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Determinants of China's structural change during the reform era

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Abstract

Purpose – Economic theories on structural change focus on factors such as fluctuations in relative prices and income growth. In addition, China's reform and opening up has also been accompanied by increasing openness, significant fluctuations in investment rates, and frictions in the labor market. Existing literature lacks a unified theoretical framework to assess the relative importance of all these determinants. The paper aims to discuss these issues.

Design/methodology/approach – To incorporate all of the potential determinants of China's structural change, the authors build a two-country four-sector neoclassical growth model that embeds the multi-sector Eaton and Kortum (2002) model of international trade, complete input-output structure, non-homothetic preference and labor market frictions. The authors decompose the sectoral employment shares into six effects: the Baumol, Engel, investment, international trade, factor intensity and labor market friction effects. Using the data of Chinese economy from 1978 to 2011, the authors perform a quantitative investigation of the six determinants' effects through the decomposition approach and counterfactual exercises.

Findings – Low-income elasticity of demand, high labor intensity, and the existence of the switching costs are the reasons for the high employment share in the agricultural sector. Technological progress, investment and international trade have comparatively less influence on the proportion difference of employment in the three sectors.

Originality/value – Therefore, to examine the impact on China's structural change, in addition to Baumol effect and the Engel effect, it is also necessary to consider the impact of three more factors: international trade, investment and switching costs. Therefore, the authors decompose the factors that may influence China's structural change into the Baumol, Engel, investment, international trade, factor intensity effect and switching cost effects. The authors evaluate these six effects using the decomposition approach and counterfactual exercises.

Keywords Structural change, Chinese economy, Multi-sector model

Paper type Research paper

1. Introduction

Structural change, that is, the reallocation of economic activities across different sectors, is a common feature among most countries that have embarked on the road to industrialization. Whether measured by output share or employment share, the structural change will reflect the Kuznets curve: with the development of the economy, the proportion of the agricultural sector economy declines, while at the same time, the proportion of the service sector

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economy increases, and the proportion of the industrial sector economy slowly declines after the initial rise. The economic development since China's reform and opening up was also in line with this trend. From 1978 to 2015, the agricultural sector's employment share fell from 70.5 to 28.3 percent, with the share of value added decreasing from 27.7 to 8.9 percent; the industry sector's employment share rose from 17.3 to 29.3 percent, with the share of added value decreasing from 47.7 to 40.9 percent; the service sector's employment share increased from 12.2 to 42.4 percent, with the share of added value increasing from 24.6 to 50.2 percent. What accounts for these changes? This paper examines the determinants on China's structural change in a unified analytical framework and analyze the direction and magnitude of each of these effects.

For a long time, the Baumol effect and the Engel effect were considered as the most important factors affecting structural change. The Baumol effect was proposed by Baumol (1967), emphasizing the influence of the relative prices of products in different sectors. If there is certain complementarity among the products of different sectors, the relative lower prices of the products of the sectors with rapid technological progress will induce the transfer of labor to other sectors (Ngai and Pissarides, 2007). Acemoglu and Guerrieri (2008) further suggested that if there is the intensity of production factors differs across sectors, even if the technological progress is at the same pace, the relative prices of the products will change and structural change will be promoted.

The Engel effect is derived from Engel's law, emphasizing the influence of the income elasticity of product demand in different sectors. As the income elasticity of demand for agricultural products is lower than that of non-agricultural products, the increase in income will raise the demand for non-agricultural products more quickly, and thus result in the transfer of labor to non-agricultural sectors (Kongsamut *et al.*, 2001). The Engel effect is often introduced with non-homothetic consumer's preferences. Foellmi and Zweimuller (2008) and Boppart (2014) considered more general forms of consumption categories and consumer preferences. Li and Gong (2012) pointed out that non-homothetic preferences are also endogenous, which has an important impact on structural change.

Both the Baumol effect and the Engel effect may affect China's structural change. However, based on the latest research on China's macroeconomic characteristics and structural change, we find that the following three factors may also play an important role. First, since China's reform and opening up, the degree of openness has been increasing, and the total value of imports and exports which are measured at the current rate of RMB occupied as a share of GDP rose from 12.4 percent in 1980 to 35.8 percent in 2015. In recent years, an important breakthrough in the field of structural change highlights the role of international trade. Matsuyama (2009) proposed that, in a closed economy, the labor force will shift from the sector with lower relative prices to other sectors due to the Baumol effect. In an open economy, the lower-priced sector is more likely to export products to the international market in order to expand its demand, which may instead lead to an increase in the employment share. From this perspective, the research results are numerous. Uy *et al.* (2013), Sposi (2015) and Swiecki (2017) demonstrated that this mechanism has a significant impact, and suggested that engaging in international trade can also bring comparative advantages and increase the rate of technological progress, thus affecting structural change through the Baumol effect. Although these works do not specifically study China, they at least imply that international trade may have affected China's structural change.

Second, since China's reform and opening up, the investment rate has been above 30 percent. After 2003, the investment rate exceeded 40 percent, which was significantly higher than other countries'. According to the nine input-output tables, since 1990, about 90 percent of China's investment products come from the industrial sector. Therefore, compared with the share of industrial added value or the output share, China's investment activities have a disproportionate impact on the demand for products in the three sectors, which may affect the structural change.

Third, China's household registration system, public education, and social security have caused labor market frictions, which has caused the labor switching costs among the sectors (Cai *et al.*, 2005; Sun *et al.*, 2011). Recent research on structural change shows that the labor switching costs have an important impact on structural change. Lee and Wolpin (2006) accounted for labor's acquirement of specific human capital for each sector. This makes it difficult for the labor force to transfer across sectors and affects the productivity of sectors. Messina (2006) and Hayashi and Prescott (2008) pointed out that the switching costs caused by the institution have an important impact on the structural change of Europe and Japan. These studies indicate that China's labor market frictions may also affect the structural change.

Therefore, to examine the impact on China's structural change, in addition to Baumol effect and the Engel effect, it is also necessary to consider the impact of three more factors: international trade, investment, and switching costs. Therefore, we decompose the factors that may influence China's structural change into the Baumol, Engel, investment, international trade, factor intensity effect and switching cost effects. We evaluate these six effects using the decomposition approach and counterfactual exercises.

This paper contributes to the study of China's structural change. The existing articles which explain China's structural change focused on the impact of market frictions while considering the Baumol effect or the Engel effect. Brandt and Zhu (2010) and Brandt *et al.* (2013) found that the distortion of China's production factor market is manifested in different regions, different ownership systems, and different sectors, affecting the allocation of production factors and productivity. Gai *et al.* (2013) pointed out that labor market frictions have affected China's structural change and brought about significant efficiency losses. Cheremukhin *et al.* (2015) studied the impact of market frictions on the process of structural change in China since 1953. They quantitatively decomposed the distortions in the product market, consumer market and labor market.

In addition to market frictions, Dekle and Vandenbroucke (2012) studied the role of government scale. They pointed out that the Chinese government promotes capital accumulation by lowering tax rates, while investment products are all produced by non-agricultural sectors, which affects the structural change. Cao and Birchenall (2013) found that China's total factor productivity in the agricultural sector grows rapidly after the reform, which can broadly explain the transfer of production activities to non-agricultural sectors. These papers have made important contributions to explaining China's structural change, but only part of the above six effects have been considered. The contribution of this paper is that it simultaneously evaluates and compares all six effects and helps us to fully explain the structural change of China.

From the perspective of research methodology, this paper has developed a multi-national and multi-sectoral study about the structural change. Our model is based on the frameworks of Uy *et al.* (2013), Sposi (2015) and Swiecki (2017), all of which employed the model in Eaton and Kortum (2002). However, these studies did not consider capital and labor market frictions. We further introduce capital, investment, and labor switching costs so that we can measure the effects of investment and switching costs. The decomposition approach and counterfactual exercises that we conduct are similar to those of Dennis and Iscan (2009) and Cai (2015). Dennis and Iscan (2009) compared the Baumol effects and Engel effects on the structural change of the USA in the past two centuries, and Cai (2015) compared the difference in the Baumol and switching cost effects on the structural changes of the USA, India, Mexico and Brazil. However, they only discussed some of the six effects and did not account for the influence of all the effects.

The rest of the paper is organized as follows. The second section establishes the model; the third section conducts the theoretical analysis; the fourth section discusses the parameter calibration and the data processing; the fifth section conducts the decomposition; the sixth section includes the counterfactual exercises; the seventh section summarizes.

2. The model

This section establishes a multi-sectoral neoclassical growth model for two countries. We use the subscript i, j $\{1, 2\}$ to represent the countries where 1 and 2 represent the home country and foreign country, respectively. The agricultural (a), industrial (m) and service (s) sectors are distinguished by subscript k, n $\{a, m, s\}$. Each sector produces multi-category intermediate goods, and intermediate goods of different categories are combined into composite products that can be used for consumption or production. The production of intermediate goods for each category all uses capital, labor, and intermediate goods. The subscript χ indicates the production of the investment products. In production, the investment product production department uses intermediate goods produced by the three sectors. We adopt the Eaton and Kortum (2002) approach of trade, that is, productivity is a random variable; there are iceberg trade costs; productivity and trade costs vary across different sectors and will change over time. Assume that the agricultural land industrial sectors can trade their intermediate goods, but the service industry cannot. Preference is non-homothetic, and there are certain alternative relationships among different consumer products. Except for frictions existing in the labor market, all other markets are fully competitive[1].

2.1 Technology

Each sector produces multi-category intermediate goods, which are distributed over a continuum [0, 1] with a measure of 1. The production technology of the intermediate good z in the sector k satisfies:

$$Q_{ik}(z) = \chi_k A_{ik}(z) L_{ik}(z)^{\lambda_k} K_{ik}(z)^{\mu_k} \left[\prod_{n=a,m,s} M_{ikn}(z)^{\gamma_{kn}} \right]^{1-\lambda_k-\mu_k}, \tag{1}$$

where in $Q_{ik}(z)$ is the output; $A_{ik}(z)$ the productivity; $L_{ik}(z)$ and $K_{ik}(z)$ are the labor and capital, respectively, and $M_{\mathrm{ikn}}(\mathrm{z})$ is the compound formed by the combination of the intermediate goods and the sector n. The parameters λ_k and μ_k are constants and represent the labor and capital share in the output, respectively. The parameter γ_{kn} is a constant that represents the share of the composite product in the sector n, which satisfies $\chi_k \lambda_k^{\lambda_k} \mu_k^{\mu_k} [\prod_{n=a,m,s} (\gamma_{kn}(1-\lambda_k-\mu_k))^{\gamma_{kn}}]^{1-\lambda_k-\mu_k} = 1$. The parameter χ_k is used to normalize prices and satisfies.

Drawing on Eaton and Kortum's (2002) hypothesis, productivity $A_{ik}(z)$ obeys the Frechet distribution and the distribution function satisfies $F_{ik}(A) = e^{-TikA^{-\theta}}$. Where the parameter $T_{ik} > 0$ determines the mean value of the productivity, and the parameter $\theta > 1$ determines the variance of the productivity. The intermediate goods used by the agricultural sector and the industrial sector can be imported through international trade, but the intermediate goods used by the service sector can only be produced domestically. International trade generates iceberg trade costs, resulting in the delivery of 1 unit of intermediate goods produced by the country i's sector k to the country j, with only $1/\tau_{jik}$ units arrived. Domestic trade has no cost, i.e., $\tau_{iik} = 1$.

Different types of intermediate goods in the same sector use CES technology to form composite products, namely:

$$Q_{ik} = \left(\int_0^1 Q_{ik}(z)^{\frac{(\eta-1)}{\eta}} dz\right)^{\frac{\eta}{(\eta-1)}}\Bigg], \tag{2}$$

wherein the elasticity of substitution $\eta > 0$ is a constant. Composites cannot be traded either for final consumption or production.

The production department of investment product uses composite products from three sectors and uses Cobb-Douglas technology to produce, namely:

$$X_i = \chi_x \prod_{k=a,m,s} M_{ixk}^{\alpha_k}, \tag{3}$$

wherein X_i is an investment product; and M_{ixk} a composite product formed by a combination of intermediate goods of the sector k. The parameter α_k is a constant, indicating the share of the sector k's composite product satisfies $\chi_x \cdot \prod_{k=a,m,s} \alpha_k^{\alpha_k} = 1$. Parameter X_x is used to standardize prices and satisfies.

The labor market has friction, which is reflected in the existence of switching costs among the sectors and the gap in wages among the three sectors. We introduce the variable ξ_{ik} to measure the switching costs, assuming that labor wages in the sectors satisfy $w_{ik} = \xi_{ik} w_{ia}$. If $k = a$, there must be $\xi_{ia} = 1$. The capital market is fully competitive, and all producers face the same rent r_i.

The product market is fully competitive, and the product price is equal to the marginal cost of production. Defining the input unit cost of the sector k:

$$v_{ik} = w_{ik}^{\lambda_k} r_i^{\mu_k} \left(\prod_{n=a,m,s} P_{in}^{\gamma_{kn}}\right)^{1-\lambda_k-\mu_k}, \tag{4}$$

wherein P_{in} is the composite product price of the sector n. Therefore, the service sector category z intermediate good price is $p_{is}(z) = v_{is}/A_{is}(z)$; the agricultural and the industrial category z intermediate good price is $p_{ik}(z) = \min_{j\in\{1,2\}}\{\tau_{ijk} v_{jk}/A_{jk}(z)\}$, in which $k \in \{a, m\}$. By $A_{ik}(z)$ obeying the Frechet distribution, the price of the composite goods in the sector k satisfies:

$$P_{ik} = \Gamma \Phi_{ik}^{-\frac{1}{\theta}}. \tag{5}$$

wherein, Γ is a constant. For $k \in \{a, m\}$, $\Phi_{ik} = \sum_{j=1,2} T_{jk}\left(\tau_{ijk} v_{jk}\right)^{-\theta}$; for $k = s$, $\Phi_{ik} = T_{ik} v_{ik}^{-\theta}$.

The proportion π_{ijk} of imports from country j in all intermediate goods of country i's sector k $\{a, m\}$ is equal to the probability value that country j can sell intermediate goods of any category to country i, satisfying:

$$\pi_{ijk} = \frac{T_{jk}\left(\tau_{ijk} v_{jk}\right)^{-\theta}}{\Phi_{ik}}. \tag{6}$$

The investment product market is fully competitive. The investment product price P_{ix} is equal to the marginal cost of production, that is:

$$P_{ix} = \prod_{k=a,m,s} P_{ik}^{\alpha_k}. \tag{7}$$

2.2 Preferences

Assume that personal labor supply is not elastic and standardized to 1. Personal utility is set to:

$$c_i = \left[\sum_{k=a,m,s} \omega_k^{\frac{1}{\varepsilon}} (c_{ik} - \overline{c}_k)^{\frac{(\varepsilon-1)}{\varepsilon}}, \right. \tag{8}$$

wherein c_{ik} represents the consumer goods produced by the sector k and is composed of intermediate goods according to (2). $\overline{C_K}$ is a constant that represents the minimum level of consumption. This setting reflects the non-homothetic preferences. If $\overline{C_K} > 0$, the income elasticity of demand of consumer goods in the industry is less than 1, and vice versa. The parameter $\omega_k > 0$ is a constant that satisfies $\Sigma_{k=a,m,s}\, \omega_k = 1$. The parameter $\varepsilon > 0$ is a constant and measures the elasticity of substitution of consumer goods in the sector. We can establish c_i as a composite consumer product formed by the product mix from three sectors.

Assuming that ϕ_{ic} and ϕ_{ix} are the consumption rate and investment rate of country i, respectively, we can conclude that:

$$\sum_{k=a,m,s} P_{ik} c_{ik} L_k = \Phi_{ic} Y_i, \tag{9}$$

$$\mathrm{P}_{ix} X_i = \Phi_{ix} Y_i, \tag{10}$$

wherein Y_i is the final product; L_i the total population.

To solve utility maximization:

$$P_{ik}(c_{ik} - \overline{c}_k) = \frac{\omega_k P_{ik}^{1-\varepsilon} c_i}{P_{ic}^{1-\varepsilon}} P_{ic} c_i. \tag{11}$$

Among these values, P_{ic} represents the price of compound consumer goods, meeting the requirements:

$$P_{ic} = \left(\sum_{k=a,m,s} \omega_k P_{ik}^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}. \tag{12}$$

2.3 The market clearing conditions

The amount of capital and labor is K_i and L_i, and the allocation of sub-sectors is represented by K_{ik} and L_{ik}. The clearing conditions of production factor market are:

$$\xi_{ik} w_{ia} L_{ik} = \lambda_k P_{ik} Q_{ik}, \tag{13}$$

$$r_i K_{ik} = \mu_k P_{ik} Q_{ik}, \tag{14}$$

$$L_i = \sum_{k=a,m,s} K_{ik}, \tag{15}$$

$$\mathrm{K}_i = \sum_{k=a,m,s} K_{ik}. \tag{16}$$

Outputs of the agricultural and industrial sectors are used for domestic consumption, domestic investment, intermediate goods of the agricultural and industrial sectors of the two countries, and intermediate goods of the service sectors in one's own country:

$$P_{ik}Q_{ik} = P_{ik}c_{ik}L_i + \alpha_k P_{ix}X_i + \sum_{n=a,m}(1-\lambda_n-\mu_n)\gamma_{nk}\sum_{j=1,2}\pi_{jin}P_{jn}Q_{jn} + (1-\lambda_s-\mu_s)\gamma_{sk}P_{is}Q_{is}. \quad (17)$$

The output of the service industry is used for domestic consumption, domestic investment and intermediate goods in the three sectors of the country:

$$P_{is}Q_{is} = P_{is}c_{is}L_i + \alpha_s P_{ix}X_i + \sum_{n=a,m,s}(1-\lambda_n-\mu_n)\gamma_{nk}P_{in}Q_{in}. \quad (18)$$

3. Six effects on the structural change

Define l_{ik} as the employment proportion of sector k, i.e., $l_{ik} = L_{ik}/L_i$. We can break l_{ik} into:

$$l_{ik} = (\Lambda_{ik,\text{Baumol}} + \Lambda_{ik,\text{Engel}} + \Lambda_{ik,\text{inv}} + \Lambda_{ik,\text{trade}}) \times \Lambda_{ik,\text{intensity}} \times \Lambda_{ik,\text{wedge}}, \quad (19)$$

wherein $\Lambda_{ik,\text{Baumol}}$, $\Lambda_{ik,\text{Engel}}$, $\Lambda_{ik,\text{nv}}$, $\Lambda_{ik,\text{trade}}$, $\Lambda_{ik,\text{intensity}}$ and $\Lambda_{ik,\text{wedge}}$ represent the Baumol, Engel, investment, international trade, factor intensity and switching cost effects, respectively:

$$\Lambda_{ik,\text{Baumol}} = \sum_{n=a,m,s} d_{nk}\Omega_{in,\text{Baumol}}, \quad (20)$$

$$\Lambda_{in,\text{Engel}} = \sum_{n=a,m,s} d_{nk}\Omega_{in,\text{Engel}}, \quad (21)$$

$$\Lambda_{ik,\text{inv}} = \sum_{n=a,m,s} d_{nk}\Omega_{in,\text{inv}}, \quad (22)$$

$$\Lambda_{ik,\text{trade}} = \sum_{n=a,m,s} d_{nk}\Omega_{in,\text{trade}}, \quad (23)$$

$$\Lambda_{ik,\text{intensity}} = \frac{\lambda_k \sum_{n=a,m,s}(\lambda_n + \mu_n)\phi_{iqn}}{\sum_{n=a,m,s}\lambda_n \phi_{iqn}}, \quad (24)$$

$$\Lambda_{ik,\text{wedge}} = \frac{1/\xi_{ik}}{\sum_{n=a,m,s}\Theta_{in}/\xi_{in}}, \quad (25)$$

wherein, d_{nk} is a constant formed by Leontief (1949) matrix generation, which is determined by λ_k, μ_k and γ_{kn}:

$$\Omega_{ik,\text{Baumol}} = \frac{\omega_k P_{ik}^{1-\varepsilon}}{\sum_{n=a,m,s}\omega_n P_{in}^{1-\varepsilon}} \times \phi_{ic},$$

$$\Omega_{ik,\mathrm{Engel}} = \left(\frac{\sum_{n\neq k}\omega_n P_{in}^{1-\varepsilon}}{\sum_{n=a,m,s}\omega_n P_{in}^{1-\varepsilon}}\right)\frac{P_{ik}\bar{c}_k}{y_i} - \frac{\omega_k P_{ik}^{1-\varepsilon}}{\sum_{n=a,m,s}\omega_n P_{in}^{1-\varepsilon}} \times \sum_{n\neq k}\frac{P_{in}\bar{c}_n}{y_i},$$

$$\Omega_{ik,\mathrm{inv}} = \alpha_k \phi_{ix},$$

$$\Omega_{ik,\mathrm{trade}} = \left[\sum_{n=a,m}\pi_{jin}(1-\lambda_n-\mu_n)\gamma_{nk}P_{jn}Q_{jn} - \sum_{n=a,m}\pi_{ijn}(1-\lambda_n-\mu_n)\gamma_{nk}P_{in}Q_{in}\right]/Y_i$$

Of these, $y_i = Y_i/L_i$ represents the ratio of final product to labor, $\phi_{iqk} = P_{ik}\, Q_{ik}/\sum_n a, m, sP_{in}Q_{in}$ represents the output proportion of the sector, $\Theta_{ik} = w_{ik}L_{ik}/\sum_{n=a,m,s}w_{in}L_{in}$ represents the proportion of labor income in the sector.

We refer to Equation (20) as the Baumol effect, because it captures the effect of changes in the relative price of the product, which is similar to the economic mechanism highlighted by Ngai and Pissarides (2007). The decrease in relative prices led to an increase in actual demand for sectoral products. However, when $\varepsilon < 1$, that is, the elasticity of substitution of the three industrial consumer goods is relatively small, the relative price decrease plays a leading role, causing a rise in the proportion of departmental product consumer spending, and the proportion of sectoral employment will tend to decline. Compared with Ngai and Pissarides (2007), there are two differences in the Equation (20). The first is that the consumption rate will affect the Baumol effect. The drop in the consumption rate not only directly reduces the employment share in the industry but also reduces the impact of relative prices on the employment share in the industry. The second is that in addition to production technology, there are other factors that affect relative prices. Through Equations (5) and (6), we can conclude that $P_{ik} = \Gamma(\pi_{iik}/T_{ik})^{1/\theta}\upsilon_{ik}$, and the higher the technical level, the greater the share of international trade, or the lower the production cost is, the lower the product price is. This reflects the comparative advantages of international trade, because the greater the degree of participation for an sector in international trade is, the higher the level of production technology relative to the closed economy is, and the lower price of the product is.

We call (21) the Engel effect because it captures the effect of income elasticity of demand, which is similar to the economic mechanism highlighted by Kongsamut *et al.* (2001). With the increase of income, the demand for products will rise. However, if income elasticity of demand of products is relatively small, the rise of demand for products will be slower than incomes', resulting in a decrease in the proportion of product consumption expenditures; and vice versa. According to (21), as the increase of income, if $\overline{C_K} > 0$, the first part of $\Omega_{ik,\ \mathrm{Engel}}$'s right side will fall, resulting in a decrease in the employment share of the sector. In the other two sectors, $\Omega_{ik,\mathrm{Engel}}$, where the second part of the right side will decline, the situation results in an increase in the employment share, and vice versa. As the income level increases, the effect of the minimum consumption level will decrease, and the Engel effect will also gradually decrease.

We call (22) the investment effect because it captures the impact of the investment. Since the production of investment goods requires the products of three sectors as intermediate goods, if the investment rate increases, the investment effect will increase the employment share accordingly. The increase in investment rate will always be accompanied by a decline in the consumption rate or net export rate, but this effect is captured by other effects. The impact of investment on the three sectors is different. If the production of investment products uses more composite products of the sector k, that is, the α_k is higher than the other two sectors, and the other conditions remain unchanged, then investment has the greatest degree of the impact on the sector.

We call (23) the effect of international trade because it captures the impact of international trade, which is similar to the economic mechanism highlighted by Matsuyama (2009) and Uy *et al.* (2013). The variable $\Omega_{ik,\text{trade}}$ measures the proportion of net exports of products in the sector to the total added value. $\Omega_{ik,\text{trade}} > 0$ means that the product exports are greater than the imports. If $\Omega_{ik,\text{trade}}$ is higher, a significant amount of products in the sector will be exported to the international market, and the positive impact on the employment share will be higher. International trade can also influence production technology through comparative advantage, but this indirect effect is captured by other effects.

In fact, $\Omega_{ik,\text{Baumol}}$, $\Omega_{ik,\text{Engel}}$, $\Omega_{ik,\text{inv}}$, and $\Omega_{ik,\text{trade}}$ measure the effects of the Baumol, Engel, investment and international trade effects applied to sector output. However, since the output of each department must become the intermediate good of other departments, the Baumol effect, Engel effect, investment effect, and international trade effect that affect the employment share in the industry are measured by $\Lambda_{ik,\text{Baumol}}$, $\Lambda_{ik,\text{Engel}}$, $\Lambda_{ik,\text{inv}}$ and $\Lambda_{ik,\text{trade}}$, each of which is also a sum of three sectors, and its weightiness is determined by the parameters λ_k, μ_k and γ_{kn}.

We call (24) the factor-intensity effect because it captures the influence of factor intensity, which is similar to the economic mechanism emphasized by Acemoglu and Guerrieri (2008). According to (24), under the same conditions, the employment share in the sectors with higher labor-intensity is relatively higher. Moreover, if the proportion of output in the sectors with higher labor-intensity begins to decline, the factor-intensity effects of the three sectors will increase, and the degree of impact on the proportion of industrial employment will also increase.

We call (25) the switching costs effect because it captures the impact of labor switching costs among sectors, which is similar to the economic mechanism highlighted by Cheremukhin *et al.* (2015). According to (25), under the same conditions, the employment share in sectors with higher switching costs is relatively lower; as the switching costs decrease, the employment share will increase inversely. Moreover, if the proportion of labor wages in sectors with a higher proportion of switching costs increases in the total labor wages, the effect of switching costs in all of the three sectors will increase, and the degree of influence on the employment share will also increase.

Consider the dynamic changes of l_{ik}, we use $\widehat{Z}$ to represent the logarithmic growth rate of the variable Z. Through (19) we can get:

$$\hat{l}_{ik} = \frac{\Lambda_{ik,\text{Baumol}}}{\Lambda_{ik,\text{sum}}}\hat{\Lambda}_{ik,\text{Baumol}} + \frac{\Lambda_{ik,\text{Engel}}}{\Lambda_{ik,\text{sum}}}\hat{\Lambda}_{ik,\text{Engel}} + \frac{\Lambda_{ik,\text{inv}}}{\Lambda_{ik,\text{sum}}}\hat{\Lambda}_{ik,\text{inv}} + \frac{\Lambda_{ik,\text{trade}}}{\Lambda_{ik,\text{sum}}}\hat{\Lambda}_{ik,\text{trade}} + \hat{\Lambda}_{ik,\text{intensity}} + \hat{\Lambda}_{ik,\text{wedge}}. \quad (26)$$

Besides, $\Lambda_{ik,\text{sum}} = \Lambda_{ik,\text{Baumol}} + \Lambda_{ik,\text{Engel}} + \Lambda_{ik,\text{inv}} + \Lambda_{ik,\text{trade}}$. We will use the above formula to carry out decomposition accounting.

4. Parameter calibration and data processing

4.1 Parameter calibration

4.1.1 Production. We differentiate sectors according to the National Bureau of Statistics National Industry Classification Standards. The parameters $\{\lambda_k, \mu_k, \gamma_{kn}, \alpha_k\}$ determine the relative shares of capital, labor and intermediate goods in the three sectors and investment product sector. We selected nine national input-output tables from 1990 to 2010, calculating the capital, labor and intermediate inputs for different sectors in each table, and summed up the sectors according to the sectors, and then obtained $\{\lambda_k, \mu_k, \gamma_{kn}, \alpha_k\}$. After that, we take the mean value of these as the estimated value of $\{\lambda_k, \mu_k, \gamma_{kn}, \alpha_k\}$. The parameter η determines the elasticity of substitution for different categories of products but does not affect the quantitative results. According to the estimations of Simonovska and Waugh (2014), we take $\theta = 4$.

4.1.2 Preferences. We learn from Uy *et al.* (2013), and take $\varepsilon = 0.751$, $\overline{cm} = 0$. Thus, the undetermined parameters are $\{\omega_a, \omega_s, \overline{ca}, \overline{cs}\}$. We adjust the values of these four parameters, to make the proportion of the nominal consumption of the three sectors calculated by the Equation (11) to the total consumption be in line with the real economy in China. To this end, we need at least two years' nominal consumption and prices for the three sectors, as well as the total labor force. We used the final consumption data in the input and output tables of 1997 and 2007, and summed them up in industry to obtain the nominal consumption of the three sectors. After that, we used the deflator of industry's added value to obtain the industrial added value price index in 1997 and 2007, and took them as the price of the sector. Finally, we obtained the total labor force in 1997 and 2007 from the China Statistical Yearbook. Normalize $\overline{ca}$ to 1, where $\overline{cs}$ 1 is equal to the ratio between $\overline{cs}$ and $\overline{ca}$ in the estimated result. Table I shows the values of all the parameters.

4.2 Data processing

4.2.1 Production. First, we construct the nominal value and the actual value of the added value in the three sectors. Based on the nominal value (VA_k^{CHN}) and index (VA_k^{INX}) of the RMB price measurement given by the National Bureau of Statistics, using the Penn World Table (PWT) purchasing power parity PPP and the nominal exchange rate to obtain the nominal value of PPP measurement and US dollar measurement of the current year (VA_k^{cPPP}, VA_k^{USD}). Afterwards, calculating the value added of the PPP constant value segment in 2005 (VA_k^{05PPP}). First, set $VA_{k,2005}^{05PPP} = VA_{k,2005}^{cPPP}$, and then through $(VA_{kt}^{05PPP}/VA_{k2005}^{05PPP}) = (VA_{kt}^{INX}/VA_{k2005}^{INX})$, iterate toward other years' data. Second, we construct the capitals of three sectors. Based on the output $P_kQ_k = VA_k^{cPPP}/(\lambda_k + \mu_k)$ measured in PPP of the current year, we use PWT 2005 PPP constant price to measure the total capital, and get $K_k = \mu_k P_k Q_k K/\sum_{n=a,m,s} \mu n P_n Q_n$. Third, we construct the labor of three sectors. After demographic censuses in 2000 and 2010, the National Bureau of Statistics adjusted employment data, but did not adjust the total employment data before 1990. Based on the census data, Holz (2006) adjusted the total employment and sub-industry employment data before 1990. We obtained employment data (before 1990) from Holz (2006) and subsequent employment data from the China Statistical Yearbook.

4.2.2 Demand. First, directly use the ratio of gross capital formation to GDP declared by the National Bureau of Statistics as the investment rate $\o_{\text{ix}}$.

Second, we construct international trade data for the agricultural sector and the industrial sector. The data comes from COMTRADE. According to the classification of SITC Rev.1, the goods belonging to code 0 are classified as the agricultural industrial products, and the goods of code 1–9 are classified as the industrial products. Afterwards, π_{ijk} can be

Table I. Results of parameter calibration

	Production							Consumption		
	λ_{kn} $(1 - \lambda_k - \mu_k)$									
Sector	a	m	s	λ_k	μ_k	a_k	θ	ω_k	$\bar{c}_k$	ε
a	0.158	0.178	0.060	0.523	0.081	0.035		0.061	1	
m	0.062	0.553	0.108	0.100	0.177	0.910	4	0.290	0	0.751
s	0.017	0.270	0.190	0.230	0.293	0.055		0.649	−2.94	

directly calculated by using the nominal added value and output measured by three sectors in US dollars. Due to the absence of international trade data in China before 1984, we take the 1984s value of π_{ijk} as the values before 1984. Figure 1 shows the calculated π_{11k}. Third, we use 1 minus the investment rate and net export rate to get the consumption rate Φ_{ic}. Compared with the data from the National Bureau of Statistics, the consumption rate calculated by us is slightly higher. However, except for individual years, the gap between the consumption rate and the statistics bureau data does not exceed 1 percentage point.

Price. First, to create the production technical parameter T_{ik}, we first calculate total factor productivity of the added value TFP_{ik}^{V}, and then calculate the total factor productivity of the output $\mathrm{TFP}_{ik}^{O} = (\mathrm{TFP}_{ik}^{V})^{\lambda_k + \mu_k}$. According to (5) and (6), if we know the values of TFP_{O}^{ik} and π_{iik}, the technical parameter T_{ik} can be calculated. Figure 2 shows the technical parameters of the three sectors, which normalized the value of 1978 to 1. Second, solve price levels of P_{ik} and P_{ic}. Given the nominal added value, capital, labor, international trade share and technical parameters of the three sectors, we first normalized the price of the first industrial product in 1978 to 1; then substituted (13) and (14) into (4), wrote v_{ik} as P_{ik}, before substituting into (6), and wrote Φ_{ik} as P_{ik}. Finally, after entering (5), the three-dimensional linear equations about log P_{ik} can be obtained to get P_{ik}. Given P_{ik}, use (12) to obtain P_{ic} through calculation.

5. Decomposition approach

First, we set the values of y and T_k in 1978. To this end, we choose the proportion of nominal added value of the three sectors in 1978 and 2011, and the proportion of nominal output in

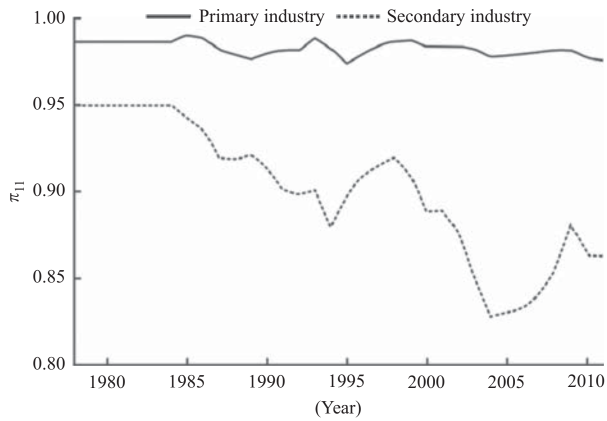

Figure 1.
Changes in the share of international trade in the primary industry and the secondary industry

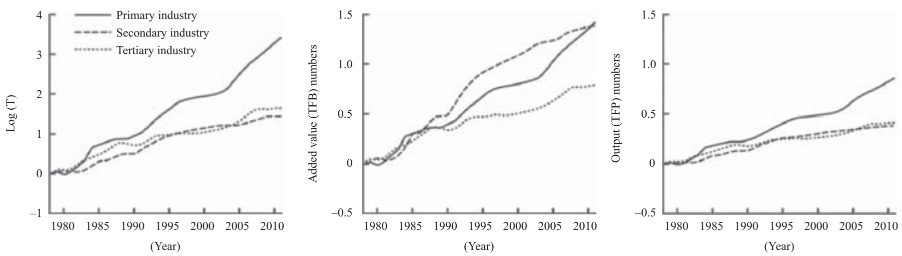

Figure 2.
Technological changes in the three sectors

1992 and 2007 as the target, which will minimize the gap between models and data. After the initial conditions are selected, the ratio between the value of the total added value per year and the labor can be calculated through the value-added and labor data. Using the T_k calculated, the technical parameters of each year can be obtained, and also the product prices of the sector can be obtained. Afterward, we calculate the Baumol effect, Engel effect, investment effect, international trade effect and factor concentration effect according to the Equations (20)–(24), and then obtain switching costs effect with Equation (19). Figure 3 shows the calculated switching costs. Finally, decompose and calculate the structural change with Equation (26).

Table II reports the accounting results according to the periods from 1978 to 2011. Due to the lack of data on international trade in different sectors before 1984, Table II only sums up

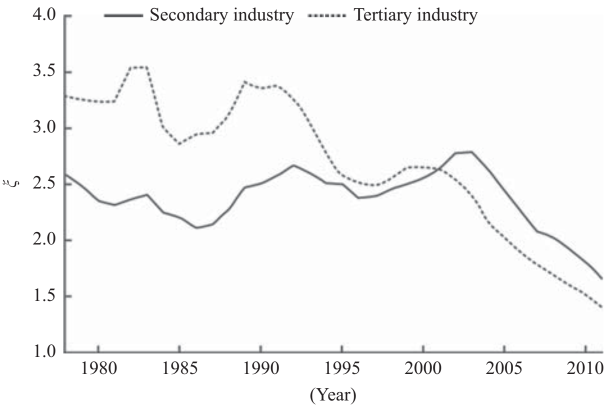

Figure 3. Switching costs of the secondary industry and tertiary industry

Period	Changes in the employment share (%)	Impact of six effects (%) Baumol	Engel	Investment	International trade	Factor intensity	Switching costs
Agricultural sector							
1978–1984	−6.5	1.7	−9.3	−1.3	0.0	1.7	0.7
1984–1992	−5.5	−2.7	−19.0	2.0	2.0	3.4	8.8
1992–2000	−8.5	1.9	−8.5	−2.6	−0.5	1.4	−0.2
2000–2011	−15.2	−4.6	−3.5	5.3	−0.7	0.8	−12.5
1984–2011	−29.2	−5.4	−31.0	4.7	0.8	5.6	−3.9
Industrial sector							
1978–1984	2.6	0.5	0.0	−1.2	0.0	0.5	2.8
1984–1992	1.8	−1.0	0.3	1.6	0.3	1.2	−0.6
1992–2000	0.8	0.6	0.1	−1.8	0.5	0.5	0.9
2000–2011	7.0	−2.3	0.1	5.1	0.2	0.5	3.4
1984–2011	9.6	−2.7	0.5	4.9	1.0	2.2	3.7
Service sector							
1978–1984	3.9	1.0	1.5	−0.4	0.0	0.4	1.4
1984–1992	3.7	−1.6	2.7	0.5	0.1	1.0	1.0
1992–2000	7.7	1.4	1.4	−0.6	0.1	0.6	4.8
2000–2011	8.2	−6.1	0.9	2.2	0.0	0.6	10.6
1984–2011	19.6	−6.3	5.0	2.1	0.2	2.2	16.4

Table II. 1978–2011 China's structural change the results of the period from 1984 to 2011. Table II shows that the Engel effect, investment effect and switching costs effect are the most important factors affecting the change in the employment share in the primary, secondary and service sectors, respectively, and the direction and degree of influence will also change in different periods. From 1984 to 2011, the employment share in the agricultural sector decreased by 29.2 percent, and the Engel effect decreased by 31.0 percent.

The employment share in the industrial sector has increased by 9.6 percent, of which the investment effect has increased by 4.9 percent; the employment share in the service sector has increased by 19.6 percent, where the switching costs effect has increased by 16.4 percent. The Engel effect has always been negative in the direction of the agricultural sector, but the degree of influence has gradually weakened. During the period of 2000 to 2011, the employment share was only reduced by 3.5 percent, which was lower than the degrees of Bowmore effect and switching costs effect. The direction of the investment effect on the industrial sector has changed. The employment share has been reduced during the two periods (1978–1984 and 1992–2000); and the investment effect was lower before 2000, and its significant impact mainly occurred in 2000–2011. So the proportion of its employment increased during this period. In 7 percentage points, the investment effect accounted for 5.1 percent. The impact of the switching costs effect on the service sector has always been positive, and the degree of influence has gradually increased. The percentage of employment increased by 10.6 percent from 2000 to 2011, which was higher than the impact of all previous periods.

The role of the Engel effect on the employment share in the agricultural sector is consistent with the changing trend of the Engel coefficient in China. According to data from the National Bureau of Statistics, the Engel coefficients of urban residents and rural residents in China from 1978 to 2011 were reduced from 57.5 and 67.7 percent to 3 and 40.4 percent, respectively, which means that the ratio of consumption of agricultural sector accounting for household consumption dropped significantly. This is consistent with the minimum consumption level of the agricultural sector that we have fitted, indicating that the proportion of agricultural products in consumption will decline as income increases. However, this degree of influence is gradually weakening. This situation is consistent with the Chinese economy. Although the Engel coefficient has been declining since the reform and opening up in China, the decline has slowed down from 2000 to 2011, and the Engel coefficients of urban residents and rural residents dropped only by 3.1 percentage points and 8.7 percentage points, respectively, which was significantly lower than those years' before 2000.

The role of the investment effect on the employment share in the industrial sector is consistent with the trend of changes in the Chinese investment rate and the investment structure. During the period from 1978 to 2011, China's investment rate rose from 38.2 to 48.3 percent. Since 91.0 percent of investment products come from the industrial sector, the increase of investment rate will significantly enhance the employment share in the industrial sector. It is worth noting that investment rates have declined in both the period of 1978–1984 and 1992–2000, and the effect of investment has also been negative. By 2000, the investment rate was 35.3 percent, even lower than the level of 1978, so the investment effect was negative overall by 2000. After that, the investment rate began to rise, and it increased by 13.0 percent in 2000–2011. Therefore, the positive effect of the investment effect on the industrial sector in this period has been significantly enhanced.

The role of switching costs effect on the employment share in the service sector is consistent with the trend of changes in switching costs. According to Figure 3, the most significant decline on the switching costs of the service sector was from 1978 to 2011, which means that the proportion of service sector employment is the most affected. Although the switching costs of the service sector fluctuate in some years, it still showed a downward trend throughout the period. In the early 1980s and early 1990s, the switching costs of the service sector had sharply fallen for two times. This may be related to the reform of the economic system in the same period. After 2000, the switching costs of the service sector continued to decline, which was in line with the influence of the reform of the household registration system after 1998. It is worth noting that, compared with the past, the decline in switching costs in 2000–2011 did not significantly increase, but the degree of influence exceeded the sum of all previous years'. This is also consistent with the previous analysis. Since the switching costs effect is affected by the proportion of labor wages in the sector, the increase in the share of employment in the service sector will also increase its impact.

In addition to the above three effects, the Baumol effect has a greater impact on the agricultural sector and service sector. The effects of international trade have a greater impact on the agricultural sector and industrial sector, and the effects of factor intensity have the greatest impact on the agricultural sector. According to the previous analysis, the Baumol effect is influenced by the consumption rate and relative commodity prices. The impact of the Baumol effect on the changes of direction is mainly caused by the changes in consumption rate over the same period. For example, the decline in China's consumption rate after 2000 has caused the Baumol effect to have negative effects on the three sectors over the same period. The effect of international trade is affected by changes in the net export rate of products in the sector. The net export rate of China's agricultural sector started to decline after 1992, and the international trade effect also turned negative. The net export rate of the industrial sector was always positive, and the international trade effect was always positive. Although the impact of international trade on the employment share in the agricultural sector was also significant before 2000, however, due to the shift in the direction of influence, international trade had little impact on the agricultural sector during the entire period from 1984 to 2011. The effect of factor intensity is affected by the changes in the proportion of industrial output. As the average labor intensity of China's agricultural sector is 86.6 percent, which is significantly higher than that of the industrial sector and service sector, and the output ratio of the agricultural sector is continuously declining, and according to the previous analysis, the factor intensity effects of the three sectors will be positive and will have the greatest impact on the agricultural sector.

Compared with the other effects, the effect of international trade is not significant, which is related to the characteristics of China's trade. Since China's reform and opening up, total exports and imports have been growing rapidly, but the overall net export rate is not high. Although the net export rate has increased significantly since 2005, it has begun to decline after being influenced by external demand shocks in 2009, offsetting the previous impact. The result in Figure 1 also roughly matches this trend. To verify this mechanism, we further decompose the net exports in the international trade effect into imports and exports, so that the independent effects of exports and imports can be separated. Table III gives the main results. It can be seen that the impact of export trade is very significant. From 1984 to 2011, the employment share in the agricultural and industrial sectors increased by 5.3 and 6.8 percentage points, respectively, and even influenced 1.7 percentage points for the

	Agricultural sector			Industrial sector			Service sector		
Period	Totality (%)	Export (%)	Import (%)	Totality (%)	Export (%)	Import (%)	Totality (%)	Export (%)	Import (%)
1984–1992	2.0	4.6	−2.6	0.3	3.1	−2.8	0.1	0.8	−0.7
1992–2000	−0.5	−0.1	−0.4	0.5	1.4	−0.9	0.1	0.3	−0.2
2000–2011	−0.7	0.8	−1.5	0.2	2.3	−2.1	0.0	0.6	−0.6
1984–2011	0.8	5.3	−4.5	1.0	6.8	−5.8	0.2	1.7	−1.5

Table III. The impact of international trade on the structural change in China service sector. The impact of export trade on the agricultural sector mainly occurred during the period of 1984–1992, and the impact on the industrial sector was evenly distributed throughout the entire period. However, the impact of export trade was offset by imports to a great extent, resulting in that effect of international trade was not significant.

6. Counterfactual exercises

This section discusses counterfactual exercises. In order to assess the impact of production technology, we successively keep the production technical parameters of the three sectors in line with the parameters of 1978. The simulation results are shown in Figure 4. It can be seen that the technological progress of the agricultural sector has a relatively large impact on the structural change. If there is no technological progress in the sector, the proportion of its employment will increase significantly, and the employment share in the industrial sector and service sector will decline. By 2011, the employment share in the agricultural sector will increase by 3.4 percent, and the share of employment in the industrial sector and service sector will decrease by 1 and 2.4 percent, respectively. Technological progress in the industrial and service sectors has little impact on the structural change, whose proportion is within 1 percent. This is consistent with the results of Figure 2. According to the left column of Figure 2, the growth rate of the technical parameters of the agricultural sector is significantly higher than that of other sectors; the growth rate of the technical parameters of the industrial and service sectors is relatively lower, and it does not appear to be too much difference between them.

In order to assess the impact of non-homothetic preferences, we set the minimum consumption levels of the agricultural and service sectors to zero, which means that the three sectors have equal income elasticity of demand for products. The results of the simulation are shown in Figure 5. It can be seen that non-homothetic preferences have a significant impact on the structural change. If the three sectors have the same income elasticity of demand, the employment share in the agricultural sector will drop sharply, and that in the industrial and service sectors will increase significantly. With the increase in income per capita, the minimum level of consumption has dropped significantly relative to

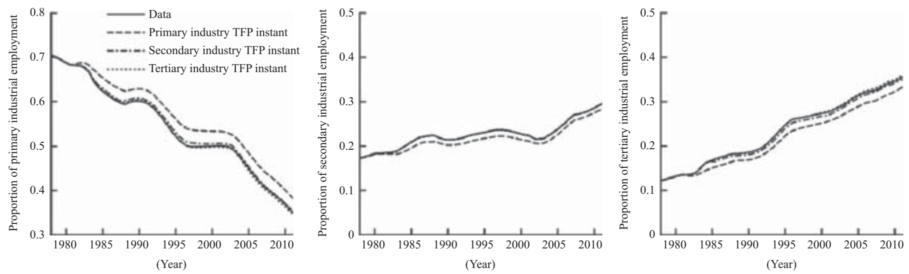

Figure 4.
Impact of technological progress on transformation of industrial structure

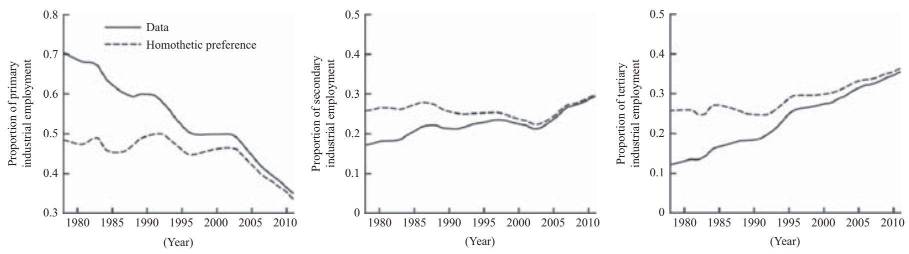

Figure 5.
Impact of non-homothetic preferences on the structural change

income, and the influence of non-homothetic preferences on the employment share has gradually declined. By 2011, the gap between non-homothetic preferences and the actual data had already narrowed within 1.5 percentage points. Compared with the impact of technological advances, the influence of non-homothetic preferences is even more important, which is consistent with the conclusions of Herrendorf *et al.* (2013). They found that non-homothetic preferences and income growth have a significant impact on the proportion of sub-sectors for final consumption goods, while changes in price only have a significant effect on the proportion of sub-sectors for the added value of consumption. Since the consumption in this model corresponds to the final consumer goods in the data rather than the added value, the comparison between Figures 4 and 5 also proves that the income growth is more important than the price fluctuation in explaining the structural change.

To assess the impact of investment, we successively keep the investment rate at the level of 38.2 and 20 percent in 1978, and, respectively, carry out simulations. Figure 6 shows the results. It can be seen that the impact of investment rate on the employment share in the industrial and service sectors is greater than that in the agricultural sector. If the investment rate remains at the level of 1978, by 2011, the employment share in the industrial sector will be 2.3 percentage points lower than the actual figure, and the employment share in the service sector will be 2.8 percent higher than the actual figure. The fluctuation of investment rate also caused the situation that the employment share under the counterfactual exercises to fluctuate around the actual data, and the direction of the fluctuation is consistent with the changes in the investment rate over the same period. It is precisely due to this characteristic that investment has less influence over the entire period since the reform and opening up. If we reduce the investment rate to 20 percent, by 2011, the employment share in the industrial sector will be 6.9 percentage points lower than the actual figure, and the employment share in the service sector will be 8.3 percentage points higher than the actual figure. Then, the investment effect will be more significant.

In order to assess the impact of international trade, we take the value of the net export rate and the international trade share of the industry for each year at zero, namely, simulating a closed economy. The results are shown in Figure 7. Compared with decomposition accounting, the impact of international trade in Figure 7 also includes the effect of comparative advantage on the technological level of the sector. It can be seen that the impact of international trade on the structural change has fluctuated. Before 2004, international trade increased the proportion of its employment in the agricultural sector, and the impact was basically within 1 percentage point. Before 1994, international trade had reduced the employment share in the industrial sector, but basically shifted to increase the employment share after 1995, especially in 2005–2011, the impact became more pronounced, and the degree of changes in the service sector also expanded during the same period.

To assess the impact of factor intensity, we use the value of labor intensity in the industrial sector as the agricultural sector's and keep the values of the industrial and service sectors unchanged. The results of the simulation are shown in Figure 8. It can be seen that

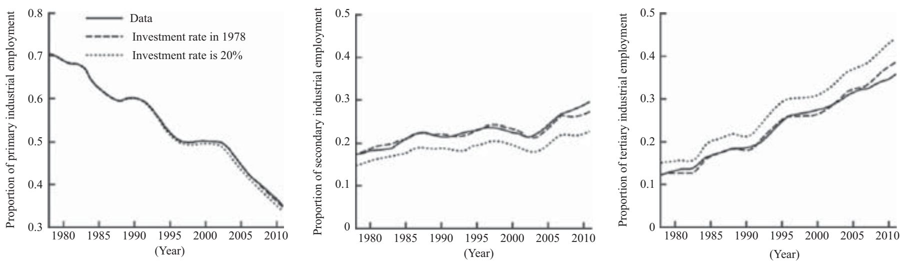

Figure 6.
Investment Impact on the structural change

the difference in factor intensity among the sectors has a significant impact on the structural change. Since the labor intensity of the agricultural sector (86.6 percent) is significantly higher than that of the industrial sector (36.1 percent), the employment share in the agricultural sector under the counterfactual exercises is 20.4 percent lower than the data, and the average ratio of employment in the industrial sector and the service sector is 10.6 and 9.8 percent higher than the data, respectively. This means that higher labor intensity is an important reason for the higher employment share in the agricultural sector, which may be related to the perception that China usually takes land income as labor income or agricultural production methods. A policy implication in Figure 8 is that if the capital intensity of the agricultural sector is increased, the employment share in the agricultural sector will decline significantly, and the proportion of employment in the industrial sector and service sector will increase significantly.

To assess the impact of the switching costs, we keep the switching costs among the three sectors at the level of 1978. Figure 9 shows the results. It can be seen that the switching costs have a significant impact on the structural change. If the switching costs do not change, the employment share in the agricultural sector will exceed 50 percent in 2011, which is

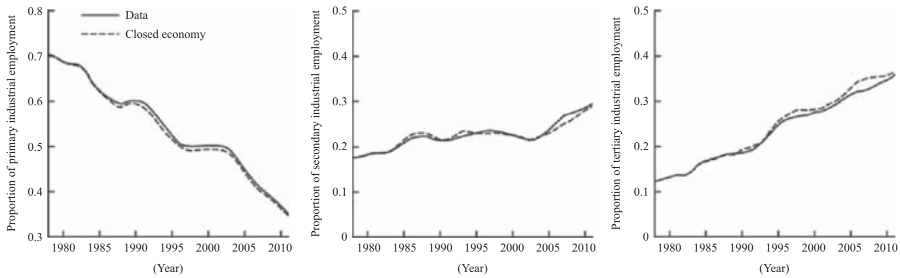

Figure 7.
The impact of international trade on the structural change

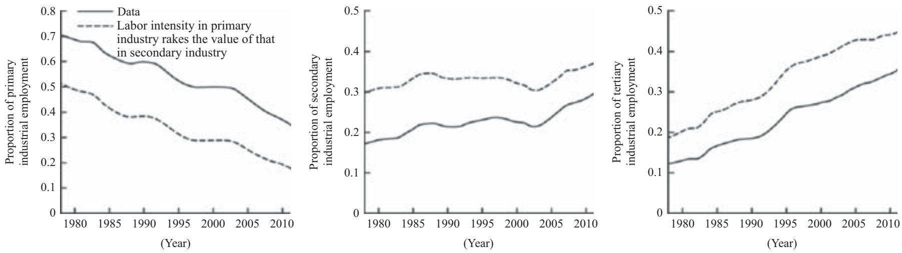

Figure 8.
The Impact of factor intensity on the structural change

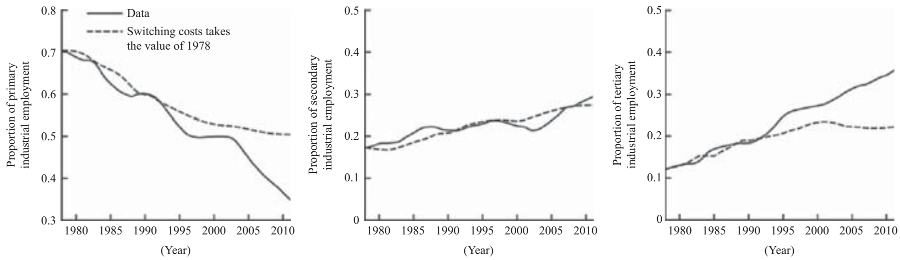

Figure 9.
The Impact of switching costs on the structural change

15.6 percent higher than the actual figure; the industrial sector will be lower than the actual figure before 1992 and after 2006. In 1992–2006, it will be higher than the actual data. The change in switching costs has a significant effect on the increase in the employment share in the service sector. Under counterfactual exercises, the employment share in the service sector rose by only 10.0 percent from 1978 to 2011, which was far below the 23.5 percent rate of increase in the actual figures.

7. Conclusion

This paper uses a multi-sectoral neoclassical growth model of two countries to measure the impact of different factors on China's structural change. The conclusions are listed as below. First, the Engel effect, the investment effect, and the switching costs effect are the main factors affecting the change in the employment share in the primary, secondary, and service sectors, respectively. The impact of the Engel effect on the agricultural sector mainly occurred before 2000, and the effect of the investment effect and switching costs on the industrial and service sectors mainly occurred after 2000. The Baumol effect has a stronger effect that decreases the employment ratio in the agricultural and service sector, and the effect of international trade has a certain role in the increasing employment share in the industrial sector. Second, low-income elasticity of demand, high labor intensity, and the existence of the switching costs are the reasons for the high employment share in the agricultural sector. Technological progress, investment, and international trade have comparatively less influence on the proportion difference of employment in the three sectors.

The above conclusions have important policy implications. From the perspective of the factors on the demand-side, the demand-side factors that have chronically promoted the structural change are difficult to sustain. First of all, although the Engel effect played an important role in the transfer of agricultural labor force before 2000, the current effect is already very small. This means that future income growth will not lead to a significant decline in the relative demand for agricultural products, and changes in the consumption demand structure will be difficult to continuously stimulate the transfer of agricultural labor. Second, investment demand has played an important role in the increasing proportion of China's industrial employment after 2000. However, Chinese investment rate has exceeded 40 percent, but it has not risen in recent years. We also find that it is difficult to expand the industry through continuous increase in the investment rate. Third, although the comparative advantage created by the low labor cost has greatly promoted the rapid growth of China's foreign trade, China's agricultural and sectors have basically achieved a trade balance, and the total net exports' share in GDP is not high. If the trade structure cannot be transformed and upgraded quickly, foreign trade will not significantly affect China's structural change.

From the perspective of the supply side, the development of modern agriculture and the reduction of labor switching costs should become policy exertions to promote China's structural change. First of all, the high labor intensity of agriculture is an important cause of its high employment share. Developing modern agriculture with capital intensity, and gradually replacing traditional agricultural production methods, will effectively promote the transfer of agricultural labor. Second, since the reform and opening up, especially in the years after 2000, there has been a gradual downward trend for the costs of agricultural labor switching to industry and service industry, which has effectively promoted China's structural change. However, the current switching costs are still high, and this factor should continue to play an important role. If we can further reduce the switching costs through policies such as the reform of the household registration system, we will effectively promote the development of sectors and service sectors. Third, China is similar to most industrialized countries in that, compared to the service industry, its agricultural and industrial technological progress is relatively fast. This means that, during the process of shifting economic activities to service sectors, technical progress in the overall economy will gradually slow down, and the economic growth rate will also drop. Therefore, the development of the service industry should be adapted to the phase of economic development. Before reaching the level of high-income countries, it is not appropriate to simply increase the proportion of service sectors. Instead, more focus should be put on the development of producer services and optimization of the service industry structure.

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Note

1. Refer to the appendix for the detailed derivation process of the theoretical model of this paper. If necessary, please contact the author.

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