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THE IMPACT OF TOTAL FACTOR PRODUCTIVITY ON ECONOMIC GROWTH BASED ON CHINESE ECONOMY

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Abstract

Total factor productivity (TFP) refers to the level of efficiency in using production factors which include labor and capital. These factors, which originate from TFP, have been presented in China for the past two decades. In this regard, the current study aimed to investigate the contribution of TFP to the Chinese economy. More precisely, it focused on accomplishing other recent studies on this area and demonstrating the misallocation of resources on TFP limitations influenced on Chinese economy. The designation of resources in the country has been noted to alter the TFP level. Similarly, a reduction in the government regulation of industries plays a role in increasing TFP in the Chinese economy. The findings of this study indicated that the growth of the Chinese economy in the past was highly driven by the capital with a limited emphasis on labor and technological investments.

Keywords: *Total factor productivity, China, economic growth, labor.*

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1. INTRODUCTION

Productivity is considered as an important element in economics and management and is determined by the amount of the generated input in comparison to the produced output (Börsch and Weiss, 2016). Consequently, an output of 1% is obtained from 2% of the input if it meets lack of productivity. This explains why productivity is important for every business activity since it can be viewed in the singular sense of labor (Preenen et al., 2015) while total factor productivity (TFP) views fecundity in a holistic sense. TFP is termed as the portion of output that is not explained by the amounts of the applied inputs in production. Mohnen and Hall (2013) considered this as the achievement of higher levels of the output using the same amount of resources. Productivity in economics is further cited in the study by (Hartwell, 2014) where components are found to contribute to cultivation, including technical skills and education (Mahy et al., 2015). In the economics literature, growth can be measured using either the neoclassical or endogenous growth theory (Pietak, 2014). The first theory assumes that economic growth is the result of an increase in capital and population. However, this theory is challenged by decreasing returns to scale, where a level of equilibrium is achieved over time, followed by slight growth (Kregel, 2017). The second theory holds that factors such as innovation, knowledge, and human capital are the determinants of economic growth (Audretsch et al., 2014) and often represent the level of technical development in an economy. Thus, economic growth, according to (Yalçınkaya et al., 2017), it can be determined by TFP as opposed to growth in capital and labor.

TFP is measured based on the Solow residual, which calculates the surplus of what remains in output growth after subtracting the volume of growth from the capital and labor (Kokotkina et al., 2017). In order to depict the TFP model, it is commenced with a production function where industry gross output is function of capital, labor, intermediate inputs and technology indexed by time. Each industry, indexed by *j*, purchase explicit standard outputs, capital and labor services, and are denoted as follows:

$$Y_j = f_j(K_j, L_j, X_j, T) \quad (1)$$

Where

Y = output, (2)

K = index of capital, (3)

L = index of labor, (4)

X= index of intermediate inputs (5)

In a competitive factor market, under the assumption that full input utilization and scale compensation remain unchanged, the growth of output can be expressed as cost-weighted growth and technological change in inputs, using the form of a lyncical function:

$$\Delta lnY_j = \overline{v}_j^K \Delta lnK_j + \overline{v}_{jt}^L \Delta lnL_j + \overline{v}_j^M \Delta lnM_j + v_j^T \quad (6)$$

Where $\overline{v}_j^K$, $\overline{v}_{jt}^L$ and $\overline{v}_j^M$ are two-period averages of nominal weights of inputs, and thus the growth of total labour input is defined as TÖrnqvist quantity index of particular labour types as follows:

$$\Delta lnL_j = \sum_h \overline{v}_{h.j} \Delta lnH_{h.j} \quad (7.1)$$

$$\Delta lnK_j = \sum_k \overline{v}_{k.j} \Delta lnZ_{k.j} \quad (7.2)$$

$$\Delta lnM_j = \sum_m \overline{v}_{m.j} \Delta lnM_{h.j} \quad (7.3)$$

Where the equation (7.1) indicates the growth of hours workedy by each labour as $\overline{v}_{h.j}$ and equations (7.2) and (7.3) represent user-cost approach in different types of assets and intermediate input in production as $\overline{v}_{k.j}$ and $\overline{v}_{m.j}$ respectively.

Since aggregation is a value-added concept, the equations can be written as:

$$\Delta lnY_j = v_j^{-V} \Delta lnV_j + v_j^{-M} \Delta lnM_j \quad (8)$$

Where V_j is the real value-added and v_j^{-V} is the nominal share of value-added in industry gross output.

Now by rearranging equations (6) and (8) we can express the source of value-added in industry as below:

$$\Delta lnV = \sum_j \overline{w}_j \Delta lnV_j = \sum_j \overline{w}_j \frac{\overline{v}_j^K}{\overline{v}_j^V} \Delta lnK_j + \overline{w}_j \frac{\overline{v}_j^L}{\overline{v}_j^V} \Delta lnL_j + \overline{w}_j \frac{1}{\overline{v}_j^V} v_j^T \quad (9)$$

Where $\overline{w}_j$ is the share industry in its gross output ($\overline{v}_j^V$) and yield a new expression of aggregate value-added growth with weighted contribution of industry capital growth, industry labour growth and TPF growth.

Since the aggregate obtained by the APPF approach can be presented as:

$$v^T = \sum_j \frac{\overline{w}_j}{v_j^{-V}} v_j^T + \rho^K + \rho^L \quad (10)$$

Where the equations have been substracted and it can be simplified by using a Greek letter ρ.

Equation 10 expresses the aggregate TFP growth in terms of three sources; Domar-weighted industry TFP growth, reallocation of capital and reallocation of labor across industries. The Domar weighting scheme ($\bar{w}_j / v_j^{-V}$), developed by Domar (1961), plays a dominant role in the direct aggregation across industries under the Jorgensonian growth accounting framework. Regardless, the next two reallocation terms which is obtained by subtracting cost-weighted inputs, emulate the impact on TFP growth and are denoted as capital (ρ^K) and labor (ρ^L) respectively.

This measure indicates how economists determine whether an economy is growing or stagnating (Acs. ZJ. et al., 2014). For example, if a country had a gross domestic product (GDP) of $2 and $2.5 million in 2017 and 2018, respectively, it could be claimed that the economy grew by 0.5%. This growth is observed by comparing the outputs of the two years (GDP). In addition, a thorough grasp at this growth reveals where it is coming from one sector or the other. Taking a deeper look demonstrates what actions that sector has taken for increasing its production or outputs. The results which cannot be pegged down to labor and capital, are assumed to contribute to the Solow residual.

The advancement in agency and institutional structures is a relevant example in this regard. According to (Acs. ZJ. et al., 2018), innovation comes from both old and new knowledge, where new knowledge is built upon old knowledge. The whole philosophy has to be turned into something economically viable, and thus entrepreneurship is born out of it. Likewise, entrepreneurs can build institutions which support agencies so that to achieve growth. Accordingly, labor and capital are not the only factors that play a role in TFP, and hence economic growth.

Therefore, the question arises as to why scrutinizing TFP is highly important. In this regard, an argument is put forth that negligible to no growth occurs if a country would solely rely on capital and labor (Egbetokun and Memon, 2018). This is observed in the industrial revolution era, where much of a country's GDP came from its production of goods. More precisely, farmers needed labor, and industries needed workers, which led to the growth of the slave trade (Domar, 2017) and thus the presence of human labor. However, the growing competition between countries resulted in the need for something that would give this country an advantage over the other since not all countries could produce the same thing. This leads to the emergence of innovation as technology. Apparently, technology has led to extensive changes over the decades. Further, production has shifted to countries that pay lower rates for labor, with the developing countries adopting service as their industries.

Technology made it necessary for most countries to adopt this new change and include the digital methods of performing tasks in their industries. Accordingly, labor was lost in most industries by replacing repetitive manual work such as postal services (replaced by email), clerical work, and administrative work with technology. Although labor was lost in some areas, productivity represented a slight increase. Technology improved the rate at which machines did their work, and hence improved efficiency and productivity (Bampatsou et al., 2017). Thus, any country should adapt to new methods of increasing efficiency in order to support economic growth, especially in today's business environment that is influenced by technology.

China is one of the countries that has witnessed what is termed as *'unprecedented growth'* in its economy, which is largely fueled by two areas of technology and manufacturing (Nahm and Steinfeld, 2014). Economists peg down this growth to two areas of large-scale capital investments that are financed by foreign investment and domestic savings and rapid growth in productivity. Large-scale capital investment and productivity can be regarded as capital and labor, respectively. Before this growth, China had a stagnated economy mainly by its trade policies (Knight, 2014). However, according to Congressional Research Services (2019), an introduction to economic reforms encouraging foreign trades and investment has led to the rapid growth of the Chinese economy although this unprecedented growth has experienced a decline over the years (Anayanwu, 2014).

Given the above-mentioned discussions, the present study sought to answer the following questions by positioning that China's future economic growth lies in its adoption of factors outside the traditional capital and labor instead of TFP:

- Could this decline be due to solely investing in capital and labor?
- What contribution has TFP made to economic growth of China?

More precisely, it aimed to answer the above-mentioned questions by:

- Gathering research articles on TFP contributions to the Chinese economy;
- Analyzing the findings in the literature;
- Providing recommendations on how TFP can contribute to China's future economic growth.

The remaining sections of the study are organized as follows:

Section 2 focuses on the literature review of TFP and its contributions to the economy in China. Additionally, Section 3 deals with the study method and evaluates the relevant literature that touches the contributions of TFP in China. Finally, the findings of the study are discussed in Section 4, followed by providing several recommendations for increasing productivity and efficiency in the Chinese economy, as well as the main findings of the study.

2. LITERATURE REVIEW

2.1. China Before Economic Growth

China's economic background can be traced back to circa 1200 although, in this study, it shall be viewed from 1978 when China was one of the poorest countries of the world. During this time, China's economy solely relied on agriculture (Zhang 2017). According to Li (2017), there were no remarkable growths in either the per capita supply of commercial agricultural products and the per capita share of agricultural products before 1978. This lack of growth was due to continued severe shortages in agricultural outputs. Table 1 presents data on the agricultural products supplied per registered person.

Table 1. Quantities of Agricultural Products Supplied per Registered Person (1957-1978)

Year Product Type	1957	1962	1965	1970	1975	1978
			(Million tons)			
Grain	85.1	57.9	64.9	66.1	67.4	62.6
Cotton	2.7	1.2	3.3	2.9	2.9	2.6
Edible oil	1.9	0.7	1.40	1.5	1.0	1.1
Live pigs	0.1	0.0	0.1	0.1	0.13	0.1
Fisheries	3.2	2.7	3.1	2.	3.3	3.3

Source: Forty Years of Rural China, (Zhongyuan nongmin chubanshe, 1989), 133

These severe shortages led to poverty among the rural peasants, whose per capita rural income was slightly over 70 yuan. Further, the per capita annual income from collective allocation was less than 50 yuan where production teams were present. Furthermore, the industrial sector in China heavily relied on the surplus from agriculture for financing during this period. Poor surplus implied that the industrial sector would largely suffer from poor finance availability as well (Rozelle, 2017). This was not different from the focus on the development industries. These industries operate in a closed environment with no competitive advantage in both the industry sector and product offerings. The heavy industry was also in a closed feedback loop where the international trade was mainly conducted using agricultural products while light industrial products were relatively lacking. Table 2 highlights per capita incomes from various sectors in China during 1957-1978:

Table 2. Rural per Capita Incomes

Income Year	1957	1962	1965	1970	1975	1978
Per capita income (yuan)	87.57	111.5	117.3	129.3	133.5	133.6
Income from collective (%)	49.6	47.4	53.9	60.6	57.0	58.3
Income from sideline industries (%)	41.2	45.4	37.0	32.8	36.8	35.6
Income from other sources (%)	9.2	7.2	9.2	6.6	6.2	6.1

Source: Forty Years of Rural China, (Zhongyuan nongmin chubanshe, 1989), 130

Overall, China's economic growth was stunted during this period although the Chinese government introduced reforms that were geared toward economic growth, with the first reform focusing on the agricultural sector (Unger, 2016). Accordingly, farmers were required to give only a fixed amount of their product to the commune (Zweig, 2015), leading to an increase in farmers' production incentive since they underwent only a fixed amount of taxation (Wang and Shen, 2014). The reforms also touched on the other factors of farming such as land rights, marketing and distribution, pricing, and the development of financing institutions, along with an improved role of government in agriculture (Chow, 2015).

According to land rights, farmers could have land ownership that secured their farming activity for years, which was more than the 30-year plan given by the government in the 1990s (Ye, 2015). The government opened trade between China and other countries, enabling farmers to export their products (Awan, 2018). This increased their earnings, and the total trade grew by about 6.0% per annum during 1980-2000. Moreover, the forces of demand and supply were used to determine market prices for farm products, increasing the price of grain relative to the fertilizer, which has risen more than 60% since the reformation. The government-supported research and development provided the chance for farmers to use technology in order to obtain higher yields (Yang et al., 2014).

This new economic growth was noted to have positively affected the country between during1981-2012 (Esmail and Shili, 2017). The Chinese government introduced policies and reforms, apart from those in agriculture that supported changes in its economic structure, which shifted from the oriental to the market-based economy, leading to a shift from an agrarian economy to a manufacturing and service-based economy (Lee, 2017). According to the literature, reforms in restructuring the economy have been the major contributors to economic growth in China.

2.2. China After Economic Growth

The following sectors were credited for contributing to the growth of the economy in China.

2.2.1. Agriculture

The agricultural sector in China was revived by the reform change, which witnessed the production of 18, 50, and 29% of the cereal grain, vegetables, and meat worldwide, respectively (Esmail and Shili, 2017). This issue changed China into the world's largest agricultural economy and the largest producer of pork, tea, cotton, wheat, rice, and fish (Alston and Pardey, 2014). China did this while utilizing only 9% of its arable land, feeding 22% of the world's population (Yu and Wu, 2018). It should be noted that agricultural production in China heavily relied on soil fertility, pollination, water availability, among others. These increases in agricultural inputs, along with total factor productivity (TFP), contributed to the growth of about 40.6 and 55.2% in inputs and outputs during 1991-2009, respectively (Yu and Wu, 2018).

2.2.2. Industries

China's industrial sector has grown from imitating mature technology to actual innovation, a phenomenon which is known as 'leapfrogging' (Painter, 2014). This industrialization led to the need for importing production equipment, aircraft, machinery, raw materials, and telecommunications technology. The industrial growth has also been supported by higher growth in productivity and per capita incomes. China further ascended in the international trade scene in 2001, which highlighted its manufacturing capabilities, leading to its production of massive exports to countries such as the United States, Europe, and other countries worldwide (Yang and Martinez-Zarzoso, 2014). Manufacturing in China contributed to the added gross value country by 35.1% in 2013 (Esmail and Shili, 2017). Additionally, China clustered its industries by industry type and regions during 1990-2004. In addition, Shanghai was the region for steel, automobile, and oil, and Zhejiang was famous for its clothing, home appliances, and clothing. On the other hand, Guangdong was changed to a region for computers, clothing, and related electronic items (Klafke et al., 2018). This clustering centrally places industries where they can have better access to markets, share technological know-how, have an easy flow of ideas, and get financial assistance through loans.

2.2.3. Trade

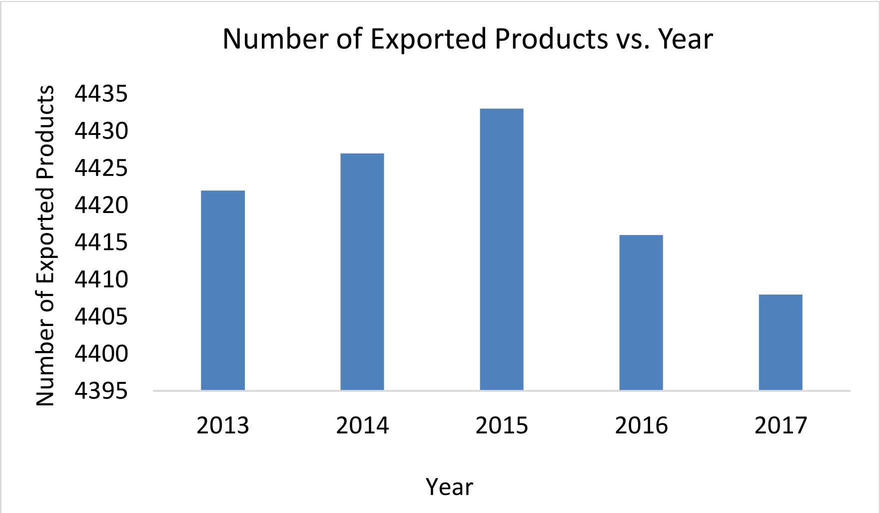
China joined the World Trade Organization in 2011 (Baldwin, 2016), mainly trading with economic powers such as the United States and Europe. Coupled with its profound change in its structural organization and economic growth, the country has continued to experience exponential expansion in its trade partners. The top five trade partners that have worked with China since 2019 are provided in Table 3.

Table 3. Top Five Trade Partners with China in Million USD

Market	Trade US$ (Million)	Partner Share (%)
United States	430,328	19.01
Hong Kong, China	279, 211	12.34
Japan	137,259	6.06
Republic of Korea	102,704	4.54
Vietnam	71,617	3.16

Source: The World Bank Group, 2019

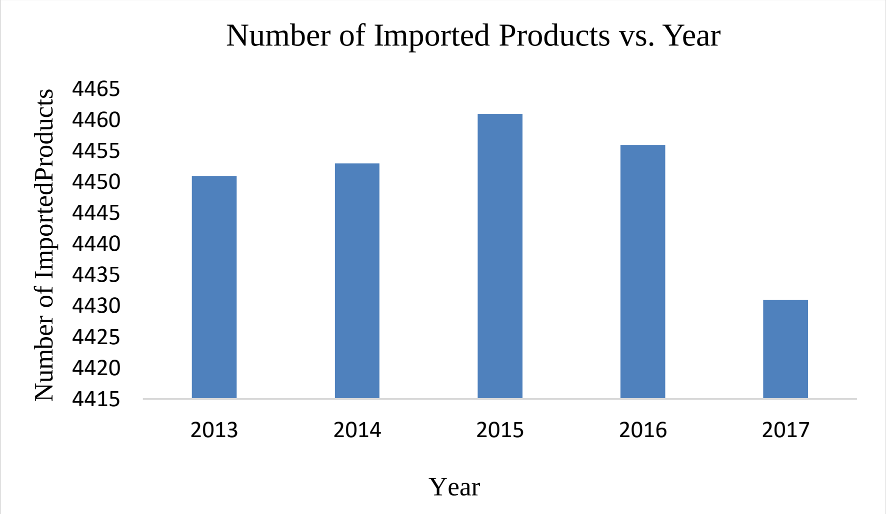
According to Esmail and Shili (2017), China's trade in merchandise exports increased from \$14 billion in 1979 to \$23 trillion in 2014, followed by an annual growth rate of 18.0% from 1990 to 2014. During the same period, the importation of merchandise represented an increase from \$18 billion to \$2.0 trillion, with an annual growth rate of 16.6%. Based on the obtained data, the number of exported products by China to other countries worldwide increased from 2013 to 2015, which then decreased in the subsequent years (Figure 1).



Source: The World Bank Group, 2019

Figure 1. Number of Exported Products by China during 2013-2017

On the other hand, the number of imported products by China between the same periods also increased between 2013 and 2015 and decreased in the following years (Figure 2).



Source: The World Bank Group, 2019

Figure 2. Number of Imported Products by China during 2013-2017

Based on these two records, the number of imported products was higher compared to exported ones. However, the value of the exported products was higher in comparison to imported ones which it will be shown below:

Table 4. China's Exports and Imports of Product Groups

Product category	Exports		Imports	
	Value in $US Mil	Product % Share	Value in $US Mil	Product % Share
Raw materials	41,292	1.82	443,963	24.08
Intermediate goods	369,082	16.31	396,326	21.50
Consumer goods	824,788	36.44	239,091	12.97
Capital goods	1,022,921	45.19	749,095	40.63

Source: The World Bank Group, 2019

As shown, China's industrial sector is the major contributor to trade in terms of exports.

2.2.4. Employment

Employment in China was divided into formal and informal sectors (Xue, Gao and Guo, 2014). In total, both sectors employed about 744 million people in 2013, including 256.39 and 487,930,000 million cases in urban and rural areas, respectively. The findings revealed that China created 96.83 million jobs duing 1990-2003, which represented an annual increase of 7.45 million jobs (Esmail and Shili, 2017). However, the country still grapples with some levels of unemployment (Li, Whalley and Xing, 2014). This is a challenge that threatens to slow down the economic growth of this country. Further, the GDP of China decreased to 7.4% in 2014. Although the ratio of job seekers to vacancies has improved, it is still less than one, implying that there are some graduates who may be unable to find employment (Ding and Tay, 2016).

2.3. Sources of Labour Growth in China

In the study by Wu (2015), labor significantly contributed to output growth during 1980-2016. The aggregate growth of TFP at 0.76 percent each year was due to 40 percent contribution within industries and 60% reallocation of labor and capital across industries. According to Zhang (2017), reductions in transaction costs, along with migrations within China have led to enhance labor productivity. As indicated in Appendix 2, TFP significantly differs in China, representing that some industries are lagging in total factor production compared to others.

Accordingly, reforms opened the doors to growth for the Chinese economy although other factors also played a role in this regard. Without the availability of resources such as land (agriculture) and the applied raw materials in industries, the economy would not have witnessed much growth. Furthermore, there would be no manipulation of the applied resources for making products without labor (human capital). Both the human capital and resources contributed to economic growth. However, these can be viewed in terms of the applied inputs for obtaining the outputs. Nonetheless, a question arises regarding the role of other factors (e.g., effectiveness and innovation which are not so obvious) in economic growth. The Method section of this study scrutinizes how various sectors have used TFP to improve their outputs.

3. METHODOLOGY

3.1. Research Design

This study was based on a systematic review of previous studies on total factor productivity (TFP) in China in the past five years. There are many advantages associated with this approach to the current study. For instance, data are collected from studies in peer-reviewed journals, as well as the reputable sources of information by reputable organizations and governments, making the findings of the study highly credible. Similarly, identifying gaps in the study process is possible by comparing the views of different studies. Moreover, the conclusions of the review are more encompassing and reliable by presenting the contributions of multiple scholars together as compared to those of a single study. Additionally, the comparison of the findings from multiple studies creates an opportunity for eliminating the bias since outliers in findings are removed so that commonly shared views are held to be the accurate view. The method section acts as a source of guidance on how the data is collected in the research.

3.2. Data

Based on the aim of the study, data were collected from scholarly articles on various TFP contributions in China and different sectors of the economy, including manufacturing and industries, along with technology. In addition, the qualitative method was used for data collection (Taylor et al., 2015). This type of research method takes into consideration on-numeric data and aims to obtain meaning and inferences from the data when compared to counts and measures. The qualitative method was found to be best suited for the present study given the lack of taking into account measures or counts.

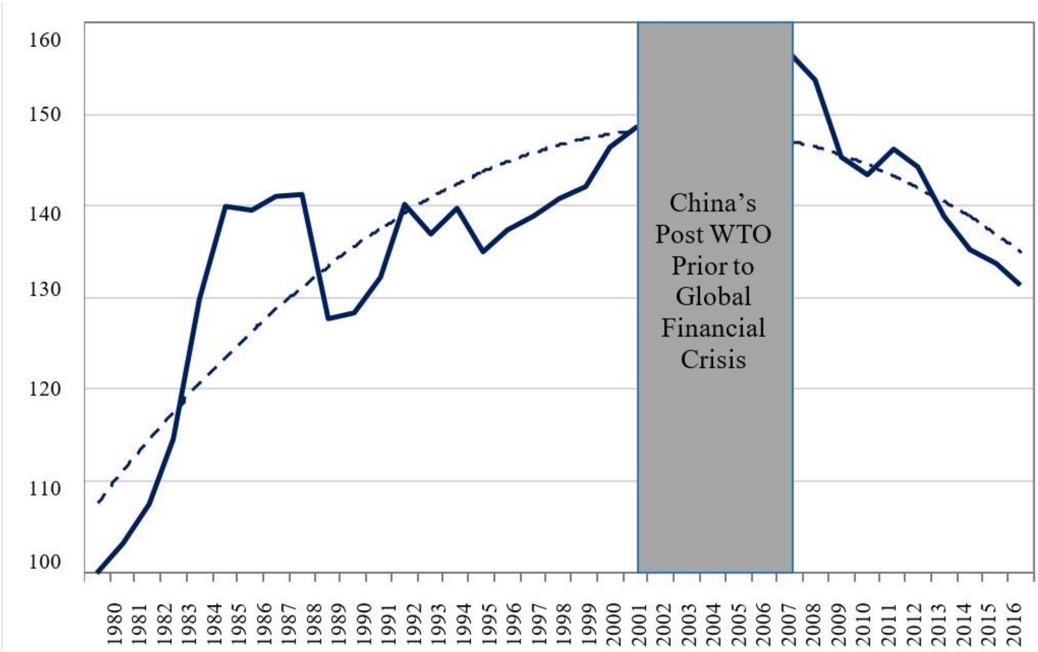
The data has been gathered from both online and library sources in past research work conducted on TFP in China (Hewson and Stewart, 2016) although they were limited to the period of the past five years. The contributions of TFP were the main determinants of the kind of data collection, which helped in filtering the data for the purpose, and Google Scholar was the online source for data collection. Further, two keywords were applied to obtain the relevant data, including “Total factor productivity” and “China”. Finally, data were analyzed based on the secondary data analysis method because of using secondary data collected online. This method is flexible and can be utilized in the selected systematic method for reviewing the literature (Johnston, 2014).

4. RESULTS AND ANALYSIS

4.1. Results

The present study is based on multiple findings from past studies and ample techniques in total factor productivity (TFP) assessment, including the aggregate production possibility frontier (APPF) and review-wise of a newly constructed economy-wide industry-level data set of the on-going China Industrial Productivity (CIP) Database Project that follows the KLEMS principles in data construction[1]. The results indicated that TFP growth amounted to 0.76% per annum during 1980-2016. This implies that opposed to the industry weighted value addition growth of 8.53% per annum, however The TFP accounted for only 8.9% in China’s growth in gross domestic product per annum during this period.

[1] KLEMS is used as an acronym for **K** Capital, **L**abor, **E**nergy, **M**aterials and **S**ervices that are used to produce any products. As it illustrates, the gross output of an industry equals the overall costs of “KLEMS” and the gross output of an economy equals the sum of the costs of KLEMS of all industries.



Source: Constructed based on results shown in Appendix 2

Figure 3. Index of Aggregate Total Factor Productivity in China (1980=100)

The Contribution of factors in Figure 3 will be comprehended that why China lost its TFP strength. Of the 8.53 – percent annual output growth rate for the whole period under investigation, the contribution of capital input was 6.74 percentage points (ppts), labor input 1.03 ppts and TFP 0.76 ppts. This depicts that 79 percent of the real value-added growth relied on capital input growth, 12.1 percent on labor input growth, and 8.9 percent on the total factor productivity growth. The assistance of capital input growth rocketed from 55 percent in the 1980s to 84.7 percent post WTO, but to more than 100 percent in the wake of the global financial crisis, that is, 113.7 percent to the period 2007-2012 and 136 percent for the period 2012-2016. The reason for the downtrend appears to be the overinvestment. Obviously, the contribution of labor input declined from 16 percent in the 1980s to 6.5 percent post WTO. Nevertheless, this shortly went opposite to 7.2 percent in 2007-2012 and 8.4 percent in 2012-2016.

4.2. Analysis

According to Wu (2018), industries that were less prone to government interventions had higher TFP compared to those that often experienced government interventions. The above-mentioned study equally indicated that the reallocation of resources across industries had a significant impact on the overall TFP, confirming the role of merits of factor reallocation in the economy in promoting productivity within such economy. According to (Lida et al., 2018), TFP growth in China in recent years has been driven by innovations, shifting the focus from mere capital allocation to investment in research and development. Many companies in China have invested in technologies meant for gathering artificial intelligence as well as the area of artificial reality applications. Based on the systematic review of Chinese TFP, China's economy has significantly increased during 1980-2008 and assumed a downward trend after such investment.

TFP is used for measuring the efficient application of the inputs. Furthermore, efficiency has the potential for growing production in a country while simultaneously enhancing the level of competitiveness in organizations. For organizations in China, focusing on the traditional factors of production such as labor and capital and investment in technology is of great importance. A change in technology results in alterations in the level of labor and capital required for the production process. It also increases efficiency, indicating that low costs of production lead to increased outputs. According to (Lida et al., 2018), TFP enhancement in China will be driven by increasing deregulation and privatization. State-owned enterprises have a very low level of TFP (Feng et al., 2015). Equally, it is to be driven by highly innovative emerging firms in the country. The continuous influx of highly efficient foreign firms will also contribute towards development.

5. RECOMMENDATION

As explained by (Lida et al., 2018), low total factor productivity (TFP) firms mainly tend to catch up with those on domestic frontiers. On the other hand, high TFP firms are inclined to replace low TFP firms. Research and development are also noted to be a key source of growth in TFP in countries. According to (Lida et al., 2018), China needs to open up the regulated industries. These industries belong to the energy, finance, and natural resource sectors (Feng et al., 2015). Moreover, discriminatory policies should be eliminated for attaining the desired growth. Glass door problems should be avoided as well. This refers to scenarios where policies are developed but hardly implemented in this regard. Additionally, TFP in the country enhances through the engagement of the high population in China in training and development. The lack of skills reduces the ability of labor to positively contribute to the TFP. As elucidated by Du, Shao and Hu (2019), labor may be substituted for capital in cases where the capital is limited but labor is in excess, resulting in enhanced total productivity in the context of low capital. For example, the government should invest more in cultivation technologies in order to reduce the cost of production while increasing production in the agricultural sector (Zhan, 2017). As indicated in Appendix 1, although some firms have high TFP levels, the other ones are making limited contributions in this respect. Thus, there is a need for the trans-industry reallocation of resources including technology regarding enhancing TFP levels and productivity.

6. CONCLUSION

As a whole, total factor productivity (TFP) touches evolutions in the gross domestic and vastly determines by resources in China. This shows the requirements for firms and the government to coordinate more assets in innovation improvements particularly in the agricultural sector. Furthermore, the preparation of the enormous labour constrain accessible in China increments the capacity of the nation to boost proficiency within the fabrication route. TFP in China has been diminishing due to destitute asset assignments in spite of the fact that intra industry reallocations have activated an upward slant in country. It is worth noticing that most insightful scholars share a common aspect of view demonstrating that advancement and productivity in asset utilization play a key part in improving TFP in China. All things considered, the success of TFP in making strides depends on whether the government will proceed or backtrack when it comes to market de-regularization.

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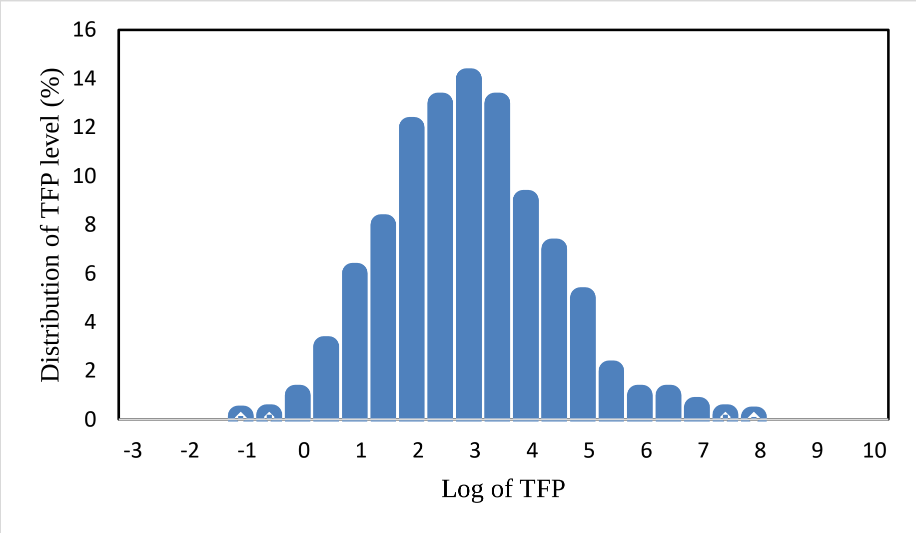
Appendix

Appendix 1: China TFP by Firm Samples as Reported by Bank of Japan (2018)



The TFP level of 3,407 firms are available for 2016

Source: Lida, Shoji & Yoneyama (2018)

Figure 4. TFP level of listed firms in Appendix 2

Appendix 2: China TFP by Industries

Table 5. Industry and Factor Contributions to China's Value-Added Growth 1980-2016

	1980-91	**1991-01**	**2001-07**	**2007-12**	**2012-16**	**1980-2016**
Value Added Growth Year (APPF, %)	Industry contributions to value-added growth					
Value added-growth (APPF, %)	8.78	8.94	10.06	7.38	5.29	**8.53**
-Agriculture	1.73	1.31	0.37	0.20	0.19	**1.01**
-Construction	0.51	0.49	0.56	0.47	0.27	**0.48**
Income from other sources (%)	9.2	7.2	9.2	6.6	6.2	**6.1**
-Energy	0.03	0.08	0.52	0.20	0.51	**0.20**
-C&P	1.12	1.99	1.58	1.96	1.32	**1.58**
-SF&F	3.22	2.44	3.66	2.54	1.00	**3.01**
-Services I	0.94	0.43	1.22	1.48	1.52	**1.07**
-Services II	0.94	1.22	2.62	2.21	1.37	**1.52**
-Services III	0.30	-0.01	-0.96	-0.18	-0.87	**-0.33**
	Factor contributions to value-added growth					
Value added-growth (APPF, %)	8.78	8.94	10.06	7.88	5.29	**8.53**
-Capital input	4.84	6.47	8.53	896	7.20	**6.74**
-Stock	4.91	6.58	8.57	8.95	7.13	**6.79**
-Capital quality (composition)	-0.08	-0.10	-0.05	0.01	0.07	**-0.05**
-Labor input	1.41	1.31	0.65	0.56	0.45	**1.03**
-Hours	1.34	0.80	0.60	-0.52	0.18	**0.57**
-Labor quality (composition)	0.06	0.51	0.06	1.18	0.26	**0.36**
-Aggregate TFP	2.54	1.16	0.88	1.54	-2.35	**0.76**

Source: Based on CIP/KLEMS Estimations on Domar-Weighted TFP Growth

Note: See Table 6 (Appendix 3) for industry abbreviation.

Table 6. CIP/China KLEMS Industrial Classification and Code

CIP	EU-KLEMS	Grouping	Industry	
1	AtB	Agriculture	Agriculture, forestry, animal husbandry &	AGR
2	1	Energy	Coal mining	CLM
3	1	Energy	Oil & gas excavation	PTM
4	1	C&P	Metal mining	MEM
5	1	C&P	Non-metallic minerals mining	NMM
6	1	Finished	Food and kindred	F&B
7	1	Finished	Tobacco products	TBC
8	1	C&P	Textile mill products	TEX
9	1	Finished	Apparel and other textile products	WEA
10	1	Finished	Leather and leather products	LEA
11	2	SF&F	Saw mill products, furniture, fixtures	W&F
12	21t22	C&P	Paper products, printing & publishing	P&P
13	2	Energy	Petroleum and coal products	PET
14	2	C&P	Chemicals and allied products	CHE
15	2	SF&F	Rubber and plastics products	R&P
16	2	C&P	Stone, clay, and glass products	BUI
17	27t28	C&P	Primary & fabricated metal industries	MET
18	27t28	SF&F	Metal products (excluding rolling products)	MEP
19	2	Semi-finished	Industrial machinery and equipment	MCH
20	3	SF&F	Electric equipment	ELE
21	3	SF&F	Electronic and telecommunication equipment	ICT
22	30t33	SF&F	Instruments and office equipment	INS
23	34t35	Finished	Motor vehicles & other transportation	TRS
24	36t37	Finished	Miscellaneous manufacturing industries	OTH
25	E	Energy	Power, steam, gas and tap water supply	UTL
26	F	Construction	Construction	CON
27	G	Services II	Wholesale and retail trades	SAL
28	H	Services II	Hotels and restaurants	HOT
29	I	Services I	Transport, storage & post services	T&S
30	71t74	Services I	Telecommunication & post	P&T
31	J	Services I	Financial	FIN
32	K	Services II	Real estate services	REA
33	71t74	Services II	Leasing, technical, science & business	BUS
34	L	Services III	Public administration and defense	ADM
35	M	Services III	Education services	EDU
36	N	Services III	Health and social security services	HEA
37	O&P	Services II	Other services	SER

Source: Based on CIP/KLEMS Estimations on Domar-Weighted TFP Growth