Enigmas of TFP in China: A Meta-Analysis[1]

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Abstract:

This paper presents a meta-analysis of 5308 observations of total factor productivity growth (TFPG) in China from 150 primary studies to provide some insightful explanations to the controversies about productivity growth in China in the current literature. The main findings include that (1) There are three cycles for TFPG after 1978 and each circle is about ten years; (2) sector-specific TFPGs are larger than aggregate economic TFPGs; (3) regional disparities of TFPG are significant and specifically the TFPG in East China is higher than that in Central and West China; (4) TFPG after 1978 is in general greater than that before 1978; and (5) characteristics of paper and journal, data sources, input measurement, model specifications and estimation methods are also important for explaining the heterogeneities in TFPG in China. Moreover, we also find a large variation in the determinants of TFPG heterogeneity in different sectors and approaches.

Keywords: Economic growth, TFP, Meta-Analysis, China

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1. Introduction

Since the market-oriented reform and the open-up policies were launched in 1978, China has experienced rapid economic growth with an average annual growth rate of 9.8% in the past three decades. GDP per capita increased rapidly from 381 *Yuan* in 1978 to 29678 *Yuan* (USD 4481) in 2010. It is called an economic miracle. Along with the remarkable performance in economic growth, a lot of arguments have been raised regarding the fundamental driving forces behind the economic miracle, particularly regarding the role of productivity growth (Hsieh and Klenow, 2009).

Some economists believe that the key driving force behind the economic miracle is the soaring input use (Krugman, 1994; Young, 2003) and the contribution of productivity growth is very limited. Many studies point out that the TFP growth rates in China are lower than 1.5% and the contribution to economic growth is less than 20% (e.g., Wang, 2000; Liang, 2000; Young, 2003), while the main contributors are the soaring increases in inputs, such as labor (increase in labor participation rate, rural-urban migration, improvement of education) (Young, 2003), and capital. For instance, the nominal gross capital formation increased to more than 90 times as much as its initial value from 1978 through 2010[2]. In addition, China has benefited a lot from the demographic bonus during the past three decades resulting from a rise of the labor force ratio due to family planning and rural-urban migration (Cai and Wang, 1999; Chen and Feng, 2000). According to the estimate of Cai and Wang (1999), the contributions of the rise of the labor force ratio and of the rural-urban migration to

[2] Data source: <China Statistical Yearbook>, (2009).

economic growth in China from 1982 to 1997 are 24% and 20%, respectively.

However, some other studies argue that the improvement of productivity or TFP plays a key role in China's rapid economic growth, and they claim that the TFP growth rates are more than 3% per year and contribute to more than 30% of the economic growth in China (e.g., Hu and Khan, 1997; Chow and Li, 2002; Zhang and Shi, 2003; Bosworth and Collins, 2008)

Why is there such a big divergence in the results regarding Chinese TFP growth rates in the current literature? What causes the differences? Which results are more credible? Given the importance of the Chinese economy in the whole world, these questions are very important both from a policy perspective and from an academic perspective. Unfortunately, the determinants of TFPG heterogeneities in China haven't been studied systematically and quantitatively. In this paper, we try to find out the causes of the differences in TFPG for China by conducting a meta-analysis, which is now made possible by a large number of studies on Chinese TFP in the current literature.

The paper is organized as follows: Section 2 discusses different approaches to TFPG estimation and other possible determinants that may affect TFPG; Section 3 then briefly introduces the approach of meta-analysis and discusses the problems with respect to data processing; Section 4 provides a brief introduction to the data on Chinese TFPG collected from the recent primary studies and presents a descriptive statistic analysis; Section 5 presents the results of the meta-analysis and has some discussion, which is followed by the conclusion in Section 6.

2. TFPG Measurement

Economic growth can be decomposed into input contribution and productivity growth. Economists prefer the concept of total factor productivity (TFP) to measure the improvement of productivity with exclusion of input contribution. TFP is a measure of an economy's long-term productivity growth or the quality of growth, and regarded as the transformation ratio of total inputs into total outputs (Diewert and Nakamura, 2007).

There are two types of productivity growth: Embodied technical progress and disembodied technical progress. The former represents the technical progress or productivity growth stemmed from changes in input factors, such as an increase in the quality of inputs, whereas the latter refers to the productivity growth that does not stem from the inputs, but takes place like manna from heaven in the form of better methods and organization that improve the efficiency of both new and old factor inputs (Solow, 1957; Chen, 1997). However, the concept of TFP is only applicable to disembodied, exogenous and Hicks neutral technical progress in neoclassical economics. Furthermore, if inputs are not measured correctly, the TFP contains not only disembodied technical progress but also some embodied technical progress (Chen, 1997; Zheng, 1998; Felipe, 1999).

Several stages are required for measuring TFP and its growth rate: Model specification, variable selection, parameter setting, data processing and et al. Hence, the heterogeneities in final TFPG may emerge on each stage. Nadiri (1970) concludes several factors that may influence TFPG: first, specifications of the production function; second, the proper measurement of factor inputs; third, the weight assigned to different inputs; fourth, time period chosen in the study. Felipe (1999) suggests that the measurement of TFPG depends critically on assumptions about production function, measurement of output, measurement of capital, quality adjustment of inputs, cyclical smoothing, time period studied, errors of measurement in the variables, and so on. Chen (1997) also believes that the measurement of TFPG is quite sensitive to the measurement of factor inputs, especially to the extent and scope of the adjustments of quality improvements made to factor inputs. Similar argument can also be found in other studies (Sun and Ren, 2005; Zhang and Gui, 2008; Liu et al., 2009).

Regarding the different results in primary studies, Alston et al. (2000) categorized all factors that might account for the variation in primary studies into five broad groups: (1) characteristics of the results in primary studies (e.g., real or nominal, marginal or average); (2) characteristics of the analysts (e.g., published or unpublished); (3) characteristics of the research (e.g., geographic region); (4) evaluation characteristics (e.g., ex post or ex ante, method); (5) random measurement errors. Nelson and Kennedy (2009) suggest that heterogeneities between primary studies can be attributed to two basic causes: Factual factors and methodological factors. Following their studies, we first discuss the methodological factors and then briefly introduce the factual factors in this section.

2.1 Methodological Factors

2.1.1 Approaches to TFPG Measurement

There are many different approaches to estimate TFPG and a lot of papers already present comprehensive reviews on this issue (e.g., Solow, 1957; Jorgenson and Griliches, 1967; Nadiri, 1970; Chen, 1997; Felipe, 1999; Hulten, 2000; Lipsey and Garlaw, 2004; Guo and Jia, 2005; Raa and Shestalova, 2011).

The first way to measure TFPG is the growth accounting approach, where TFP is estimated by removing the contributions of all inputs. The residual is then presumed to be attributable to technical progress. Two commonly used growth accounting approaches are the Arithmetic Index Number Approach (AINA) and the Solow Residual Method (SRM). When using the AINA, TFP is taken as the ratio of the output index and the input index, while the production function is not specified. The SRM is also called production function method. In this method, TFPG is the residual after subtracting the growth rates of all inputs from the growth rate of total output, so that a production function needs to be specified (Solow, 1957). Based on the assumptions of cost minimization for producers, perfect technical efficiency, constant return to scale and Hicks neutral technical progress, TFPG equals the technical progress.

In addition, two other approaches are also widely used in TFPG estimation: namely the Latent Variable Approach (LVA) and the Potential Output Approach (POA). In the LVA, TFPG is taken as a latent variable, and in the POA, also called Frontier

Production Function Approach (FPFA), TFP change arises not only from technological innovation but also from the improvements in technical efficiency, allocative efficiency and the scale effect (Brummer et al., 2006; Jin et al., 2010; Brandt et al., 2011; Li and Liu, 2011).

The FPFA usually includes the non-parametric and the parametric approach. The former mainly refers to the data envelopment analysis (DEA) and the latter basically refers to the stochastic frontier approach (SFA). The non-parametric approach may be more flexible because it does not require specification of a production function and price information of the inputs. However, the SFA is more capable of distinguishing the effects of statistical noises from those of inefficiency, particularly when measurement errors are present (Lovell, 1996). Since it is impossible to eliminate all measurement errors, the parametric approach might be more reasonable. Consequently, the estimates of TFPG by means of the SFA would be smaller due to the elimination of some measurement errors. Meanwhile, SFA converges to SRM if all assumptions aforementioned hold.

While in practice, it is very difficult to satisfy the assumptions of perfect technical efficiency and constant returns to scale. If technical efficiency is considered, as in SFA and DEA, TFPG not only includes the technical progress, but also the efficiency change. As Nishimizu and Page (1982) suggested, technical efficiency change in developing country is quite obvious and important for TFP growth. In the case of China, as some studies (e.g., Kalirajan et al., 1996; Wu, 2000; Meng and Li, 2004; Zhang and Gui, 2008 et al.) find, the technical efficiency deteriorated from 1952 to

1978, while the success of economic reform started in 1978 helped regional economies to catch up with the frontier producers, which indicates a significant increase in technical efficiency from 1978 to 1985; after 1985, technical efficiency improvement slowed down, even became negative in agricultural sector after the mid of 1990s, mainly due to the deterioration of extension system and land infrastructure, particularly with regard to the existing water conservation systems that prevent farmers from applying the best practice production techniques (Bruemmer et al., 2006), as well as the disequilibrium that occurs during the expansion of crop production (Jin et al., 2009). The efficiency change in China implies that TFPG calculated by SFA and DEA should be relatively smaller before 1978 and larger at the beginning of the reform than those calculated by other approaches with an assumption of perfect technical efficiency. Similarly, we can also argue that if the assumption of constant return to scale does not hold in China, TFPG estimated by SRM may be biased. Jefferson et al. (1992) finds a slightly increasing return to scale in state and collective industries in 1980s, while Zhang and Gui (2008) think the scale economy is deteriorating after 1978. Similarly, Bruemmer et al. (2006) also find a decreasing return to scale in Chinese agriculture sector after the economic reform in 1978. In this paper we use a dummy variable to distinguish these studies with an assumption of constant return to scale from those without the assumption in SRM.

2.1.2 Inputs

Since TFP is the residual by removing the contribution of all inputs from the output, the measurement of inputs is critical in estimating TFPG. Here, three issues arise: (1) how many inputs are included in the production function; (2) how to weight each input (or output elasticity with respect to inputs appropriately); and (3) how to deal with the heterogeneity of inputs.

In most TFP studies on the aggregate economy, only labor and capital are included in production function, such as Li (1992), Woo (1998), Chow (2002) and Zhang and Shi (2003). Others, such as Bosworth and Collins (2008), Zheng and Hu (2005, 2008) and Liu and Hu (2008), also take human capital as an additional input by separating it from physical inputs. Particularly, Fleisher et al. (2010) find that education can contribute to TFP growth both at regional level and at firm level. For the studies on sector-specific TFPG, more inputs are often included in the econometric exercises. For instance, Tang (1986) uses four inputs to estimate agricultural TFPG: Labor, capital, land and intermediate inputs. Lin (1992) uses fertilizer as an intermediate input, and Fan (1997) even includes 7 inputs, namely labor, land, fertilizer, machinery, animal power, irrigation and organic fertilizer. However, most studies for calculating TFPG in manufacturing still use the three main inputs: labor, capital and intermediate inputs , such as in Zhu and Li (2005), Wang and Gu (2005), and Li and Li (2008). Obviously, more inputs included in production functions often result in a lower TFPG. In this paper, we use a dummy variable to distinguish the studies using more than two inputs from those only using labor and capital.

In the recent literature, three ways are presented to construct the output elasticities of inputs: (1) calculating: under the assumption of cost minimization, producers will equate an input's output elasticity to the product of that input's cost share and the scale elasticity, which implies that all factors including education are paid at their marginal productivity (Fleisher and Wang, 2004, 2005; Fleisher et al., 2010); (2) regressing: output elasticity can also be estimated by regressing the production function, which implies that elasticity is constant over time; (3) assuming: some literature assigns the input share subjectively. As aforementioned, output elasticities are not required in DEA and AINA; and in SFA and LVA, They are estimated by regressing the production function. While in SRM, all three ways are used. It is not easy to conclude the general impacts of the methods on estimated TFPG. However, the only thing we know is that calculating and assuming automatically assume constant return to scale, while if the input share is measured independently (such as regressing without restriction or adjustment), TFPG can be derived without the assumption of constant return (Hulten, 2000). This paper uses also dummy variables to control the influence of the estimating methods for on output elasticities on TFPG.

Strictly speaking, the definition of an input, for example, the quality and utilization efficiency, should be consistent across a study, which is not yet satisfied in the current literature. Nadiri (1970) notes that labor and capital as aggregate elements, are heterogeneous in longevity, impermanence, productive quality, mobility, etc. Consequently, inconsistent definitions are used in the previous studies which lead to diverse TFPG results. In particular, we take a brief look at the definitions of labor and capital.

First, labor input should be defined as the working time with standard labor intensity, not as the number of workers, because the latter doesn't reflect heterogeneities in working hours per worker (Solow, 1957; Jorgenson and Griliches, 1967; Owyong, 2000). Additionally, the contributions of labor input for different occupations are also different, so that in order to calculate the labor input precisely we should sum up individual labor input time and assign different weights to the heterogeneous quality, such as occupations. However, this cannot be realized in practice due to data limitations. The most commonly used approach is to use labor's marginal output value to measure the quality, and labor heterogeneity can can be mirrored by education and work experiences which then are used as the weights for calculating labor input. Nevertheless, information on these variables is not widely available in China, and labor input usually is just measured by the number of labor forces or just by population in most studies. For instance, Wang and Yao (2003), and Zhang and Shi (2003) use the total number of workers as a proxy for labor inputs, while Graham and Wada (2001) use population. Other measures include working time (Kong et al., 1999), total wage (Lu and Jin, 2005), and a labor index calculated from working time and wage (Sun and Ren, 2005).

On the other hand, the ratio of working forces in total population in China has increased sharply from 61.50% in 1982 to 73.14% in 2008 due to the so-called demographic bonus[3]. In other words, working forces grew faster than the population during this period, so that the labor input will be underestimated when the population is used as a proxy for labor input, and consequently the TFPG will be overestimated.

[3] Data source: *China Population and Employment Statistics Yearbook*, 2009.

However, the TFPG will be underestimated if the wage is used as a proxy for labor input, because the wage increased much faster than labor input[4]. For instance, the real wage in China in 2008 is about 8-fold higher than that in 1978[5].

Second, the measurement of capital input is also very crucial for TFPG estimation particularly in China where there are no official statistics for it. Jorgenson and Griliches (1967) as well as Norsworthy et al. (1979) made important contributions in this field. Following Diewert's (1980) definition, capital consists of constructions, land, natural resources, machinery equipment, other durable facilities and the private inventories. Chen (1997) introduces a three-step method to calculate capital input index: first, decide what kind of the capital inputs should be taken into account; second, adjust capital input for capacity utilization; third, adjust capital for physical depreciation. While most researchers, such as Li et al. (1996), Li (1997) and Ezaki and Sun (1999) use capital stock as capital input because of lacking necessary data on capital quality and utilization efficiency; some other researchers, including Wen (2005) and Zhao et al. (2005), use total investment in fixed assets as a proxy for capital input. To calculate capital stock, three steps are introduced in the prevalent perpetual inventory approach: (1) selection of a base period; (2) calculation of investment in each year; and (3) use of constant prices to calculate the capital stock in each year under an appropriate depreciation rate. Different base periods, depreciation rates and price indices can lead to different results for capital stocks calculation, which obviously affects the final TFPG estimates.

[4] Young (2003) find that the weighted wages grow at 12.5% per year from 1978-1998, which is 1.5 times higher than implied employment growth rate.
[5] Data source: *China Population and Employment Statistics Yearbook*, 2009.

However, such information is not available in most studies, so that we cannot control for these variables in our meta-analysis even we know they are important. What we can do here is to add a dummy variable to control for the differences caused by the adjustment of input quality. As discussed earlier in the paper, once quality of input is adjusted, some TFPG that embodied in input will be taken away from the residual, hence the TFPG will be possibly biased downward.

2.1.3 Dummy Variables

In order to control for unobserved heterogeneities and structural changes in the data, some primary studies include dummy variables in the production function (SRM, SFA and LVA). For instance, Kong et al. (1999) and Zhao and Zhang (2006) add regional dummies; Sheng and Zhao (2006), and Wang et al. (2009) add time dummies; and Lin (1992) and Mead (2003) include both regional and time dummies. Obviously, dummy variables also influence the TFPG estimations. In General, inclusion of dummy variables usually lowers the TFPG estimates because they capture some effects of the TFPG.

2.1.4 Price and Discounting

TFPG estimates can also be influenced by the prices of inputs and outputs. In particular, both real and nominal values for inputs and outputs are used in the current literature. For instance, Liu and Wang (2003) and Jin (2006) use nominal values, while most others use real values (e.g., Kalirajan et al., 1996; Woo, 1998; Coelli and

Rao, 2005; Sun and Ren, 2005). In order to capture the impacts of prices on final TFPG estimates, we include a dummy variable to compare the studies using real values with those using nominal values.

2.1.5 Peer-Review Process and Published Journals

Peer-review process and the flavor of an academic journal might also account for the variation in estimated TFPG (Alston et al., 2000). For instance, the studies that generate TFPGs that fall outside the range of "conventional wisdom" prevailing in the profession at the time may be discriminated in the publication process, thus published work and unpublished work may have different estimations.

Accordingly, variation of the TFPGs might also be attributed to the characteristics of an academic journal. For instance, Chinese journals may get some pressure from the government and the Chinese scientific community, such that the studies with low TFPG or with politically sensitive contents might not be allowed to be published, while English journal usually have more freedom.

To control for the potential biases resulting from peer-review process and the flavor of an academic journal, we include two dummy variables respectively to distinguish published studies from unpublished paper, and to distinguish Chinese paper from English ones.

2.2 Factual Factors

After discussing the methodological factors, we will now shed some light on the factual factors. A large body of literature has estimated Chinese TFPG for different periods of time, different regions, and different economic sectors. Given the fact that China is a huge country with high economic growth rates but with heterogeneities between different regions and sectors, we will take a close look at the TFPG differences with respect to time periods, regions and economic sectors, which are the basic factual factors.

First, TFPG is a dynamic concept and changes over time. In this respect, most studies show that TFPG is very low or even negative in China before 1978 (e.g., Kalirajan et al., 1996; Chow and Li, 2002; Wang and Yao, 2003), but becomes positive and significantly contributes to economic growth after 1978 (e.g., Hu and Khan, 1997; Chow and Li, 2002), as shown in Figure 1 and Table 1.

[Insert Figure 1 & Table 1]

Second, the current literature indicates that the TFPG values of the different regions are quite heterogeneous even in the same period (Li and Meng, 2006), Fu et al. (2009) find that average TFP growth rate in the central region is below that in the eastern region, higher than that in the western region and is below that in the nation as a whole, and Fleisher et al. (2010) suggest that human capital might be related to the regional inequality. Most studies classify China into three regions: East, central and west China. This classification is based on the levels of economic development in China[6]. The coastal eastern provinces in China are the most developed ones, whereas

[6] This paper follows the classification standard used by most studies: The eastern provinces include Hebei, Beijing, Tianjin, Guangdong, Jiangsu, Liaoning, Shandong, Shanghai, Zhejiang, Fujian and Hainan; the central provinces are Anhui, Henan, Heilongjiang, Jilin, Hubei, Hunan, Jiangxi, Inner Mongolia and Shanxi; and the western provinces are Guangxi, Guizhou, Yunnan, Sichuan, Chongqing, Xizang (Tibet), Ningxia, Qinghai, Gansu, Shaanxi and Xinjiang.

the level of development is generally lower in the central and even lower the western provinces. The statistics in table 2 also show that the TFPG in East China is far higher than that in other areas.

[Insert Table 2]

Third, the TFPG significantly varies from sector to sector. In order to analyze heterogeneities of TFPG in different economic sectors, this paper classifies economic activities into three sectors according to the standards of the Chinese National Bureau of Statistics (CNBS)[7]: Agriculture, manufacturing, and service sector. Our primary results, presented in table 2, indicate that the mean TFPG of manufacturing and service sector are significantly higher than that of agriculture and the aggregate economy, consistent with the estimation of Dekle and Vandenbroucke (2010) that agricultural labor productivity is much lower than non-agricultural labor productivity.

2.1.5 Data

Data sources also play a significant role when estimating TFPG. Both time series data and panel data have been used in the current literature. It is however worth to note that the SFA and DEA can only be used with panel data. Different types of data sources may lead to different results. For instance, panel data would be better for capturing unobservable heterogeneities than time series data.

In addition, some studies use micro-data while others use macroeconomic data.

[7] The agricultural sector includes plantations, forestry, animal husbandry and fishery as well as services supporting these industries. The manufacturing sector comprises mining and quarrying, manufacturing, electricity production, water and gas supply, and construction. The service sector in turn includes all other economic activities not included in the agricultural and manufacturing sectors.

This could also cause the differences between the results of different studies.

3. Meta-Analysis

A meta-analysis is a qualitative analysis of a body of similar related studies and is used to summarize them or to evaluate the reliability of their findings (Card and Krueger, 1995). This technique has been widely used in the economics literature (Nelson and Kennedy, 2009).

In a standard regression model used for a meta-analysis, the dependent variable is given by the results from primary empirical studies (effect size), which is TFPG in this paper. The independent variables are all factors that could cause differences in TFPG. As aforementioned, these factors include sectors, time, region, data characteristics, model specifications, sample size and other quality variables like time of publication and the origin of the journal in which the study has been published.

In particular, Nelson and Kennedy (2009) point out that three characteristics of the primary studies have strong implications for the choice of a meta-analysis model: (1) Sample heterogeneity, which could be handled by adding dummies to capture those effects; (2) heteroskedasticity of effect-size variances, which can be eliminated by taking sample sizes as proxies for the weights in Weighted Least Squares Regression (WLS); and (3) non-independence of primary studies, which can be controlled by employing fixed-effects or random-effects regression models. In this paper, WLS model is chosen to deal with heteroskedasticity, and the squared root of the number of observations in each primary study is used as a proxy for weights.

4. Data

The sources of economic growth in China have been of particular interest for economists since the 1980s, as China achieved a prolonged period of rapid economic growth after the reforms in 1978. We have collected 150 papers and 5308 observations using Google scholar and from the database of the China National Knowledge Infrastructure (CNKI). If the TFPG is measured for one period, we assume that it is the TFPG of the medium year in this period. To distinguish these observations from those estimated for each single year, we define them as Period TFPGs and Single-year TFPGs, respectively. Finally, 3292 observations are single-year TFPG, and 2016 are TFPGs in a period.

[Insert Table 3]

These studies can be classified by characteristics of journal and paper, region, sector, data type, model specification, price and input. A brief summary of the TFPG results and the primary studies themselves are shown in Table 2 and Table 3, respectively.

Table 2 indicates that the disparities of TFPG between different regions, sectors and approaches are quite substantial. First, regional average TFPG is in general larger than the TFPG at the national level and the TFPG in eastern areas is the highest. Second, TFPG in manufacturing and services is much higher than that in the aggregate economy, while TFPG in agriculture is slightly lower than that in the aggregate-economy. Third, TFPGs estimated by DEA and SRM are higher than that estimated by others approaches on average.

Even though the TFPG is characterized by a positive trend, it fluctuates very much during the whole period from 1950 until 2007, particularly before 1978. Statistics show that the average TFPG before 1978 was -0.008 and that the number rises to 0.035 after the reform in 1978[8]. The results are shown in Table 1, Figure 1 and Figure 2.

Interestingly, Figure 1 and Figure 2 indicate that there are three cycles for TFPG after 1978 and each circle is about ten years (namely 1978-1988, 1989-1998, and 1998-now). Even though we cannot give a specific explanation to this, it might be linked to the conjectures of business cycles in China.

[Insert Figure 2]

5. Empirical Results

Similar to other meta-analyses, the dependent variable is the TFPG in primary studies and the independent variables include region, sector, approaches to estimate TFPG, characteristics of paper and journal, data type, measures of capital and labor, number of inputs, price information, inclusion of dummies and time. The definitions of the variables are presented in Table 4.

5.1 Full Sample

We pooled all observations together and used four different econometric models, including an OLS model with time trend and time squared, a WLS model with time dummy, a WLS model with time trend and a WLS model with time trend and time

[8] Average TFPG is calculated by averaging all TFPG observations in individual years.

squared. The results are reported in Table 5, and they are quite consistent for there is no substantial difference among the five models. We prefer WLS models because they can deal with heteroskedasticity of effect-size variance. However, we also find that both time and time squared are significant at the 1% level in the respective model, which makes the WLS model with two time variables the best. Hence our discussion is based on it.

[Insert Table 5]

First, our estimation results indicate that region-specific and sector-specific TFPGs are significantly larger than those at the nation level and for the aggregate economy, respectively. Regional-average TFPG is larger than the nation-level. Although the coefficients for Central China and West China dummies are not statistically significant, the coefficient for East China is significant at the 1% level in all models. This implies that the results are quite robust and not overly affected by model specifications. The results indicate that TFPGs in eastern areas is on average 0.018 higher than the national-level TFPG, after controlling for the above-mentioned factors. It is plausible that some regional-level economic data are manipulated or that intermediate inputs cross regions are not captured. Similarly, sector-specific TFPGs are also considerably larger than those for the aggregate economy. After controlling for other factors, TFPGs in agriculture, manufacture and service are 0.011, 0.031 and 0.026 higher than the aggregate-economy TFPG, respectively. These results are robust and not affected by model specifications. The reasons might be similar to the above-mentioned ones regarding the regional differences.

Second, we find characteristics of paper and journal significantly influence the estimates. TFPGs in published works are 0.011 higher than that in working papers, and English studies estimate higher TFPGs than Chinese ones by 0.007. It is plausible that there is a sample-selective bias during publish process and low estimates are dropped out. Regarding the higher estimates in English papers, further research is needed to find out the reason.

Third, the number of inputs included in econometric models also affects the results. If more inputs are included in the regression besides labor and capital, TFPG will fall by 0.015, implying that more inputs will result in smaller TFPGs. One possibility is that the additional inputs contain some information of quality change in labor and capital, hence the TFPG drops down.

Fourth, approaches, data type, quality adjustment and price have no significant impact on TFPG.

Finally, we also find an increasing trend for TFPG, and the growth rate is significantly higher after 1978. As the coefficient of time squared is negative, this implies that the relationship between the TFPG and the time trend might take the form of an inverse U-shape.

5.2 Subsamples and Sensitivity Analysis

In the previous section we pooled all data and obtained some general results. Now we take a close look at the heterogeneity of subsamples. It is possible that there are structural differences between different subsamples, which can be tested by

Likelihood Ratio Tests.

Our tests reveal that there are indeed significant differences between region-specific samples and the national sample as well as between sector-specific samples and the aggregate-economy sample. Therefore, it is necessary to estimate each subsample separately. The estimation results for national sample, the region-specific samples, the aggregate-economy sample and the sector-specific samples are reported in Table 6 from column 1 to 4.

[Insert Table 6]

The main results of these regressions can be summarized as follows:

(1) TFPGs in East China are significantly higher than that at the national level in all regressions, and it is also higher than the TFPGs in Central and West China by 0.017 and 0.013, respectively.

(2) Sector-specific TFPGs are still significantly higher than aggregate-economy TFPGs. Furthermore, TFPGs in manufacturing sector are 0.011 higher than that in agriculture, which can partly explain the shrinking share of agriculture in national output.

(3) Model specifications have a substantial impact on TFPG estimates, but the effect varies across sub-samples. For instance, result obtained by employing the DEA is higher than AINA in region-specific sample, and SFA estimates a higher TFPG in nation-level sample than AINA. That might be because DEA and SFA take technical efficiency into account and there is an improvement in efficiency.

(4) Consistent with the results in full sample, published studies have higher

estimates than unpublished ones in region-specific and sector-specific samples, and TFPGs in English papers are significantly higher than that in Chinese ones in all sub-samples.

(5) In the aggregate-economy model, TFPGs estimated by micro data are 0.027 lower than that estimated by macro data. That could be explained as follows: first, the micro data is more precise than macroeconomic data that might be manipulated; second, the technical progress of firms is indeed slower than that of the whole economy; third, if the statistical data is not distorted and technical level is identical between firms and whole economy, it is possible that inputs in firm-level data (micro data) is adjusted by quality; fourth, it is also possible that most studies of firms' TFP use state-owned firms and their TFP growth rates could be lower due to misallocation (Hsieh and Klenow, 2009).

(6) Unlike the non-significant negative coefficients found in the full sample, TFPGs decline in sector-specific subsample after quality-adjustment, which can be explained as that quality adjustment captures some embodied technical progress and thus lowers the estimated TFPG.

(6) The impact of inputs on TFPG is also significant. If more inputs are added in the model, TFPG decreases by 0.003 to 0.039, though the results are not as robust as in the full sample.

(7) The influence of the price used to measure output and input on TFPG is uncertain. TFPG estimates using nominal value are lower in region-specific sample, while higher in nation-level and aggregate-economy samples. Further research is

needed to look into this effect.

(8) TFPG shows an upward trend, and takes an inverse U-shape as in full sample.

In addition, in the previous regressions we made a strong assumption that the TFPG in each year for period-observations is identical. Here we separate out all single-year observations and conduct the econometric exercise. The results are reported in column 5 of Table 6. Compared with the results regarding the full sample, the main differences are in region. Except for East China, TFPGs in central and west China are also significantly higher than nation-level.

Moreover, most research may be more interested in TFPGs at the national level and for the aggregate-economy, to shed some light on this, we also conduct econometric exercises on these subsamples. The corresponding results are reported in Table 6 from column 6 to 8. However, we find that these results are quite similar to those in the first 5 columns, which implies that our main conclusions are robust.

5.3 Different Approaches and Sectors

Data type (panel or time series), restriction on return to scale, output elasticity with respect to inputs and dummies may also affect the TFPG estimation, but they are not included in the above regressions because they are only available in some approaches. In order to analyze their effects on the results, we additionally include these factors and test their impact in different models. We focus on SRM, DEA and SFA since they are the most widely used approaches. The results are reported in column 1 to 3 in Table 7. The main findings are:

First, region-specific TFPGs are significantly higher than that in nation-level in SRM, but in DEA and SFA, region-specific TFPGs are not always significantly higher than nation-level. That might be caused by the difference of technical efficiency across regions and the level of aggregation in estimating TFPG.

Second, TPFGs in all three sectors are significantly higher than that in aggregate-economy in DEA, but not in SRM and SFA. Further research is needed regarding this finding.

Third, similar with the results in former sections, estimates in published papers and English papers are higher than that in unpublished ones and Chinese ones.

Fourth, consistent with previous result, estimates decline when more inputs are accounted for in SRM and DEA model, while in SFA, the coefficient is not significant.

Fifth, some factors have conflicting impact on TFPG in different approaches. For instance, micro data results in higher TFPG in DEA model, but lower TFPG in SFA model. Price has different impact on TFPG in different approaches. In DEA the estimate is lower by using current price, while in SRM it is higher.

Sixth, TFPG takes an inverse U shape in all approaches.

In addition, more conclusions can be drawn regarding SRM: (1) TFPG estimated by panel data in SRM is higher than that from time series data. It might be because panel data can better capture the unobserved heterogeneity across regions including efficiency variation and hence yields higher TFPGs. (2) Once constant return to scale is held in SRM, TFPGs will be lower, which implies a decreasing return to scale in China (consistent with the studies of Bruemmer et al. in 2006 and Zhang and Gui in

2008). This could be explained by the emerging of small private enterprises after the reform. (3) Methods to estimate output elasticity also have some impact on TFPG and the estimate is lower if input share is estimated by regressing. Regarding the amazing accumulation rate of capital, it is plausible that we get more reasonable output elasticity with respect to capital by regressing, which is exaggerated by calculating and assuming. (4) Dummy variables capture some effect of TFPG and thus lower the estimates.

Moreover, determinants of TFPG in different sectors might be different. Thus we conduct the meta-analysis separately for each sector and the results are shown from column 4 to 6 in Table 7. We indeed find a large variation in the determinants of TFPG across sectors.

First, we find that geographical factor still plays an important role in TFPGs: agricultural TFPG in nation-level is lower than that in east area; manufacturing TFPGs in nation-level are lower than all region-specific TFPGs; while in service, there is no significant difference between sector-specific and nation-level TFPGs.

Second, approaches explain some variation in TFPGs. DEA and SFA estimate lower agricultural TFPGs than AINA, implying a deteriorating technical efficiency in agriculture (Jin et al., 2009). While in manufacture and service sectors, TFPGs estimated by AINA are lower than that estimated by other approaches and SRM, respectively.

Third, published paper and English paper report higher TFPGs in manufacture, while in service sector, TFPG in English studies is lower than that in Chinese ones, and in agriculture sector, there is no significant difference.

Fourth, TFPG estimated by micro-data is 0.057 lower than that using macro-data in manufacture, coincide with the results in previous sections.

Fifth, TFPG in manufacture will decline if the quality of inputs is adjusted or more inputs are accounted for. While in service, including more inputs in the production function will increase the TFPG. It is plausible that labor is the fastest increasing input in service sector, and once more inputs are accounted for, the share of labor declines and thus TFPG increases.

Sixth, using current price increases the agriculture TFPG. That is mainly because the prices of agricultural products are seriously distorted in the early times in China and agricultural output measured in current price grows much quicker than the real output increase.

Seventh, there is an inverse U trend in agricultural TFPG, but U trend in manufacturing TFPG, implying that the agricultural TFPG trends to decline while manufacturing TFPG trends to increase in the future.

[Insert Table 7]

5.4 Subsample After 1978

According to the results in the previous section, we find that the TFPG after 1978 is quite different from that before 1978 (Table 1). Since China's economy performed impressively after the reform in 1978, it has significant policy implications to separate out the observations after 1978.

We conducted an LR test to check if there is a structural difference between the situations before and after 1978. The result rejects the null hypothesis of there being no difference. After sorting out all observations after 1978, we lead new regressions and the results are reported in Table 8. Since no substantial difference is found between these results and that of the full sample, we believe that our main results are robust.

[Insert Table 8]

6. Conclusion

This paper collected 5308 observations of total factor productivity growth rates (TFPG) for China from 150 primary studies and used a meta-analysis to analyze the impacts of a number of related factors on the heterogeneities of TFPG in the primary studies. Our results show that both factual factors and methodological factors can cause heterogeneities in TFPG in China. The main results are robust with respect to different models and subsamples.

In general, TFPGs in East China are higher than the TFPGs in West and Central China, which might explain the increasing regional inequality in China. Sector-specific TFPGs are higher than aggregate-economy TFPGs, and TFPGs after 1978 are much larger than those before.

After controlling for region, industry and time, we find that some methodological factors, such as characteristics of paper and journal, model specifications, data types, quality adjustment, input selection, inclusion of dummy variables, restriction on return to scale and methods to estimate input shares also affect TFPG. In particular, TFPGs in English papers and published works are higher than that in Chinese ones and unpublished ones, respectively. Approaches have some impact on estimates but the influence is unclear. Micro data used in DEA increases TFPG, while decreases TFPG in SFA. Quality adjustment removes some technical progress and hence lowers TFPG. Additional inputs affect TFPG in different ways respect to different approaches and sectors. Dummies added in SRM model capture some effect of TFPG and will pull TFPG downward. In SRM, restriction on constant return to scale will lower TFPG, implying a decreasing return to scale in China. In addition, we also find that TFPG is influenced by methods to estimate output elasticity with respect to input in primary studies. Interestingly, we find that there are three cycles for TFP growth rates after 1978 and each circle is about ten years.

Furthermore, we also find a large variation in determinants of TFPG in different sectors. For instance, including more inputs in production function will reduce TFPG in manufacture but increase TFPG in service.

We uncover some potential problems in the current literature of empirical TFPG studies for China and find some factors that cause heterogeneities among previous studies, which is helpful to clarify some misunderstandings regarding the TFPG in China. Future studies should pay attention to these factors in order to make their research more convincing.

In addition, the measurement of capital input is also vital for TFPG studies, but we can’t take a deeper look at how capital measurement affects TFPG due to data limitations. This issue should be taken up by future research.

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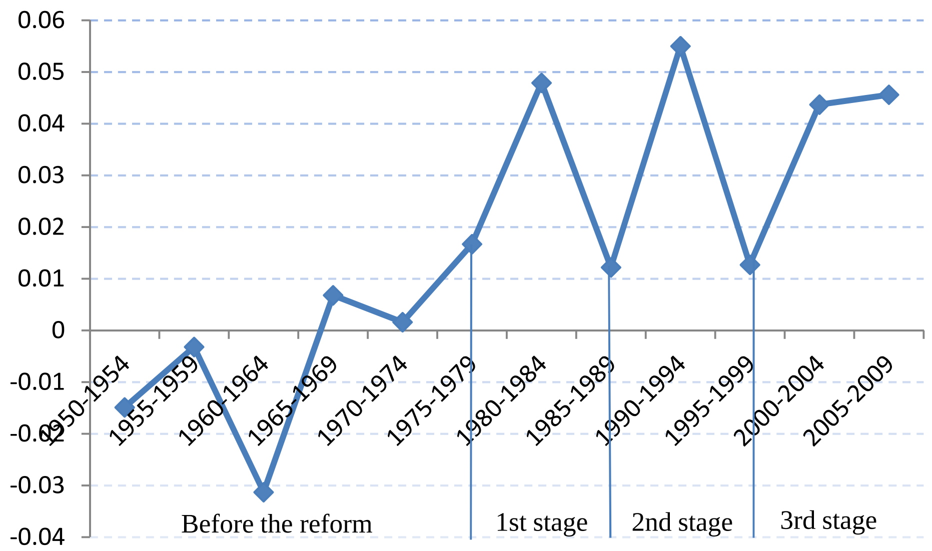
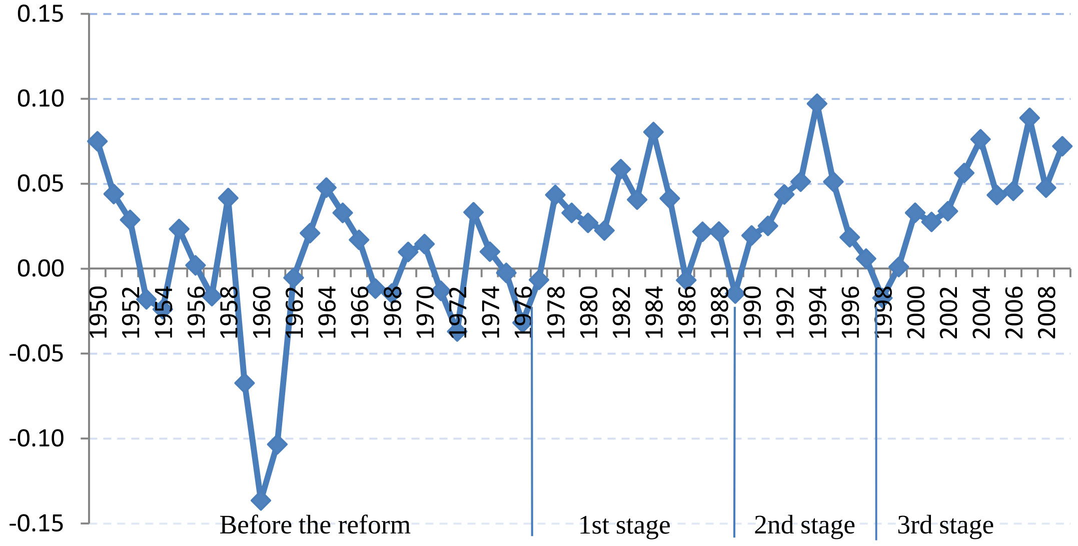


Note: Only single-year TFPGs are included. The total number of observations is 3292.

Figure 1 Trend of TFPG in China after 1950



Notes: 1. The solid line shows the average TFPG in each year.

2. Only single-year TFPGs are included. The total number of observations is 3292.

Figure 2 Average TFPG from 1950 to 2009

Table 1 TFPG in Different Periods

Period	Observations	Mean	Std. Dev.	Min	Max
1950-1954	35	-0.0149	0.0704	-0.2470	0.1234
1955-1959	80	-0.0032	0.0812	-0.2670	0.1997
1960-1964	86	-0.0313	0.1098	-0.3346	0.1740
1965-1969	90	0.0068	0.0592	-0.1139	0.1769
1970-1974	90	0.0016	0.0536	-0.0980	0.2058
1975-1979	147	0.0167	0.0512	-0.1160	0.2020
1980-1984	301	0.0479	0.0715	-0.0791	0.9430
1985-1989	349	0.0122	0.0534	-0.5229	0.2708
1990-1994	430	0.0550	0.0986	-0.1867	0.9603
1995-1999	678	0.0127	0.0716	-0.2560	0.7670
2000-2004	825	0.0436	0.0931	-0.3990	0.9760
2005-2007	181	0.0456	0.0821	-0.3330	0.4320
1950-1977	437	-0.0080	0.0748	-0.3346	0.2058
1978-2007	2855	0.0345	0.0828	-0.5229	0.9760
1950-2007	3292	0.0288	0.0830	-0.5229	0.9760

Note: Only single-year TFPGs are included.

Table 2 TFPGs in Different Sectors, Regions and Approaches

Category	Observations	Mean	Std.Dev.	Min	Max
East China	1145	0.0418	0.0763	-0.3500	0.9430
Central China	964	0.0264	0.0790	-0.3990	0.7670
West China	950	0.0283	0.0835	-0.5185	0.9760
Whole Nation	2249	0.0215	0.0616	-0.5229	0.9603
Agriculture	2357	0.0203	0.0714	-0.5185	0.9430
Manufacture	583	0.0759	0.1213	-0.5229	0.9760
Service	88	0.0538	0.0551	-0.0350	0.2848
Aggregate-economy	2281	0.0227	0.0500	-0.3346	0.4320
SRM	1769	0.0276	0.0588	-0.5229	0.9603
DEA	2634	0.0328	0.0819	-0.3990	0.9760
SFA	593	0.0164	0.0719	-0.5185	0.5800
AINA	250	0.0089	0.0593	-0.1776	0.1889
Others	62	0.0249	0.0509	-0.0594	0.2130
Full sample	5308	0.0280	0.0728	-0.5229	0.9760

Table 3 Summary of Primary Studies

Journal/Paper	Region	Sector	Data	Method	Price	Inputs	Observations*
English 47	Nation 130	Aggregate 69	Panel data 80	AINA 8	Constant 126	Capital and labor 86	Single-year 3292
Chinese 103	East 48	Agriculture 41	Time series 70	SRM 72	Current 17	More inputs 64	Period 2016
	Central 40	Manufacture 38		DEA 55			
	West 38	Service 6		SFA 14			
Published 136		Non-agriculture 1	Micro-data 141				
Unpublished 14			Micro-data 9	Others 4	Unknown 7	Quality-adjusted 23	

Notes: 1. The numbers denote the numbers of primary studies.

2. There are more primary studies than papers because some papers have more than one study.

3. In the last column, Single-year refers to the TFPG estimated for each year, while Period refers to the TFPG reported for a period.

Table 4 Definition of variables

Variables	Definition
Published	Dummy for published studies.
English	Dummy for primary studies written in English.
Region	Dummy for region-level studies.
East	Dummy for East China, including Hebei, Beijing, Tianjin, Guangdong, Jiangsu, Liaoning, Shandong, Shanghai, Zhejiang, Fujian and Hainan.
Central	Dummy for Central China, including Anhui, Henan, Heilongjiang, Jilin, Hubei, Hunan, Jiangxi, Inner Mongolia and Shanxi.
West	Dummy for West China, including Guangxi, Guizhou, Yunnan, Sichuan, Chongqing, Tibet, Ningxia, Qinghai, Gansu, Shaanxi and Xinjiang.
Sector	Dummy for sector-specific economy study.
Agriculture	Dummy for primary sector, including plantation, forestry, animal husbandry, fishery and services in support of these industries.
Manufacture	Dummy for secondary sector, including mining and quarrying, manufacturing, production and supply of electricity, water and gas, and construction.
Service	Dummy for tertiary sector, refers to all other economic activities not included in agriculture or manufacturing.
SRM	Solow Residual Method used in primary studies.
DEA	Data Envelopment Analysis used in primary studies.
SFA	Stochastic Frontier Analysis used in primary studies.
AINA	Arithmetic Index Number Approach used in primary studies.
Others	Other approaches used in primary studies.
Micro data	Dummy for primary studies using micro data.
Quality-adjust	Dummy for primary studies adjusting the quality of inputs.
Inputs	Additional inputs except for labor and capital are included in primary studies.
Current price	Nominal value is used in primary studies.
Time	Year (1949 is set to be 1).
Time squared	Year Squared.
Reform	1= after 1978, 0= others.
Panel	Panel data is used in primary studies.
Scale	Restriction of constant return to scale is held in primary studies.
Reg-elasticity	Output elasticity with respect to input is estimated by regressing.
Dummies	Dummy variables are used in primary studies.

Table 5 Results based on the Full sample

Variables	OLS	WLS		
	Time square	Reform	Time	Time square
East	0.0221 (7.58)***	0.0174 (6.30)***	0.0181 (6.52)***	0.0179 (6.45)***
Central	0.0054 (1.75)*	-0.0001 (-0.04)	0.0008 (0.25)	0.0004 (0.14)
West	0.0087 (2.84)***	0.0029 (0.91)	0.0039 (1.24)	0.0035 (1.12)
Agriculture	0.0201 (4.96)***	0.0111 (3.34)***	0.0112 (3.34)***	0.0113 (3.37)***
Manufacture	0.0601 (16.87)***	0.0332 (11.34)***	0.0303 (10.17)***	0.0314 (10.44)***
Service	0.0299 (3.90)***	0.0290 (5.02)***	0.0243 (4.15)***	0.0262 (4.45)***
SRM	0.0045 (0.84)	0.0014 (0.30)	0.0053 (1.16)	0.0036 (0.77)
DEA	-0.0049 (-0.90)	-0.0020 (-0.45)	-0.0005 (-0.11)	-0.0017 (-0.35)
SFA	-0.0132 (-2.18)**	0.0011 (0.21)	0.0020 (0.36)	0.0006 (0.10)
Others	0.0005 (0.05)	0.0084 (0.97)	0.0110 (1.26)	0.0096 (1.09)
Published	0.0193 (6.32)***	0.0107 (3.27)***	0.0116 (3.52)***	0.0111 (3.37)***
English	0.0068 (2.57)***	0.0070 (2.84)***	0.0075 (3.01)***	0.0071 (2.86)***
Micro data	-0.0245 (-3.13)***	-0.0091 (-1.64)	-0.0061 (-1.11)	-0.0071 (-1.24)
Quality adjust	0.0004 (0.12)	-0.0011 (-0.39)	-0.0016 (-0.55)	-0.0016 (-0.57)
Inputs	-0.0178 (-4.77)***	-0.0143 (-4.83)***	-0.0152 (-5.11)***	-0.0151 (-5.07)***
Current price	-0.0111 (-3.20)***	-0.0022 (-0.72)	0.0001 (0.03)	-0.0008 (-0.26)
Time/Reform	0.0028 (6.64)***	0.0375 (11.18)***	0.0009 (9.07)***	0.0019 (4.86)***
Time squared	-0.00003 (-4.82)***			-0.00001 (-2.66)***
Intercept	-0.0666 (-7.38)***	-0.0225 (-3.79)***	-0.0299 (-4.63)***	-0.0435 (-5.28)***
R^2	0.0987	0.0745	0.0671	0.0684
Adjusted R^2	0.0957	0.0715	0.0641	0.0652
F	32.19***	25.05***	22.39***	21.57***
Observations	5308	5308	5308	5308

Notes: 1. The first column uses OLS models, and the last three use WLS with the squared root of the sample size as weight.

2. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

3. We take the whole nation and the aggregate economy as the control region and the control sector, respectively. Therefore, the benchmark group is the nation-level aggregate-economy TFPG using constant price and macro-data without quality adjustment, and it is estimated by arithmetic index number approach with only two inputs, moreover, it is written in Chinese and has not been published.

4. If price information is not available in the primary study, we assume a constant price.

Table 6 Results based on subsamples

Variables	Nation-level	Region	Aggregate-economy	Sectors	Single year	Nation-single year	Nation-aggregate	Nation-aggregate-single year
East			0.0148	0.0204	0.0268			
			(4.80)***	(4.51)***	(5.88)***			
Central		-0.0174	0.0008	0.0004	0.0102			
		(-5.62)***	(0.22)	(0.08)	(1.76)*			
West		-0.0132	-0.0028	0.0069	0.0166			
		(-4.22)***	(-0.78)	(1.39)	(2.75)***			
Agriculture	0.0077	0.04443			0.0168	0.0117		
	(1.54)	(7.90)***			(3.42)***	(1.85)*		
Manufacture	0.0092	0.0757		0.0110	0.0350	0.0186		
	(2.13)**	(15.19)***		(2.41)**	(8.02)***	(3.29)***		
Service	0.0273	0.0328		0.0034	0.0716	0.0967		
	(3.12)***	(3.95)***		(0.45)	(5.86)***	(5.92)***		
SRM	0.0004	0.0312	0.0141	-0.0040	0.0009	0.0024	-0.0106	-0.0009
	(0.07)	(4.73)***	(1.96)**	(-0.70)	(0.16)	(0.40)	(-1.05)	(-0.06)
DEA	0.0015	0.0120	0.0021	-0.0012	0.0017	-0.0005	-0.0040	0.0073
	(0.25)	(2.12)**	(0.29)	(-0.20)	(0.29)	(-0.08)	(-0.39)	(0.50)
SFA	0.0176	(omitted)	0.0157	-0.0025	0.0022	0.0186	(omitted)	(omitted)
	(2.34)**		(1.47)	(-0.36)	(0.29)	(2.00)**		
Others	0.0110	-0.0273	(omitted)	0.0387	0.0184	0.0178	-0.0192	-0.0115
	(1.04)	(-1.19)		(2.32)**	(1.55)	(1.41)	(-1.52)	(-0.64)
Published	-0.0031	0.0118	0.0009	0.0237	0.0355	0.0158	0.0162	0.0234
	(-0.48)	(3.08)***	(0.23)	(4.44)***	(6.46)***	(1.81)*	(1.72)*	(1.83)*
English	0.0081	0.0110	0.0146	0.0099	0.0171	0.0155	0.0173	0.0335
	(2.19)**	(3.09)***	(5.14)***	(2.41)**	(4.16)***	(3.35)***	(3.78)***	(4.61)***
Micro data	0.0010	-0.0127	-0.0273	-0.0043	-0.0126	-0.0071	-0.0268	(omitted)
	(0.14)	(-1.06)	(-3.19)***	(-0.55)	(-1.39)	(-0.65)	(-2.60)***	
Quality adjust	0.0004	-0.0016	0.0040	-0.0150	-0.0037	-0.0035	0.0090	0.0083
	(0.09)	(-0.36)	(1.29)	(-2.87)***	(-0.66)	(-0.50)	(2.20)**	(1.26)
Inputs	-0.0105	-0.0393	-0.0025	-0.0254	-0.0273	-0.0177	-0.0088	-0.0153
	(-2.44)**	(-8.23)***	(-0.69)	(-5.69)***	(-5.95)***	(-2.77)***	(-1.72)*	(-1.71)*
Current price	0.0091	-0.0189	0.0110	-0.0026	-0.0072	0.0014	0.0118	0.0095
	(2.04)**	(-3.81)***	(2.19)**	(-0.65)	(-1.64)	(0.25)	(2.04)**	(1.35)
Time	0.0021	0.0036	0.0035	0.0012	0.0024	0.0026	0.0040	0.0044
	(4.29)***	(2.12)**	(7.16)***	(2.02)**	(4.60)***	(4.51)***	(6.63)***	(5.92)***
Time squared	-0.00002	-0.00004	-0.00004	-0.0000	-0.00002	-0.00002	-0.00005	-0.0001
	(-2.38)**	(-2.20)**	(-5.94)***	(-0.02)	(-2.91)***	(-2.84)***	(-5.59)***	(-5.11)***
Intercept	-0.0321	-0.0776	-0.0627	-0.0286	-0.0719	-0.0581	-0.0649	-0.0883
	(-2.87)***	(-2.20)**	(-5.23)***	(-2.27)**	(-6.18)***	(-4.30)***	(-3.74)***	(-3.70)***
R^2	0.0637	0.1146	0.0705	0.0898	0.0903	0.0766	0.0695	0.0770
Adjusted R^2	0.0574	0.1100	0.0648	0.0846	0.0853	0.0693	0.0605	0.0667
F	10.12***	24.61***	12.28***	17.46***	18.06***	10.37***	7.70***	7.48***
Observation	2249	3059	2281	3027	3292	1890	1145	908

Notes: 1. *, ** and *** respectively denote the significant levels at the 10%, 5% and 1%.

2. We set East China as the control region in region subsamples and agriculture as the control industry in sector subsamples.

Table 7 Different approaches and sectors

Variables	SRM	DEA	SFA	Agriculture	Manufacture	Service
East	0.0226 (4.39)***	0.0201 (5.75)***	0.0501 (1.75)*	0.0192 (4.42)***	0.0350 (2.43)**	0.0188 (1.00)
Central	0.0163 (2.46)**	-0.0059 (-1.59)	0.0442 (1.34)	-0.0076 (-1.64)	0.0391 (2.68)***	0.0009 (0.04)
West	0.0149 (2.38)**	-0.0027 (-0.71)	0.0787 (2.39)**	-0.0041 (-0.91)	0.0639 (3.55)***	-0.0049 (-0.26)
Agriculture	0.0143 (2.07)**	0.0215 (4.21)***	0.1138 (1.45)			
Manufacture	-0.0014 (-0.23)	0.0463 (11.23)***	0.0692 (1.31)			
Service	-0.0143 (-1.10)	0.0297 (4.16)***	(omitted)			
SRM				-0.0027 (-0.52)	-0.0229 (-0.97)	-0.0465 (-2.31)**
DEA				-0.0106 (-2.01)**	-0.0321 (-1.26)	(omitted)
SFA				-0.0170 (-2.81)***	0.0325 (1.20)	(omitted)
Others				-0.0100 (-0.48)	0.0848 (1.85)*	(omitted)
Published	0.0097 (1.22)	0.0191 (4.40)***	0.0374 (0.85)	0.0046 (0.86)	0.0721 (2.87)***	(omitted)
English	0.0160 (2.81)***	0.0040 (1.13)	0.0057 (0.24)	-0.0009 (-0.24)	0.0548 (2.66)***	-0.0723 (-2.86)***
Micro data	-0.0097 (-1.00)	0.1286 (7.03)***	-0.1090 (-3.01)***	0.0036 (0.24)	-0.0565 (-2.92)***	(omitted)
Quality adjust	0.0057 (1.30)	-0.0041 (-0.74)	0.0423 (0.72)	-0.0068 (-1.51)	-0.0781 (-3.11)***	(omitted)
Inputs	-0.0052 (-3.42)***	-0.0053 (-3.37)***	-0.0270 (-0.72)	0.0002 (0.20)	-0.0520 (-5.44)***	0.0545 (5.08)***
Current price	0.0180 (3.42)***	-0.0119 (-2.65)***	(omitted)	0.0084 (2.11)**	-0.0098 (-0.73)	(omitted)
Time	0.0027 (4.17)***	0.0062 (6.73)***	0.0266 (3.33)***	0.0041 (7.83)***	-0.0030 (-1.07)	-0.0059 (-0.56)
Time squared	-0.00003 (-3.55)***	-0.0001 (-5.51)***	-0.0003 (-2.94)***	-0.00005 (-5.70)***	0.0001 (1.80)*	0.00004 (0.40)
Panel	0.0110 (1.94)*					
Constant scale	-0.0149 (-3.13)***					
Regress	-0.0059 (-1.44)					
Dummy	-0.0135 (-2.45)**		-0.0841 (-1.52)			
Intercept	-0.0143 (-0.93)	-0.1364 (-7.13)***	-0.5556 (-2.21)**	-0.0569 (-5.70)***	0.1095 (1.77)*	0.1356 (0.53)
R^2	0.0665	0.1457	0.2547	0.0703	0.1596	0.4232
Adjusted R^2	0.0567	0.1411	0.2006	0.0644	0.1373	0.3647
F	6.83***	31.89***	4.71***	11.81***	7.18***	7.24***
Observation	1747	2634	193	2357	583	88

Notes: 1. Methods for estimating input shares are indicated by dummies.

2. If the method of calculating the input shares is not presented in primary studies, we assume the input shares are not estimated by regression.

3. *, ** and *** respectively denote the significant levels at the 10%, 5% and 1%.

Table 8 Results after 1978

Variables	Full sample	Single year	Nation-level	Aggregate economy	SRM	DEA	SFA	Agriculture	Manufacture	Service
East	0.0172	0.0245		0.0135	0.0222	0.0189	0.0509	0.0206	0.0335	0.0188
	(6.30)***	(5.35)***		(4.90)***	(4.38)***	(5.42)***	(1.69)*	(4.87)***	(2.26)**	(1.00)
Central	-0.0004	0.0077		-0.0004	0.0146	-0.0064	0.0406	-0.0077	0.0381	0.0009
	(-0.12)	(1.32)		(-0.13)	(2.23)**	(-1.73)*	(1.03)	(-1.70)*	(2.53)**	(0.04)
West	0.0034	0.0135		-0.0040	0.0134	-0.0035	0.1301	-0.0025	0.0618	-0.0049
	(1.08)	(2.23)**		(-1.22)	(2.17)**	(-0.92)	(3.30)***	(-0.56)	(3.32)***	(-0.26)
Agriculture	0.0120	0.0159	0.0075		0.0131	0.0228				
	(3.59)***	(3.19)***	(1.44)		(1.90)*	(4.49)***				
Manufacture	0.0314	0.0336	0.0091		-0.0016	0.0450	0.0327			
	(10.41)***	(7.41)***	(2.06)**		(-0.27)	(10.93)***	(0.62)			
Service	0.0243	0.0634	0.0264		-0.0141	0.0245				
	(4.21)***	(5.09)***	(3.03)***		(-1.10)	(3.42)***				
SRM	0.0052	-0.0005	0.0010	-0.0009				-0.0034	-0.0260	-0.0465
	(0.84)	(-0.06)	(0.13)	(-0.12)				(-0.54)	(-1.00)	(-2.31)**
DEA	0.0032	0.0080	0.0076	-0.0101				-0.0067	-0.0330	
	(0.51)	(1.04)	(1.01)	(-1.33)				(-1.05)	(-1.17)	
SFA	0.0083	0.0052	0.0208					-0.0096	0.0317	
	(1.20)	(0.58)	(2.32)**					(-1.35)	(1.06)	
Others	0.0125	0.0173	0.0130	-0.0155				-0.0047	0.0821	
	(1.31)	(1.34)	(1.11)	(-1.61)				(-0.23)	(1.73)*	
Published	0.0132	0.0381	-0.00005	0.0006	0.0059	0.0204	0.0145	0.0080	0.0731	
	(3.91)***	(6.40)***	(-0.01)	(0.17)	(0.70)	(4.64)***	(0.33)	(1.46)	(2.81)***	
English	0.0095	0.0230	0.0120	0.0130	0.0132	0.0041	-0.0108	0.0043	0.0553	-0.0723
	(3.62)***	(4.95)***	(2.92)***	(4.85)***	(2.17)**	(1.16)	(-0.45)	(1.11)	(2.62)***	(-2.86)***
Micro data	-0.0089	-0.0108	-0.0011	-0.0263	-0.0077	0.1322	-0.0732	-0.0040	-0.0565	
	(-1.64)	(-1.18)	(-0.15)	(-3.44)***	(-0.79)	(7.26)***	(-1.93)*	(-0.28)	(-2.86)***	
Quality adjust	-0.0044	-0.0133	-0.0039	0.0025	0.0065	-0.0035	-0.0625	-0.0090	-0.0770	
	(-1.47)	(-2.15)**	(-0.83)	(0.83)	(1.40)	(-0.64)	(-1.41)	(-2.08)**	(-2.99)***	
Inputs	-0.0146	-0.0280	-0.0090	0.0002	-0.0030	-0.0056	-0.0444	0.0004	-0.0516	0.0545
	(-4.90)***	(-6.00)***	(-2.04)**	(0.06)	(-1.75)*	(-3.58)***	(-1.21)	(0.46)	(-5.05)***	(5.08)***
Current price	-0.0014	-0.0079	0.0098	0.0092	0.0189	-0.0116		0.0056	-0.0094	
	(-0.46)	(-1.68)*	(1.98)**	(1.92)*	(3.32)***	(-2.59)***		(1.37)	(-0.68)	
Time	-0.0076	-0.0056	-0.0073	-0.0004	0.0006	-0.0053	-0.0068	-0.0044	-0.0093	-0.0059
	(-4.75)***	(-2.45)**	(-3.04)***	(-0.27)	(0.21)	(-2.17)**	(-0.47)	(-1.84)*	(-0.99)	(-0.56)
Time squared	0.0001	0.0001	0.0001	0.0000	-0.0000	0.0001	0.0001	0.00004	0.0001	0.00004
	(4.90)***	(2.46)**	(3.11)***	(0.19)	(-0.30)	(2.33)**	(0.57)	(1.51)	(1.27)	(0.40)
Panel					0.0113					
					(1.97)**					
Constant scale					-0.0154					
					(-3.21)***					
Regress					-0.0061					
					(-1.43)					
Dummy					-0.0171		0.0145			
					(-2.94)***		(0.42)			
Intercept	0.1645	0.1050	0.1706	0.0376	0.0309	0.1195	0.2885	0.1338	0.2499	0.1356
	(4.73)***	(2.12)**	(3.34)***	(1.05)	(0.52)	(2.19)**	(0.76)	(2.62)***	(1.25)	(0.53)
R^2	0.0531	0.0751	0.0383	0.0430	0.0562	0.1174	0.2647	0.0514	0.1559	0.4232
Adjusted R^2	0.0495	0.0692	0.0300	0.0366	0.0445	0.1126	0.2051	0.0443	0.1325	0.3647
F	14.85***	12.79***	4.63***	6.73***	4.82***	24.30***	4.44***	7.27***	6.65***	7.24***
Observation	4787	2855	1761	2113	1476	2572	161	2031	556	88

Note: *, ** and *** respectively denote the significant level at the 10%, 5% and 1%.

Appendix: List of primary studies

Author	Time paper	Journal	Region	Sector	Method	Data	Inputs	Price	Period	TFPG
Bai and Yin	2008	Chinese	East, west and central	Aggregate	SRM	Panel data	Labor and capital	Constant price	1979-2005	-0.1160, 0.4320
Bai and Zhang	2010	WP	China	Manufacture	SRM	Panel data	Labor and capital	Constant price	1953-2005	-0.4702, 0.3452
Bosworth and Collins	2008	JEP	China	Aggregate, agriculture, manufacture and service	SRM	Time series	More	Constant price	1978-2004	0.0090, 0.0610
Brandt et al.	2011	JDE	China	Manufacture	SRM	Panel data	Labor and capital	Constant price	1998-2007	0.0280
Bruemmer et al.	2006	JDE	East	Agriculture	SFA	Panel data	More	Constant price	1986-2000	0.0010, 0.1120
Cao and Birchenall	2011	WP	China	Agriculture	SRM	Time series	More	Constant price	1991-2009	0.0650
Cao and liu	2011	WP	China	Manufacture	LVA	Panel data	Labor and capital	Constant price	1999-2007	-0.0260, 0.2130
Cao et al.	2009	RIW	China	Agriculture, manufacture and service	SRM	Time series	More	Constant price	1982-2000	-0.0350, 0.0500
Cao G.	2006	Chinese	China	Service	DEA	Panel data	More	Current price	2000-2003	0.0152, 0.2848
Cao J.	2007	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1980-2005	-0.0401, 0.0884
Chen H.	2009	Thesis	East, west and central	Aggregate	DEA	Panel data	Labor and capital	Unknown	1979-2004	-0.0703, 0.1461
Chen and Santos-Paulino	2010	WP	China	Manufacture	SFA	Panel data	More	Constant price	1981-2006	0.0200, 0.0980
Chen et al.	2009	WP	China	Manufacture	SFA	Panel data	Labor and capital	Constant price	1981-2006	0.0200, 0.1000
Chen et al.	2009	CER	China	Aggregate	DEA	Panel data	Labor and capital	Unknown	1997-2004	0.0369, 0.0578
Chen W.	2006	Chinese	China, east, central and west	Agriculture	DEA	Panel data	More	Constant price	1991-2003	-0.3185, 0.3433
Chow and Li	2002	EDCC	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1952-1978	0.0000, 0.0303
Chu et al.	2009	Chinese	China	Manufacture	SRM	Time series	Labor and capital	Constant price	2002-2007	0.0237
Coelli and Rao	2005	AE	China	Agriculture	DEA	Panel data	More	Constant price	1980-2000	0.0600
Cui Z.	2005	Chinese	East	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2002	-0.0110, 0.2708
Dekle and Vandenbroucke	2010	RDE	China	Agriculture	SRM	Time series	More	Constant price	1978-2003	0.0060
Deng and Yu	2006	Chinese	East	Aggregate	DEA	Panel data	Labor and capital	Constant price	1981-2004	0.0030, 0.0490
Diao and Tao	2003	Chinese	China	Agriculture	SRM	Time series	More	Constant price	1980-2001	-0.0791, 0.0806
Ezaki and Sun	1999	AEJ	China, east, central and west	Aggregate	SRM	Time series	Labor and capital	Constant price	1981-1995	-0.1130, 0.1120
Fan and Zhang	2002	EDCC	China, east, central and west	Agriculture	SRM	Time series	More	Constant price	1953-1997	-0.1923, 0.1553
Fan S.	1991	AJAE	China	Agriculture	SFA	Panel data	More	Constant price	1965-1985	0.0074, 0.0213
Fan S.	1997	Food Policy	China	Agriculture	SRM	Time series	More	Constant price	1953-1995	-0.2297, 0.1650
Fan S.	1998	Chinese	China	Agriculture	AINA	Time series	More	Constant price	1953-1995	-0.1705, 0.1650
Fang et al.	2004	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-1999	-0.0591, 0.1412
Feng H.	1993	Chinese	China	Agriculture	AINA	Time series	More	Constant price	1950-1990	-0.1414, 0.1700
Fu and Floor	2004	WP	China	Manufacture	DEA	Panel data	Labor and capital	Constant price	1991-1997	-0.2180, 0.2150
Fu and Gong	2009	AEP	China	Manufacture	DEA	Panel data	More	Constant price	2001-2005	0.0111
Gao and Wang	2010	Chinese	China	Manufacture	DEA	Panel data	Labor and capital	Constant price	2003-2007	0.0853
Gao J.	2003	Chinese	China	Manufacture	AINA	Time series	More	Current price	1992-2000	-0.1437, 0.1320
Graham and Wada	2001	wp	East, west and central	Aggregate	SRM	Panel data	Labor and capital	Constant price	1978-1997	-0.0200, 0.2600
Gu and Meng	2002	Chinese	China	Agriculture	DEA	Panel data	More	Unknow	1981-1995	-0.0260, 0.1080

Guo and Jia	2005	Chinese	China	Aggregate	SRM, LVA, POA	Time series	Labor and capital	Constant price	1979-2004	-0.0599, 0.0613
Guo and Jia	2004	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1978-2002	-0.0012, 0.0034
Guo et al.	2005	Chinese	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1979-2003	-0.0161, 0.0378
Han and Zhai	2005	Chinese	East, west and central	Agriculture	DEA	Panel data	More	Current price	1982-2002	-0.0621, 0.9430
Hayami and Ruttan	1985	Book	China	Agriculture	AINA	Time series	More	Constant price	1953-1989	-0.1352, 0.1471
He et al.	2009	Chinese	East	Agriculture	DEA	Panel data	More	Constant price	1993-2005	-0.0410, 0.1520
He Y.	2007	Chinese	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1986-2003	-0.0430, 0.0790
Hong et al.	2005	Chinese	East	Agriculture	SRM	Time series	More	Constant price	1999-2003	0.0184
Hu and Liu	2007	Chinese	China	Aggregate	SRM	Time series	More	Constant price	1994-2004	-0.0103, 0.0039
Hu et al.	2008	Chinese	China, east, central and west	Aggregate	SRM	Time series	Labor and capital	Constant price	1978-2005	-0.0055, 0.0812
Huang and Zhou	2010	Chinese	China	Agriculture	SFA	Panel data	More	Unknow	1979-2008	0.0075, 0.0212
Islam et al.	2006	AEJ	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2002	-0.0128, 0.1017
Jeanneney et al.	2006	WP	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1993-2001	0.0126, 0.0660
Jiang et al.	2005	Chinese	China, east, central and west	Agriculture	DEA	Panel data	More	Constant price	1978-2002	-0.0330, 0.0570
Jin et al.	2006	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1980-2003	-0.0946, 0.1139
Jin X.	2006	Chinese	China	Aggregate	DEA	Panel data	Labor and capital	Current price	1992-2003	-0.0950, 0.2380
Jin Z.	2003	Chinese	Central	Agriculture	LVA	Time series	Labor and capital	Constant price	1979-2000	0.0189
Kalirajan et al.	1996	AJAE	China, east, central and west	Agriculture	SFA	Panel data	More	Constant price	1970-1987	-0.5186, 0.4780
Kong et al.	1999	AEJ	China	Manufacture	SFA	Panel data	Labor and capital	Constant price	1991-1994	-0.0730, 0.1240
Lambert and Parker	1998	JAE	China, east, central and west	Agriculture	DEA	Panel data	More	Current price	1970-1995	-0.0910, 0.2770
Li and Chen	2008	Chinese	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1978-2005	-0.0230, 0.0710
Li and Li	2008	Chinese	China	Manufacture	SFA	Panel data	More	Constant price	1986-2005	0.0006, 0.0354
li and liu	2011	EM	China	Aggregate	SFA	Panel data	More	Constant price	1987-2006	-0.011, 0.0782
Li and Meng	2006	Chinese	China, east, central and west	Agriculture	DEA	Panel data	More	Constant price	1978-2004	-0.0120, 0.0590
Li and Zeng	2009	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1980-2007	-0.0467, 0.0967
Li et al.	1992	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-1990	-0.3346, 0.2058
Li et al.	2008	Chinese	China	Manufacture	DEA	Panel data	Labor and capital	Constant price	1999-2003	0.0200, 0.1500
Li J.	1992	ESQ	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-1990	-0.3346, 0.2058
Li W.	1997	JPE	China	Manufacture	SRM	Panel data	Labor and capital	Constant price	1981-1989	-0.0218, 0.1075
Liang Z.	2000	Chinese	China	Aggregate	LVA	Time series	More	Constant price	1978-1997	0.0127, 0.0196
Lin J. Y.	1992	AER	China	Agriculture	SRM	Panel data	More	Constant price	1978-19874	0.0003, 0.0029
Liu and Hu	2008	Chinese	China, east, central and west	Aggregate	SRM	Time series	Labor and capital	Constant price	1987-2005	0.0020, 0.0793
Liu and Liu	2000	Chinese	China	Manufacture	AINA	Time series	Labor and capital	Current price	1976-1984	-0.0920, 0.1111
Liu and Wang	2003	RP	China	Manufacture	SRM	Panel data	Labor and capital	Current price	1995	0.0879, 0.1278
Liu and Zhou	2008	Chinese	East	Manufacture	DEA	Panel data	Labor and capital	Constant price	1997-2005	-0.0430, 0.2060
Liu and Zhou	2008	Chinese	East	Manufacture	DEA	Panel data	Labor and capital	Constant price	2006	0.0620

Liu and Zhu	2007	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Current price	1985-2005	-0.2254, 0.0838
Liu et al.	2009	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2007	0.0181, 0.0359
Liu et al.	2007	Chinese	China	Manufacture	SFA	Panel data	More	Constant price	1996-2005	0.0900, 0.5800
Lu and Jin	2005	Chinese	China	Manufacture	SRM	Panel data	Labor and capital	Current price	1990-2000	-0.0333, 0.0109
Ma J.	1989	Chinese	China, east, central and west	Manufacture	SRM	Time series	Labor and capital	Current price	1984-1993	-0.0264, 0.0794
Mao and Koo	1997	CER	East, west and central	Agriculture	DEA	Panel data	More	Unknown	1979-1984	0.0045, 0.1132
McMillan et al.	1989	JPE	China	Agriculture	SRM	Time series	More	Constant price	1979-1984	0.0045, 0.1132
Mead R. W.	2003	ECP	China, west	Aggregate	SRM	Time series	More	Constant price	1984-1999	-0.0750, 0.1559
Meng and Gu	2001	Chinese	China, east, central and west	Agriculture	DEA	Panel data	More	Current price	1998	-0.0350, 0.1650
Meng and Li	2004	Chinese WP	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1952-1998	-0.0310, 0.0451
Ni and Wang	2005	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2002	-0.0267, 0.1644
Ni H.	2008	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-2005	-0.0105, 0.0165
Nin et al.	2010	JPA	China	Agriculture	DEA	Panel data	More	Constant price	1962-2006	-0.1050, 0.1400
Nin-Pratt et al.	2010	JPA	China	Agriculture	DEA	Panel data	More	Unknown	1962-2006	-0.1050, 0.1400
Peng and Gou	2007	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1986-2004	-0.1504, 0.0921
Ren and Yuan	2006	Chinese	China	Manufacture	DEA	Panel data	Labor and capital	Constant price	1997-2003	0.0280, 0.0860
Rong and Wang	2004	Chinese	China	Manufacture	SRM	Time series	Labor and capital	Constant price	1986-2002	-0.2051, 0.1176
Shen and Zhao	2006	Chinese	East	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2003	-0.0630, 0.0972
Shen et al.	2007	Chinese	China	Manufacture	DEA	Panel data	Labor and capital	Current price	1985-2003	-0.0150, 0.0550
Shen K.	1999	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-1997	-0.0003, 0.0585
Shen K.	1997	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Current price	1953-1994	-0.0873, 0.1070
Shen N.	2006	Chinese	China, east, central and west	Manufacture	DEA	Panel data	Labor and capital	Current price	1985-2003	-0.0220, 0.0620
Shi and Liu	2006	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2003	-0.0851, 0.0750
Sun and Ren	2005	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1981-2002	-0.0422, 0.0967
Sun and Nian	2011	Chinese	China, east, central and west	Service	DEA	Panel data	Labor and capital	Constant price	2005-2009	-0.0220, 0.1070
Tang A. M.	1986	Book	China	Agriculture	AINA	Time series	More	Constant price	1953-1989	-0.1686, 0.1742
Tong et al.	2009	WP	China, east, central and west	Agriculture	DEA, SFA	Panel data	More	Constant price	1994-2005	-0.2560, 0.5240
Tu Z.	2007	Chinese	China	Manufacture	DEA	Panel data	Labor and capital	Constant price	1996-2004	-0.1170, 0.1760
Wang and Cheng	2005	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-2002	-0.0457, 0.0827
Wang and Ge	2007	Chinese	China, east, central and west	Agriculture	DEA	Panel data	More	Constant price	1982-2004	-0.0010, 0.0880
Wang and Gu	2005	Chinese	Central	Manufacture	DEA	Panel data	More	Constant price	1994-2002	-0.1400, 0.1200
Wang and Liu	2006	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-2001	-0.2901, 0.1511
Wang and Yan	2004	Chinese WP	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1979-2001	-0.0503, 0.0720
Wang and Yao	2003	CER	China	Aggregate	SRM	Time series	More	Constant price	1953-1999	-0.0167, 0.0306
Wang and Zhou	2008	Chinese	China	Aggregate	DEA	Panel data	More	Constant price	1995-2005	-0.0170, 0.0480
Wang et al.	2005	Chinese	China	Aggregate	DEA	Panel data	Labor and capital	Constant price	1953-2002	-0.2670, 0.1980

Wang et al.	2009	Chinese	China	Aggregate	SRM	Time series	More	Constant price	1953-2007	0.0181, 0.0374
Wang et al.	2008	Chinese	China	Service	SRM,DEA	Panel data	Labor and capital	Constant price	1980-2005	-0.0278, 0.0720
Wang Q.	2009	Chinese	East	Aggregate	SRM	Time series	Labor and capital	Constant price	1980-2006	0.0880
Wen G. J.	1993	EDCC	China	Agriculture	AINA	Time series	More	Constant price	1953-1989	-0.1762, 0.1889
Wen H.	2005	Chinese	China, east, central and west	Aggregate	SRM	Time series	Labor and capital	Constant price	1989-2001	-0.0131, 0.0905
Wong L.	1986	Book	China	Agriculture	AINA	Time series	More	Constant price	1953-1989	-0.1651, 0.1792
Woo W. T.	1997	CE	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-1993	-0.0519, 0.0547
Wu and Wang	2002	Chinese	China	Aggregate	SRM	Time series	More	Constant price	1981-1998	0.0294, 0.0420
Wu et al.	2001	RDE	China, east, central and west	Agriculture	DEA	Panel data	More	Constant price	1980-1995	-0.0395, 0.0853
Wu S.	2007	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1952-2003	-0.0050, 0.0228
Wu Y.	2008	Chinese	China	Aggregate	SFA	Panel data	More	Constant price	1993-2004	0.0164, 0.0430
Xiao and Lin	2011	Chinese	China	Aggregate	DEA	Panel data	Labor and capital	Constant price	2003-2007	0.0110, 0.1250
Xiao and Wang	2006	Chinese	Central	Manufacture	DEA	Panel data	More	Constant price	1999-2003	-0.1010, 0.7670
Xie et al.	2008	Chinese	China	Manufacture	SRM	Panel data	More	Current price	1998-2005	0.1026
Xin and Qin	2009	WP	East, west and central	Agriculture	DEA	Panel data	More	Constant price	1988-2005	-0.0480, 0.0830
Xu and Du	2005	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-2003	0.0276, 0.0501
Xu and Wang	2008	Chinese	East	Aggregate	DEA	Panel data	Labor and capital	Constant price	1990-2005	0.0089, 0.0165
Yang and Wang	2008	Chinese	China, east, central and west	Manufacture	DEA	Panel data	Labor and capital	Constant price	2000-2005	-0.3990, 0.9760
Yang T.	1994	Chinese	China	Manufacture	SRM	Time series	Labor and capital	Current price	1981-1990	-0.5229, 0.9603
Ye Y.	2002	Chinese	China, east, central and west	Aggregate	SRM	Time series	Labor and capital	Constant price	1979-1998	0.0359, 0.0558
Young A.	2003	JPE	China	Non-agricultural sector	SRM	Time series	More	Constant price	1978-1998	0.0140
Zeng and Li	2008	Chinese	China, east, central and west	Agriculture	DEA	Panel data	More	Constant price	1981-2005	-0.0865, 0.1534
Zeng X.	2008	Chinese	China	Agriculture	DEA	Panel data	More	Constant price	1981-2005	-0.0380, 0.0830
Zhang and Gui	2008	Chinese	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1979-2005	-0.0424, 0.0886
Zhang and Shi	2003	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1953-1998	-0.2909, 0.1260
Zhang and Xu	2009	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1980-2005	-0.0376, 0.0849
Zhang et al.	2006	Chinese	China	Manufacture	DEA	Panel data	More	Constant price	1999-2005	-0.0030, 0.0130
Zhang et al.	2009	Chinese	China	Manufacture	SFA	Panel data	Labor and capital	Constant price	1981-2006	0.0200, 0.1000
Zhang Y.	2007	Chinese	China	Aggregate	DEA	Panel data	Labor and capital	Constant price	1981-2004	-0.0900, 0.1700
Zhang Z.	2008	Chinese	China, east, central and west	Service	DEA	Panel data	Labor and capital	Constant price	1994-2004	-0.0060, 0.2280
Zhao and Hu	2005	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1952-2003	-0.0028, 0.0256
Zhao and Zhang	2006	Chinese	China	Agriculture	SRM	Panel data	More	Constant price	1986-2003	0.0005, 0.0283
Zhao et al.	2005	Chinese	China, east, central and west	Aggregate	DEA	Panel data	Labor and capital	Constant price	1980-2003	-0.1730, 0.1510
Zhao H.	2004	Chinese	China	Agriculture	SRM	Time series	Labor and capital	Constant price	1980-2000	-0.0732, 0.4366
Zhao X.	2008	Chinese	China, east, central and west	Manufacture	DEA	Panel data	More	Constant price	2002-2005	-0.0010, 0.0540
Zheng and Hu	2005	Chinese	China, east, central and west	Aggregate	DEA	Panel data	More	Constant price	1980-2000	-0.0204, 0.1091
Zheng et al.	1995	Chinese	East	Manufacture	SFA	Panel data	More	Constant price	1991-1992	-0.1389, 0.1785

Zheng et al.	2008	Chinese	China	Aggregate	SRM	Time series	More	Constant price	1978-2005	0.0079, 0.0427
zheng et al.	2009	WD	China	Aggregate	SRM	Time series	Labor and capital	Unknown	1978-1995	0.0079, 0.0427
Zhi D.	1997	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Current price	1978-1994	-0.0280, 0.0957
Zhi D.	1995	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1978-1993	-0.0472, 0.0877
Zhu and Li	2005	Chinese	China	Manufacture	SRM	Panel data	More	Constant price	1987-2002	-0.0566, 0.0317
Zhu W.	2008	Chinese	China	Aggregate	SRM	Time series	Labor and capital	Constant price	1984-2004	-0.1867, 0.1936

Notes: 1. Time-paper in the second column denotes the date of publication for published work and the date of finishing the paper for working paper.

2. There are two values in the TFPG Range column. The former is the minimum TFPG in the respective primary study and the latter is the maximum TFPG.