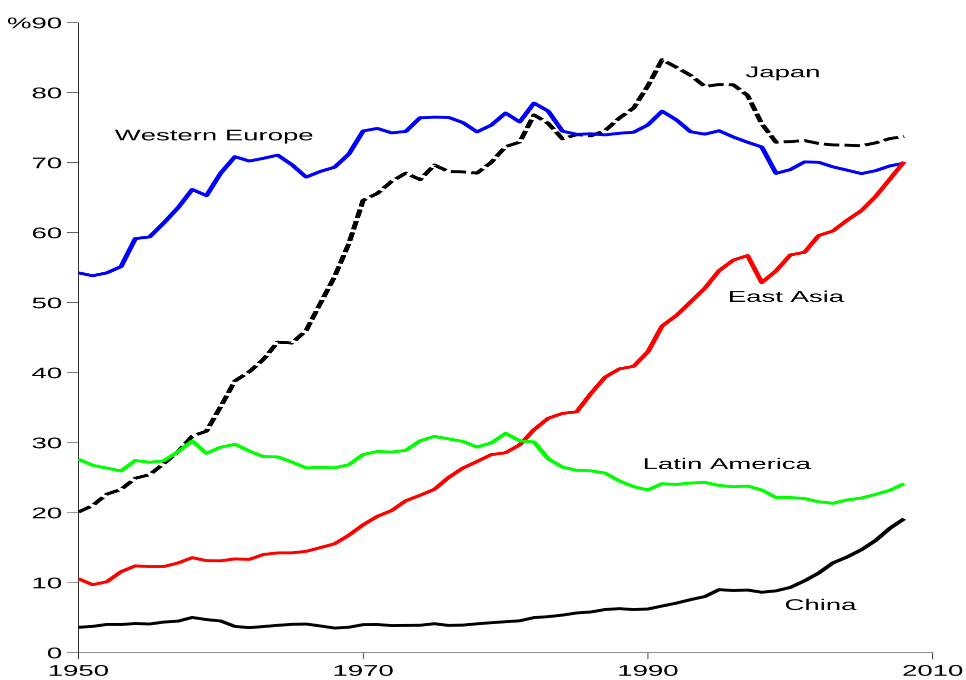

Figure 2: GDP per Capita as a Percentage of the U.S.

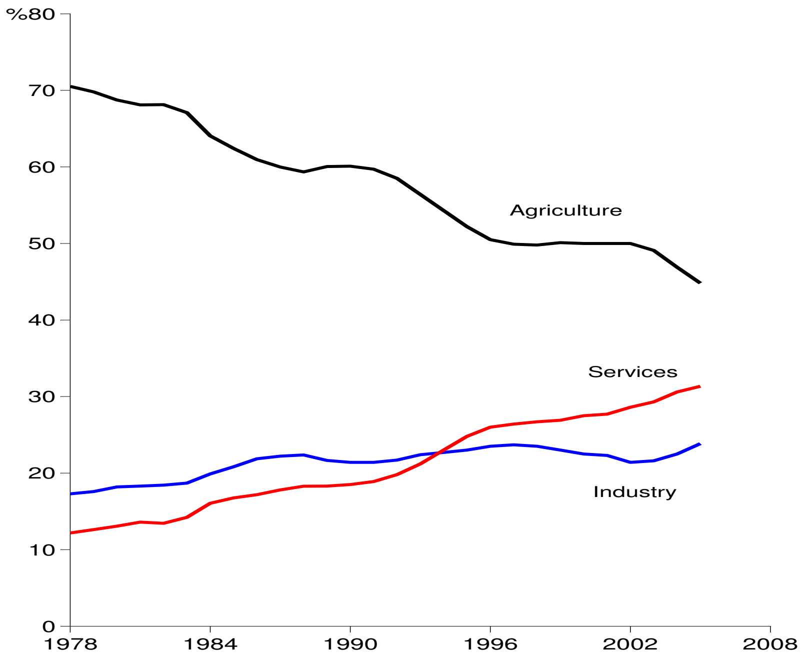

Figure 3: Employment Shares, China, 1978-2005

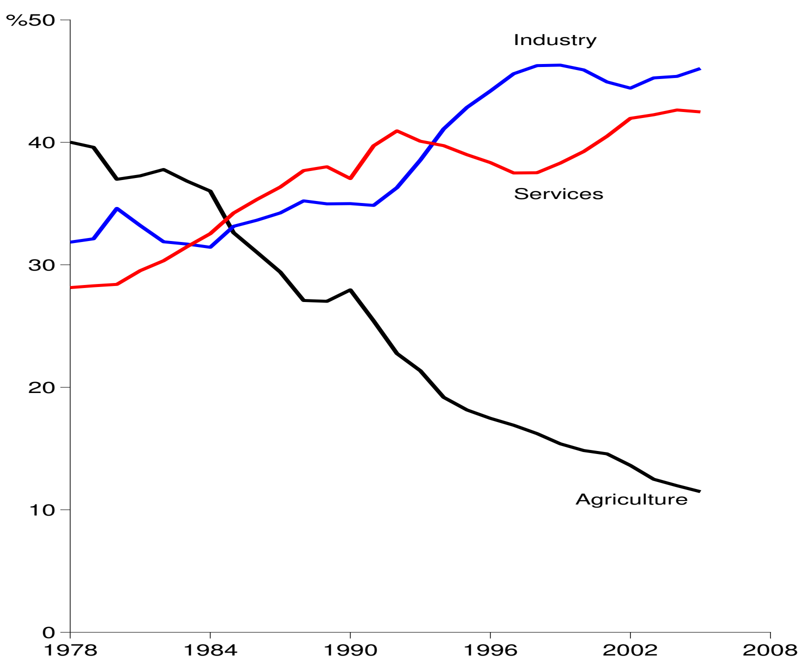

Figure 4: Real GDP Shares, China, 1978-2005

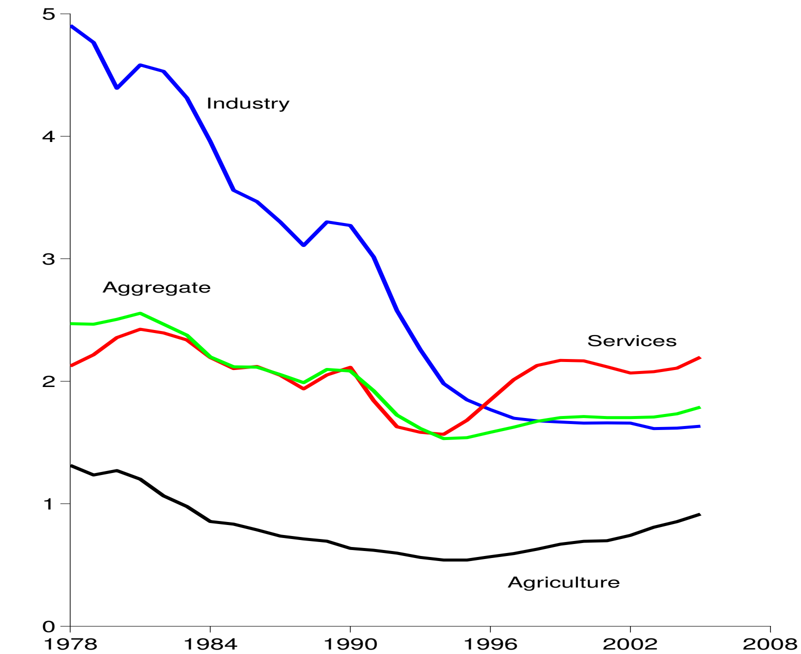

Figure 5: Capital-Output Ratios, China, 1978-2005

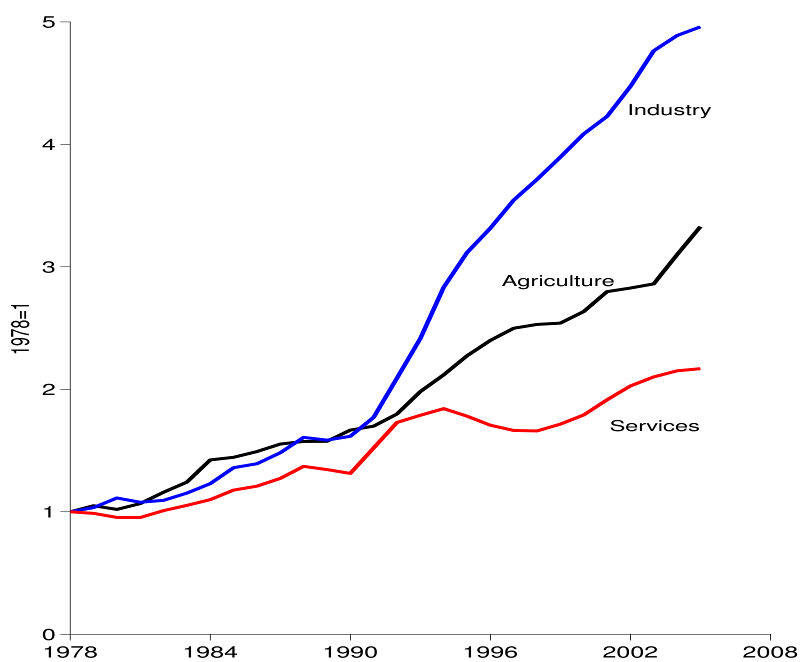

Figure 6: TFP by Sector, China, 1978-2005

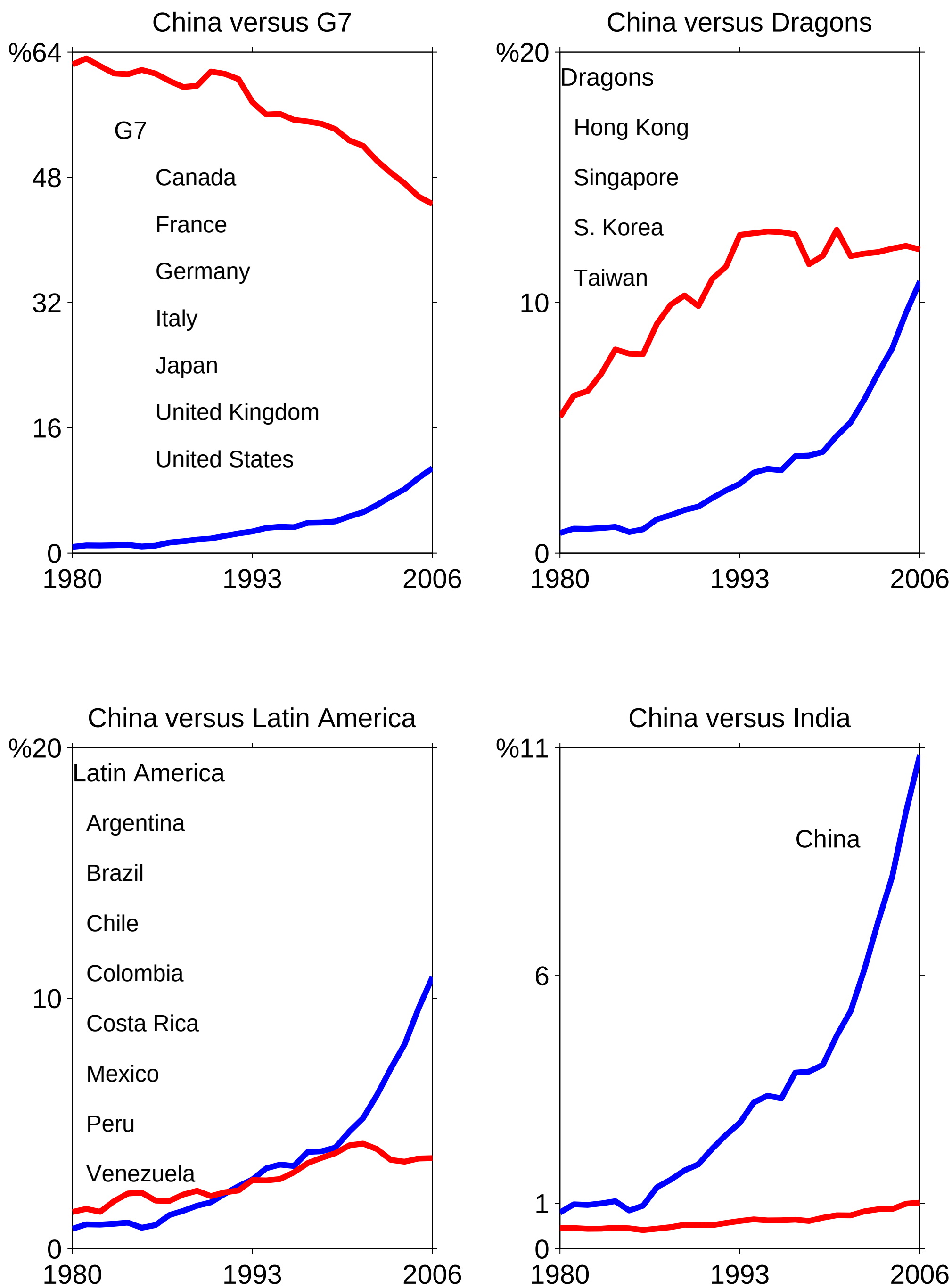

Figure 7: China's Share of World Manufactured Exports, 1980-2006

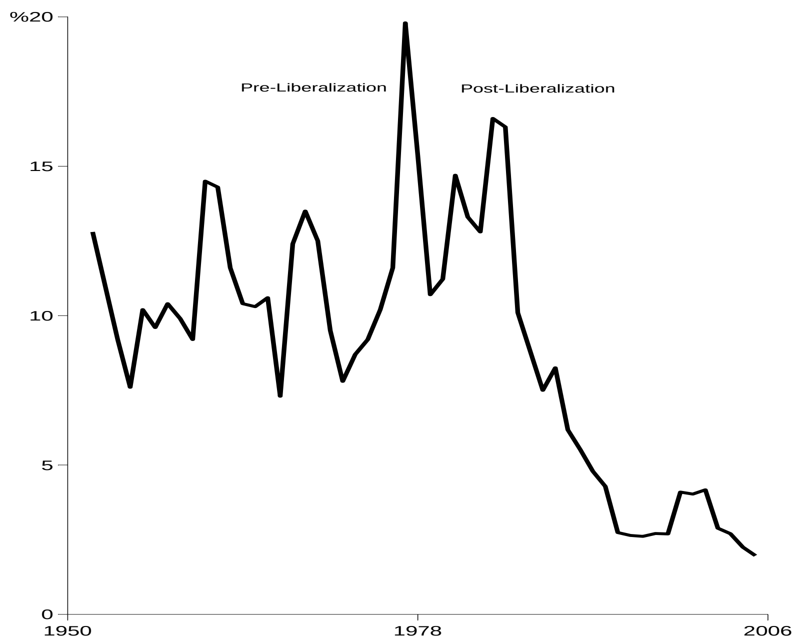

Figure 8: Effective Tariff Rates, China, 1952-2005

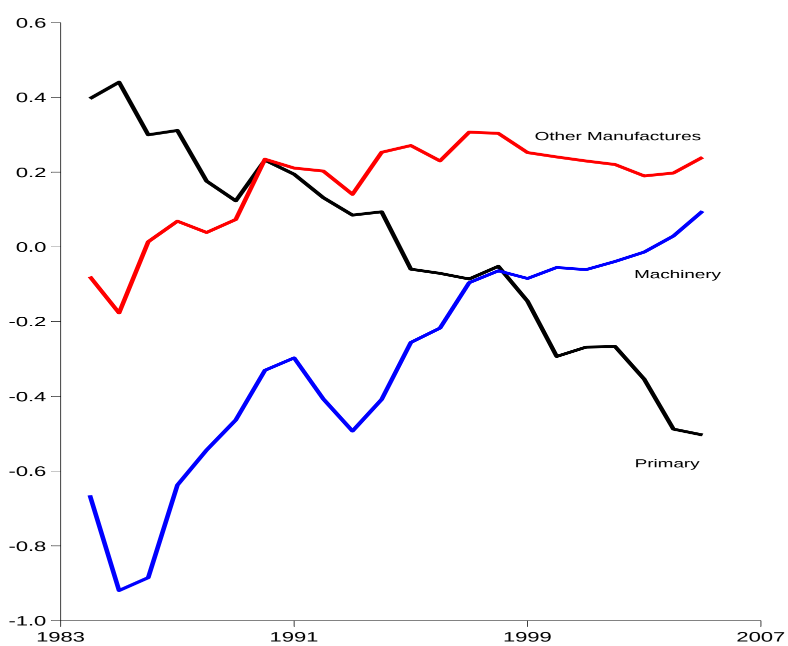

Figure 9: Stages of China's Trade Structure, 1984-2005

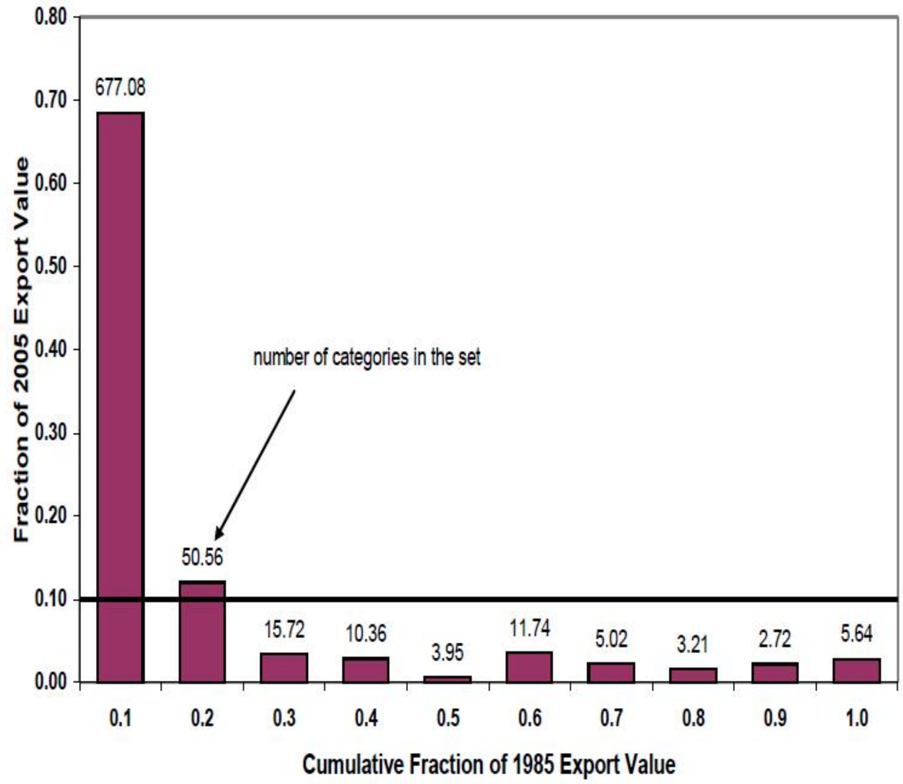

Figure 10: Composition of Exports: China to the Rest of the World

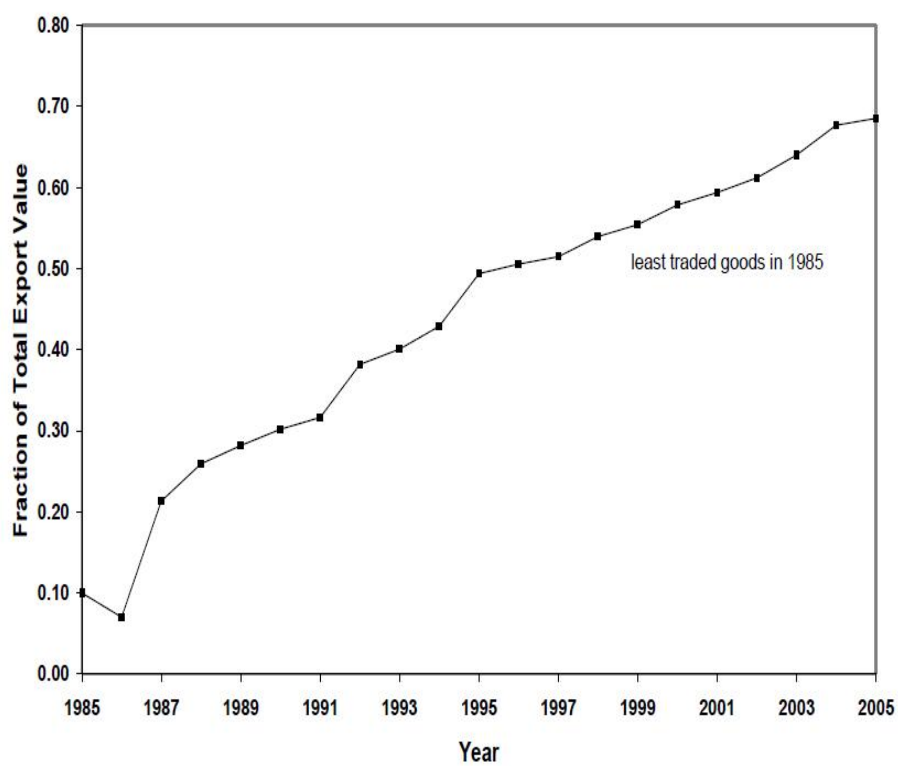

Figure 11: Exports: China to Rest of the World, 1985-2005

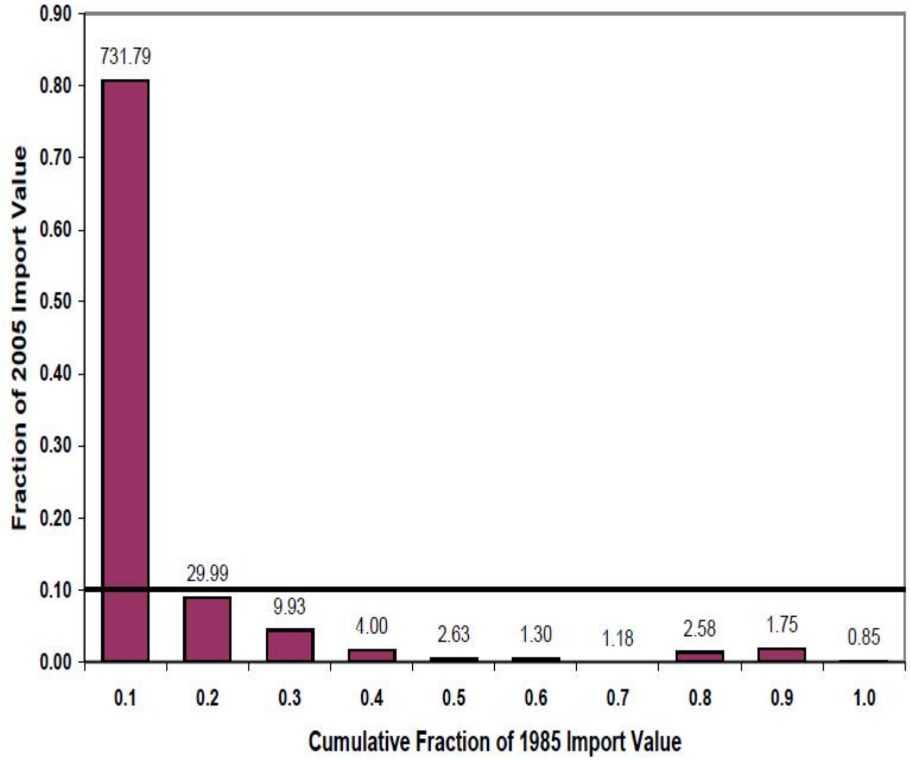

Figure 12: Composition of Imports: China from the Rest of the World

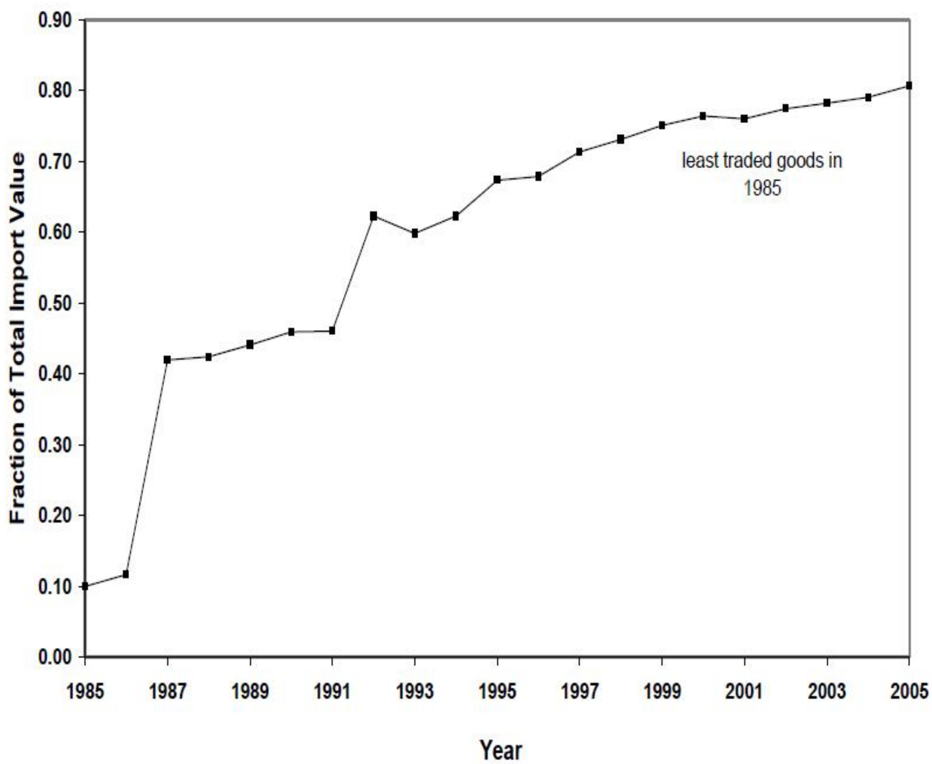

Figure 13: Imports: China from the Rest of the World, 1985-2005

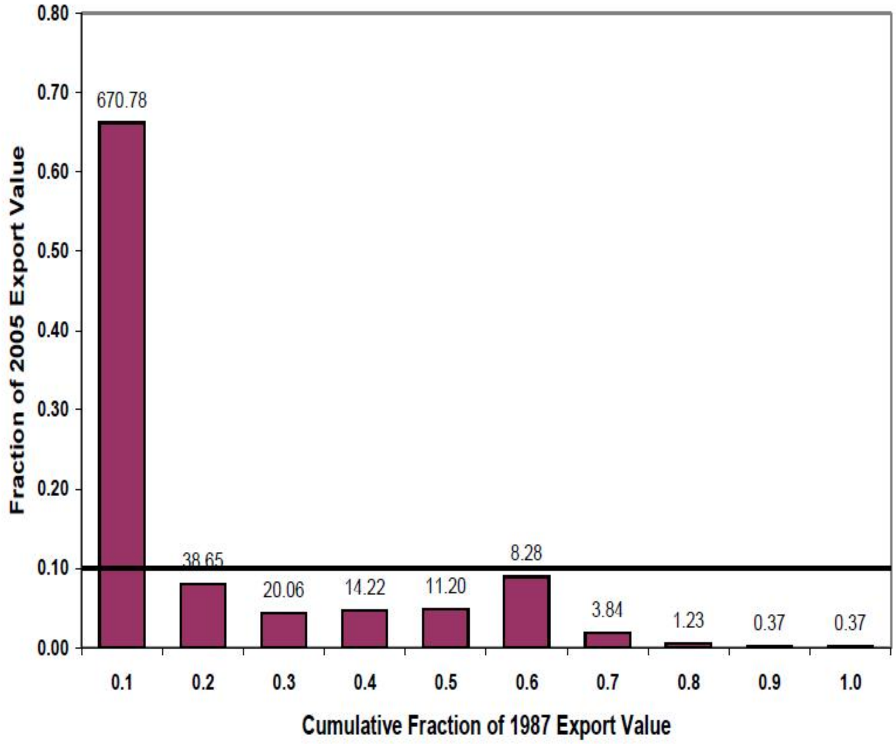

Figure 14: Composition of Exports: China to Japan

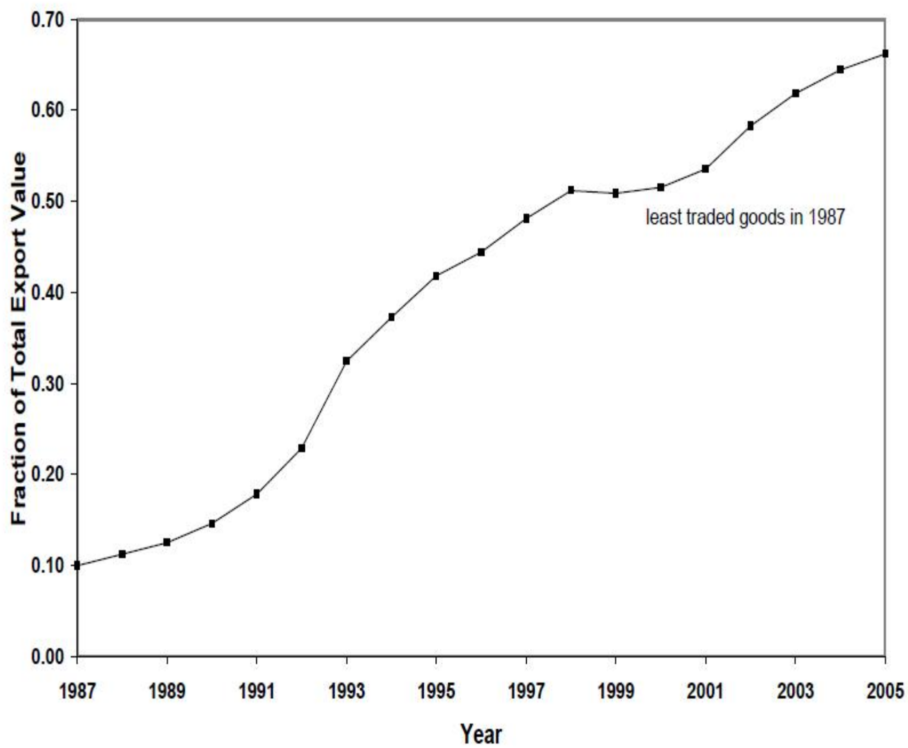

Figure 15: Exports: China to Japan, 1987-2005

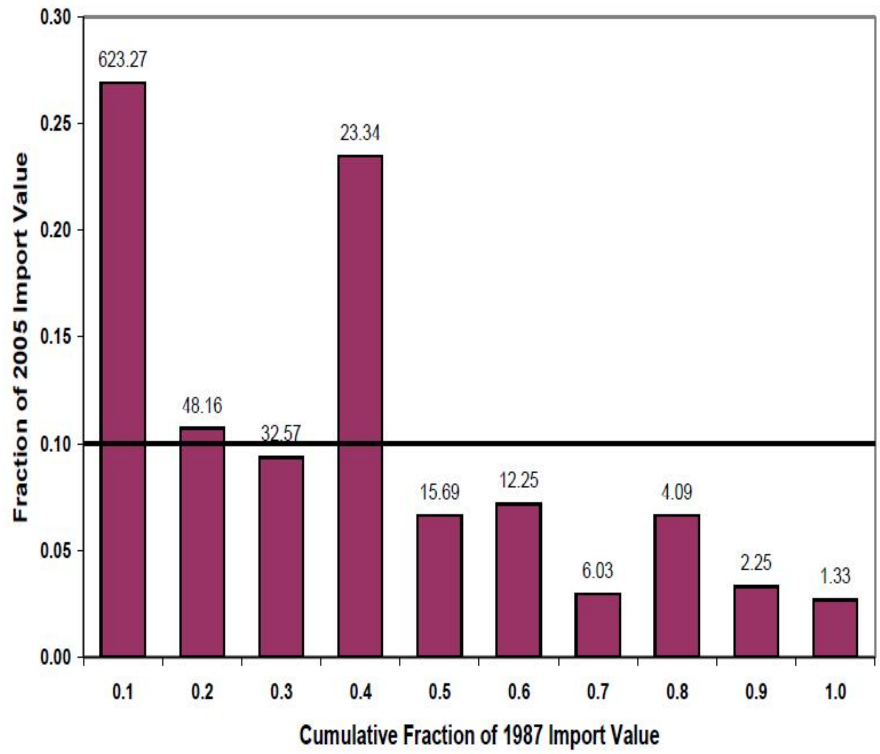

Figure 16: Composition of Imports: China from Japan

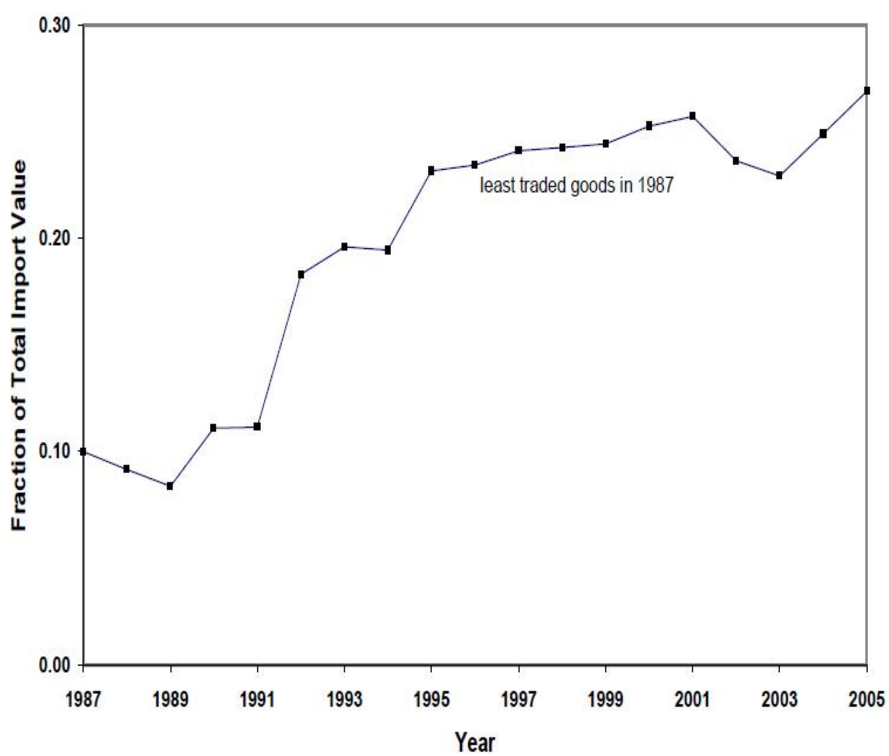

Figure 17: Imports: China from Japan, 1987-2005

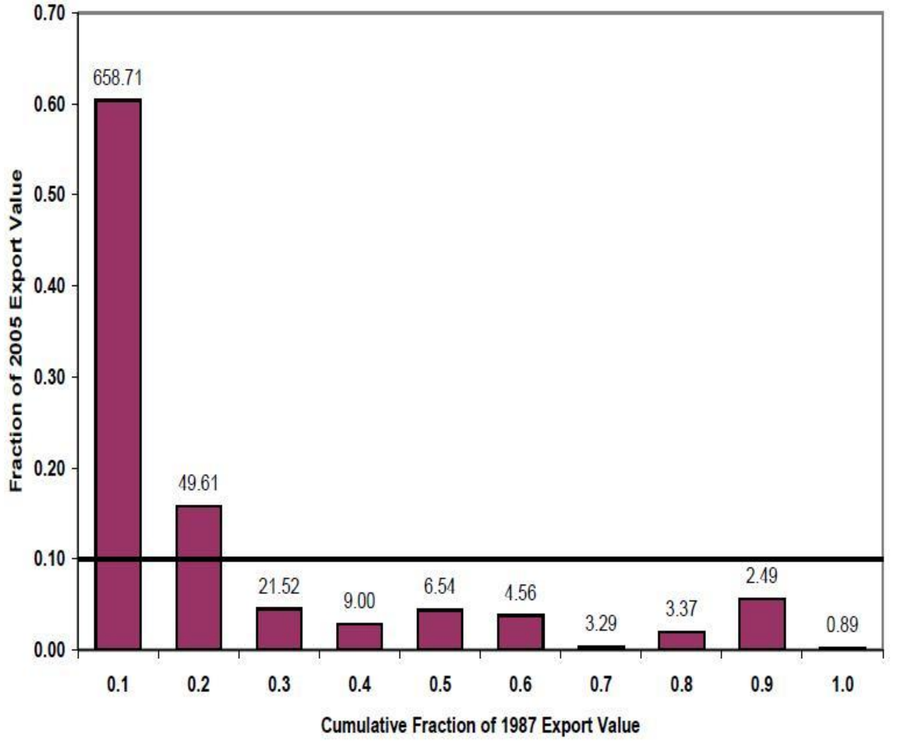

Figure 18: Composition of Exports: China to the United States

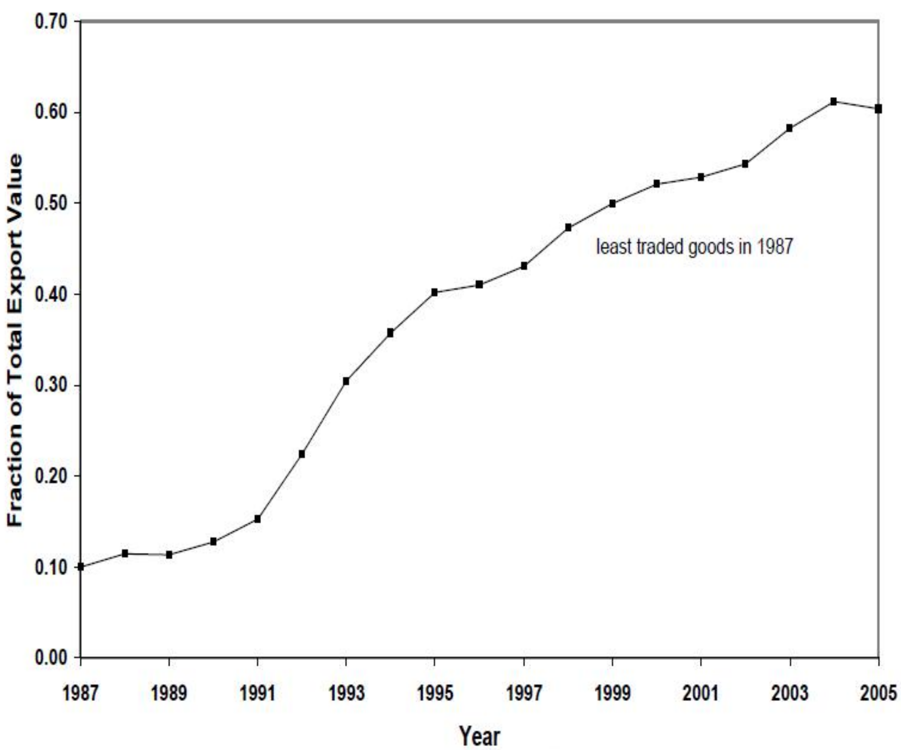

Figure 19: Exports: China to the United States, 1987-2005

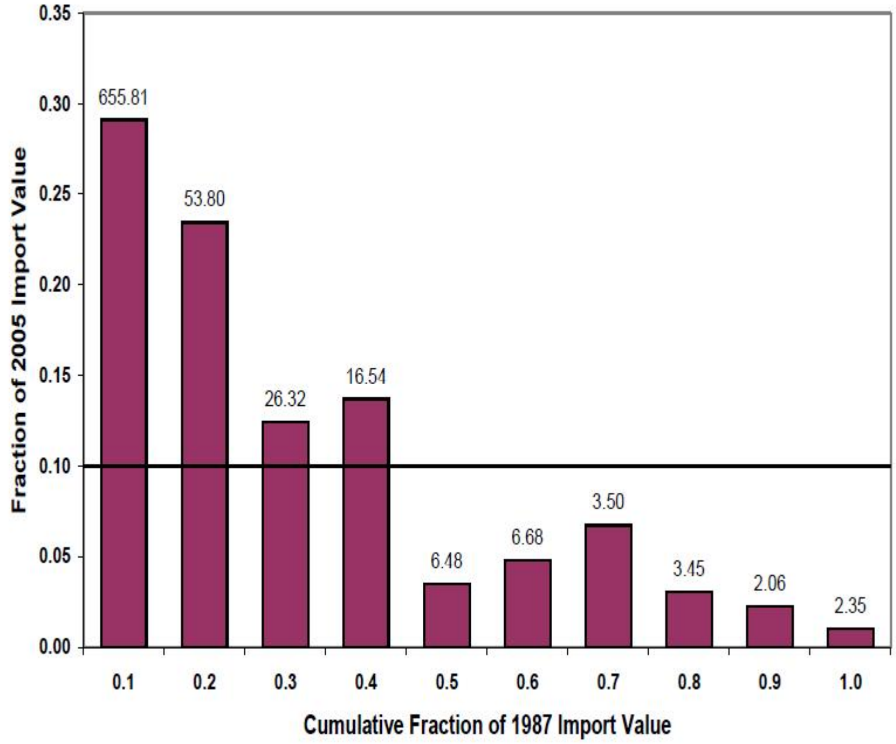

Figure 20: Composition of Imports: China from the United States

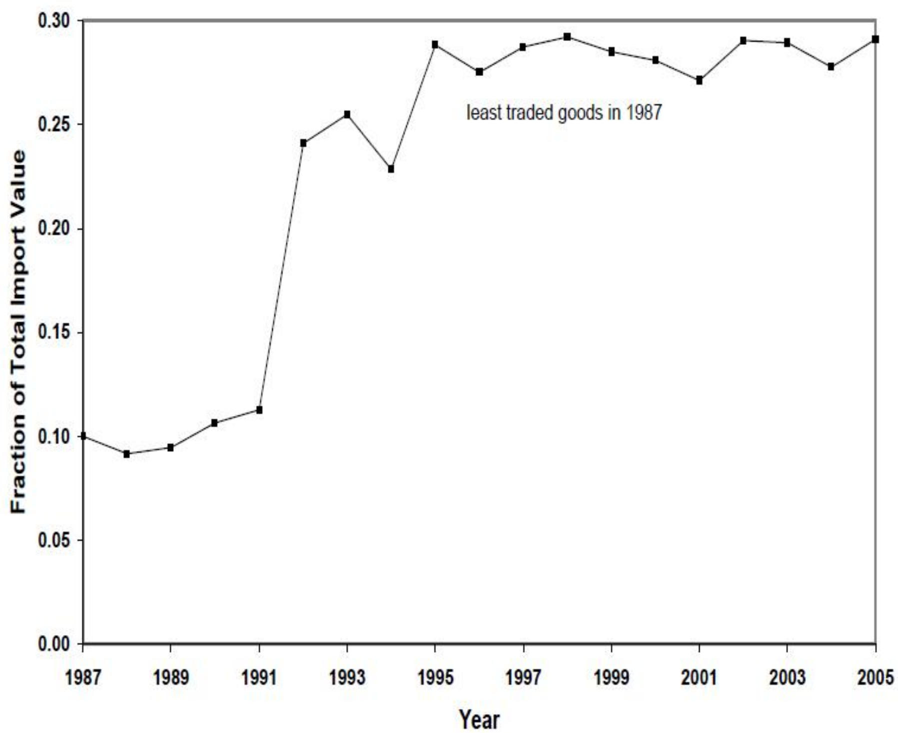

Figure 21: Imports: China from the United States, 1987-2005

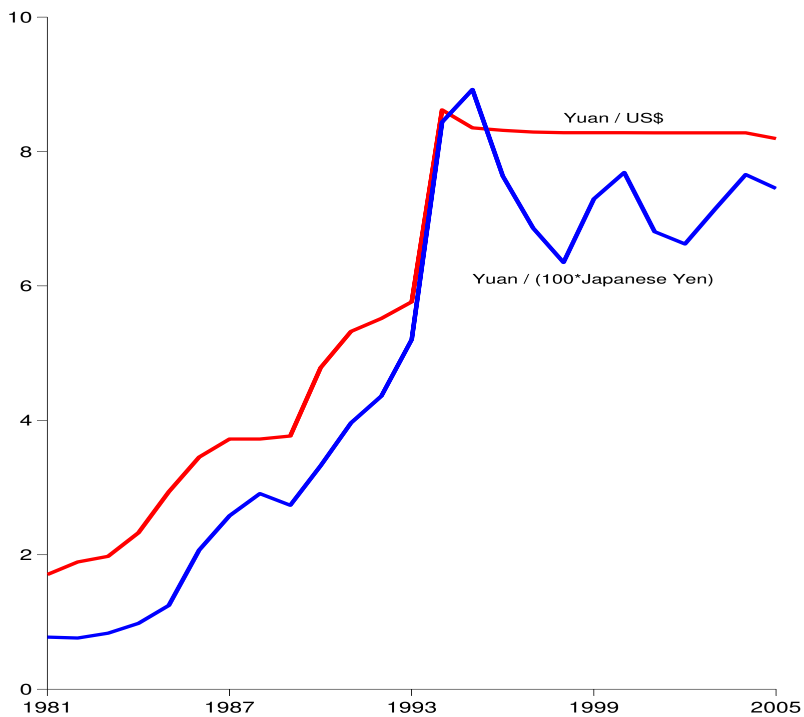

Figure 22: Nominal Exchange Rate of the RMB, 1981-2005

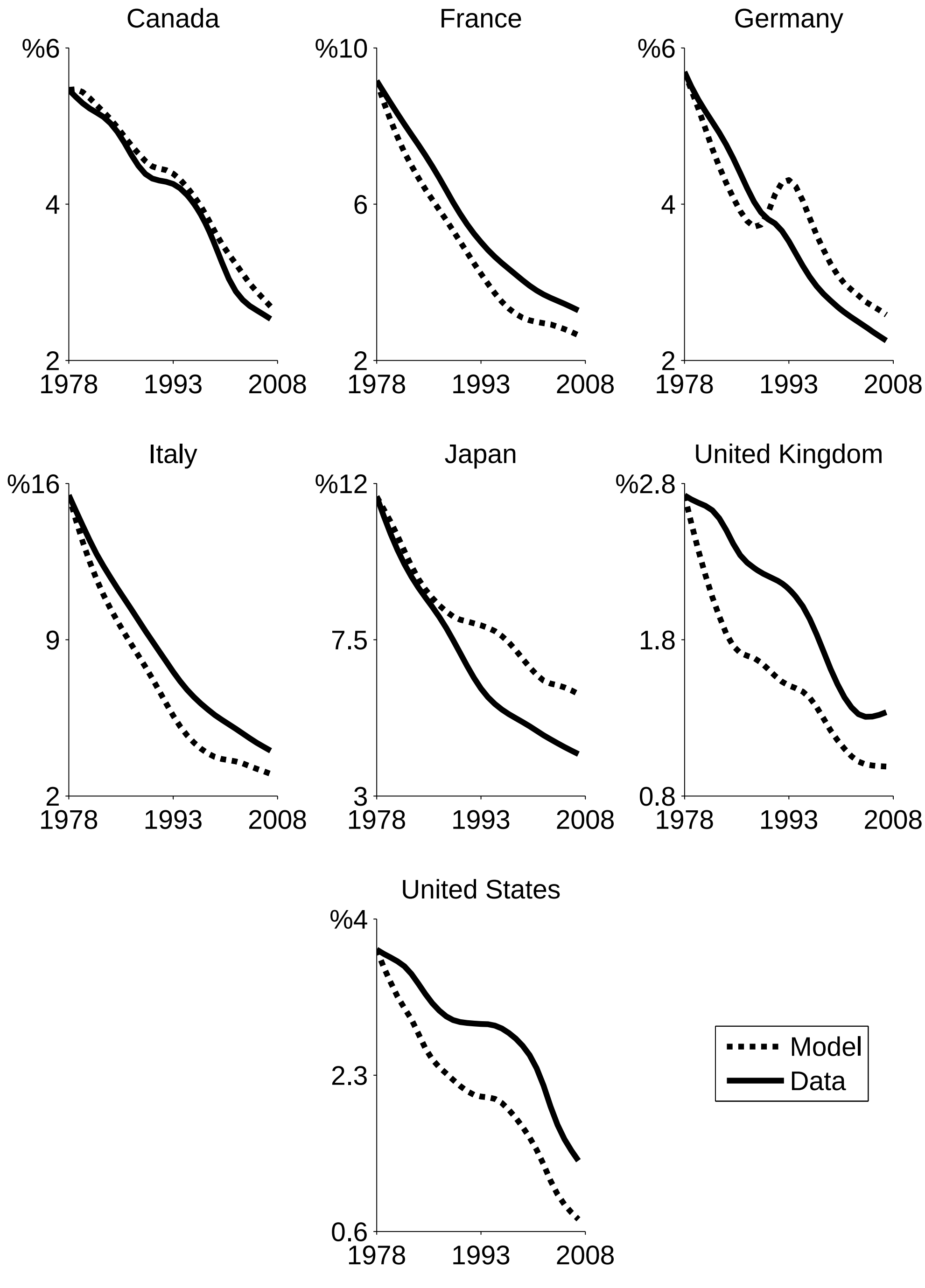

Figure 23: Employment Share of Agriculture, Data versus Model, 1978-2007

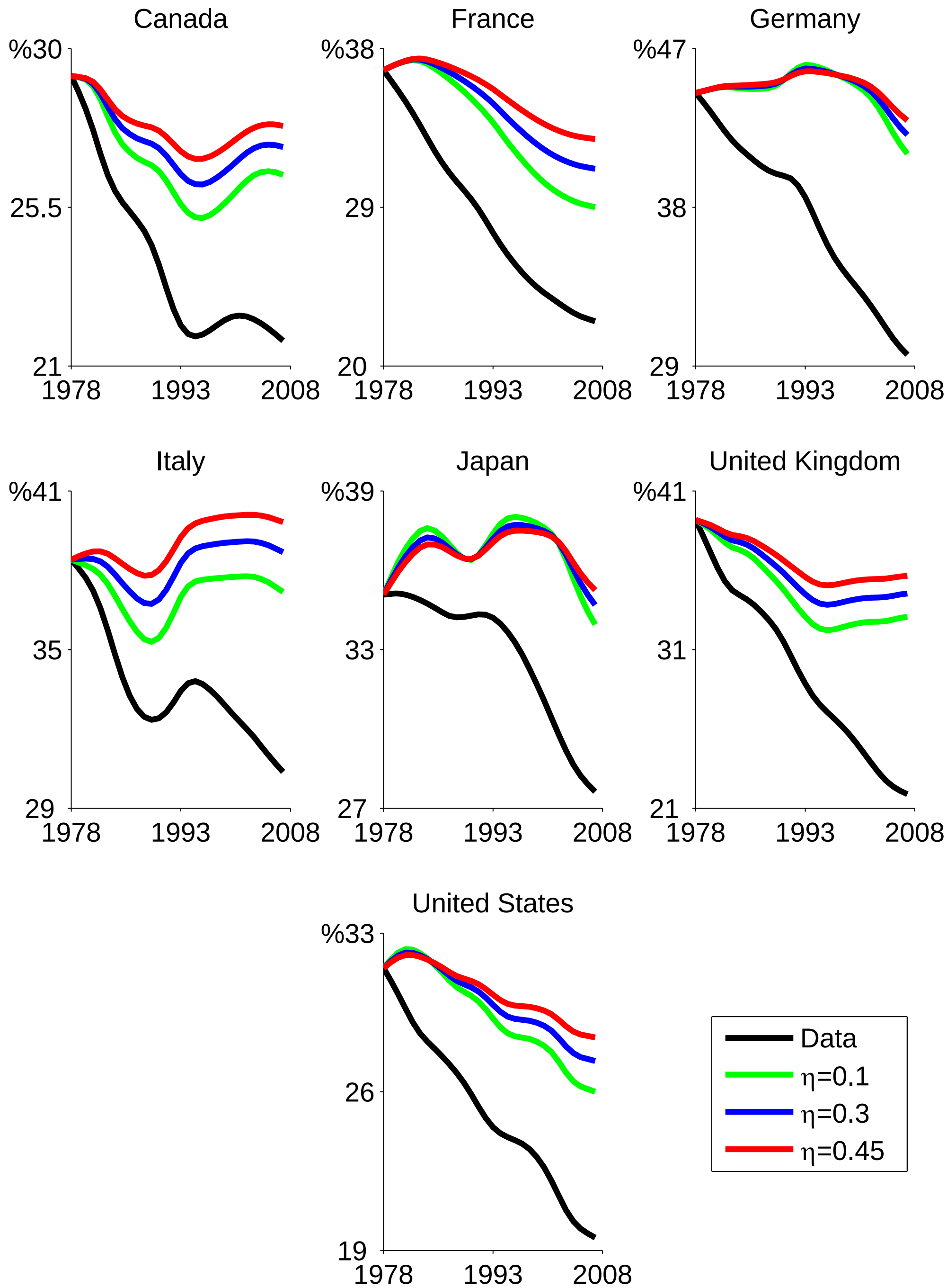

Figure 24: Employment Share of Industry, Data versus Model, 1978-2007