

# A Review of the Influence of Exchange Rates on Total Factor Productivity

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**Abstract:** Total factor productivity (TFP) is a crucial factor influencing the economy. As we all know, the flexibility and volatility of the RMB exchange rate have been significantly enhanced after the exchange rate reform on "8.11" in 2015, China. As the exchange rate and TFP are both important factors in the economy, the study of the impact of the exchange rate on TFP has been a hot topic for scholars at home and abroad. This review is of great significance for guiding China's high-quality development and promoting the formation of "new quality productivity". At present, research on the impact of exchange rates on total factor productivity can be mainly classified into two categories: the level of exchange rates and the effects of exchange rate fluctuations on total factor productivity. As the exchange rate cannot directly influence TFP, understanding the mechanism of how the exchange rate impacts TFP is crucial.

**Keywords:** Total Factor Productivity; Exchange Rate; Exchange Rate Volatility; Review

## 1. Introduction

The exchange rate is a core variable that influences the development of an open economy. It also serves as an important bridge connecting domestic and foreign economies. Since the exchange rate reform of "8.11" in 2015, the volatility of the RMB exchange rate has significantly increased. Moreover, the flexibility of the exchange rate has been significantly enhanced. The acceleration of the process of RMB marketization has increased the RMB exchange rate and optimized the allocation of resources. This has also resulted in the situation where the exchange rate is being influenced by more factors in the economy. Total factor productivity measures the contribution of technological progress to economic growth and the quality of economic growth as well. China is in a transition period of high-quality development. Improving total factor productivity is not only crucial for achieving high-quality development in China but also a significant method for establishing "new quality productivity." With the internationalization of the Renminbi (RMB) and the marketization of the exchange rate, the influence of the RMB exchange rate on total factor productivity has gradually intensified. The impact of the exchange rate on total factor productivity can be divided into two aspects: the impact of changes in the exchange rate level on total factor productivity and the impact of exchange rate fluctuations on total factor productivity. Since the exchange rate does not have a direct impact on total factor productivity, most studies have examined the relationship between the exchange rate and total factor productivity. This paper summarizes the research on the impact of exchange rates on total factor productivity and provides guidance for China's exchange rate policy and high-quality development.

## 2. Research on the Balassa-Samuelson effect

The Balassa-Samuelson effect (B-S effect) was proposed by Balassa (1964) and Samuelson (1964) from the perspective of undervaluation of exchange rates in developing countries and overvaluation of the exchange rate in the United States after the war. A large number of scholars have conducted empirical studies to verify whether the actual economic performance of various countries supports the B-S effect, and most scholars believe that the economic situation is in line with the B-S effect. Choudhri and Khan utilized data from 16 developing countries to illustrate that developing countries do exhibit a B-S effect. If tradable goods can circulate freely internationally, then the differences in productivity between the two sectors will significantly affect the prices of non-tradable goods, and thus the real exchange rate<sup>[1]</sup>. Bordo (2017) analyzed data from 14 developed countries between 1880 and 1997 using panel dynamic least squares measurement methods. The results show that the effect coefficients vary across different periods.

There is a significant, albeit small, B-S effect in the gold standard period. The coefficient of the B-S effect is significantly negative, which is contrary to the B-S effect observed during World War I and World War II. Under the Bretton Woods system, the coefficient of the B-S effect is close to zero. While the coefficient is significantly positive in the floating exchange rate period<sup>[2]</sup>. Some scholars have found that the B-S effect does not exist. Empirical tests of the B-S effect conducted by Matthias Gubler, Christoph Sax, and Daan Steenkamp have shown that the B-S effect does not hold in New Zealand and OECD countries. Liu Xiaohui and Wu Jianli (2021) used panel data from 29 different provinces and cities in China from 1995 to 2015 to conduct an empirical test. Researchers found that the B-S effect is applicable in China. However, it is further found that the division of the labor market between the trading and non-trading sectors will inhibit the B-S effect<sup>[3]</sup>. Li Zhishen and Sheng Yingbo (2020) utilized panel data from 30 provinces and cities in China spanning from 1987 to 2017 to confirm a notable positive correlation between labor productivity and the real exchange rate of RMB. This study validates the applicability of the B-S effect in China<sup>[4]</sup>. Wu Jianli and Liu Xiaohui (2020) utilized the spatial Durbin model to investigate the correlation between inter-sector income gaps, relative productivity, and internal real exchange rates. The study showed that income disparities and relative labor productivity do have a significant negative impact on internal real exchange rates<sup>[5]</sup>. Ding Jianping (2020) used the data from 2004Q1 to Q4 2016 to test the B-S effect and its transmission mechanism. The study focused on the manufacturing and subdivided service industries in China and the United States. They have proven that the B-S effect is indeed valid, but the mechanism of relative wages as the transmission intermediary is not valid<sup>[6]</sup>.

### **3. Research on the impact of exchange rates on total factor productivity**

#### ***3.1 The exchange rate has a positive effect on total factor productivity***

Scholars have conducted extensive research on the relationship between exchange rates and total factor productivity. In general, the impact of the exchange rate on total factor productivity mainly lies in two aspects. On the one hand, the exchange rate has contributed to the enhancement of total factor productivity. Jeanneney (2011) utilized panel data from 29 provinces in China spanning from 1986 to 2007 to construct an econometric model. This model was employed to empirically test the relationship between the real exchange rate of RMB and labor productivity. The results of empirical analysis showed that the appreciation of the real exchange rate of RMB has promoted the improvement of labor productivity<sup>[7]</sup>. Ekholm et al. (2012) found that the Norwegian krone appreciated by 17% during the period from 2000 to 2004, and that this exchange rate appreciation led to a 24% increase in labor productivity in the Norwegian manufacturing industry<sup>[8]</sup>. Bussière et al. (2014) conducted an empirical test to study the relationship between exchange rates, productivity, and capital flows in emerging and developing economies using the propensity score matching method. As a result, the test has shown that currency appreciation effectively promotes productivity improvement<sup>[9]</sup>. Beckmann et al. (2015) conducted an empirical study based on data from European economies from 1995 to 2013. The results showed that the appreciation of real effective exchange rates in Eastern European countries has significantly promoted the improvement of labor productivity<sup>[10]</sup>. Lan Leqin (2014) began by focusing on efficiency and measured economic growth efficiency using total factor productivity. With the elasticity of the exchange rate system selected as the variable, she conducted an empirical test on the relationship between the RMB exchange rate system and total factor productivity. It is found that the RMB exchange rate system has played a positive role in promoting productivity in the long and short term after several reforms. It is also found that the floating exchange rate system is an efficient institutional arrangement, and appropriate improvements to the flexibility of the RMB exchange rate system will promote economic growth<sup>[11]</sup>. Xu et al. (2015) conducted an empirical analysis using China's TFP data and RMB real effective exchange rate data from 2000 to 2007. The study demonstrated that the exchange rate can enhance total factor productivity by leveraging factor allocation effects and scale effects<sup>[12]</sup>. Liu Ming et al. (2018) constructed a "spatial" Durbin panel model based on the input-output table data of various industries from 2008 to 2014 to empirically test the impact of the real effective exchange rate of RMB on the growth of industrial total factors. In the sample period, empirical results indicated that the growth rate of the effective exchange rate of RMB increased by 1% and the total factor productivity increased by 0.55%<sup>[13]</sup>. Wu Jianli and Liu Xiaohui (2020) utilized the spatial Durbin model to examine the correlation between inter-sector income gaps, relative productivity, and internal real exchange rates using data from 29 provinces and cities in China spanning from 1995 to 2015. The study's findings indicated that an increase in relative labor productivity would result in the appreciation of the internal real exchange rate, ultimately leading to an appreciation of the real exchange rate<sup>[3]</sup>. Sun Shaoqin and Zuo Vanilla (2020) examined the correlation between the real effective exchange rate of RMB and total factor

productivity by focusing on the quality of imported intermediate goods. They utilized data from Chinese industrial enterprises and customs databases spanning from 2000 to 2006. The findings of their research indicated that the appreciation of the real effective exchange rate and the importation of high-quality intermediate goods can significantly enhance total factor productivity. That is, the real exchange rate can enhance the total factor productivity of enterprises by facilitating access to high-quality intermediate goods<sup>[14]</sup>.

### ***3.2 The exchange rate has a negative effect on total factor productivity***

On the other hand, scholars have found that for countries with a low level of development, exports play a crucial role in influencing economic growth. The appreciation of the exchange rate hinders exports, which, in turn, negatively impacts productivity growth. Based on the dynamic panel data of 83 countries from 1960 to 2000, Aghion (2009) empirically studied the impact of exchange rates on productivity at various financial levels using a cross-sectional augmented distribution lag estimator. The results showed that real exchange rate appreciation had a significant negative effect on the productivity growth in countries with low financial development but had no significant impact on countries with high financial development<sup>[15]</sup>. Caglayan and Demir (2015) conducted an empirical test based on panel data from 1000 manufacturing firms in Turkey from 1993 to 2005. Their study revealed that an increase in the real effective exchange rate had a significant inhibitory effect on the growth of total factor productivity. Further study provided evidence that the impact on export-oriented firms is more significant<sup>[16]</sup>. Based on the data of 74 countries from 1975 to 2004, Diallo (2015) studied the relationship between real effective exchange rate volatility and TFP growth. The study concluded that real effective exchange rate appreciation has a negative effect on TFP growth in countries with low financial development<sup>[17]</sup>. Pyun and Choi (2018) utilized data from 2006 to 2013 on the productivity of Korean manufacturing firms and discovered that the persistent depreciation of the real exchange rate had a beneficial effect on the productivity of exporters. Furthermore, this positive effect had a compounding impact on the escalation of export risk exposure<sup>[18]</sup>. Alfaro (2018) utilized firm data from 2001 to 2010 to evaluate the influence of exchange rates and productivity among manufacturing firms. The study revealed that real exchange rate depreciation in export-oriented emerging Asian economies enhanced firm-level Total Factor Productivity (TFP). However, it had a negative impact on firm-level productivity gains in other emerging economies with relatively high import dependence<sup>[19]</sup>. Cao Wei (2014) utilized the systematic GMM method to investigate the influence of RMB exchange rate fluctuations on productivity via investment channels across various industry intensities. It is pointed out that labor-intensive firms have significantly reduced their investment due to exchange rate appreciation, which, in turn, will lead to a decline in firm productivity<sup>[20]</sup>. Based on the data of China's industrial enterprises from 1999 to 2013, Yang Wenpu (2019) examines the relationship between exchange rates and financing constraints on firm total factor productivity at the firm level. The study found that both exchange rates and financing constraints had a negative impact on firm productivity<sup>[21]</sup>.

### ***3.3 The channels through which exchange rates affect total factor productivity***

The exchange rate, as the price of two currencies, affects total factor productivity through price transmission. There are various mechanisms through which exchange rates impact total factor productivity. Scholars have analyzed various mechanisms through which exchange rates affect total factor productivity and have found that the impact of exchange rates on total factor productivity varies. Some scholars believe that exchange rates have a positive impact on total factor productivity through technology spillovers, optimizing resource allocation, and other factors. Amity and Konings (2007) argued that when the exchange rate appreciates, the exchange rate, as the price of two currencies, affects total factor productivity through price transmission. There are various mechanisms through which exchange rates impact total factor productivity. Scholars have analyzed various mechanisms through which exchange rates affect total factor productivity and have found that the impact of exchange rates on total factor productivity varies. Some scholars believe that exchange rates have a positive impact on total factor productivity through technology spillovers, optimizing resource allocation, and other factors.<sup>[22]</sup> Sylviane Guillaumont and Ping Hua (2010) found that the appreciation of the RMB will reduce the relative price of imported goods and intensify the competition in the domestic industry. This will help enterprises to survive through competition, optimize the efficiency of resource use, and improve the TFP level of the entire industry<sup>[23]</sup>. Shi and Xu (2010), who analyzed in the view of imported products, argued that exchange rate appreciation reduces the relative cost of imported products, offsets part of the export costs of enterprises, and increases the import of high-quality products, thereby ultimately improving the productivity of enterprises<sup>[24]</sup>. Hu and Liu (2014) argue that in the context of the globalization of

international trade, the exchange rate affects trade between countries, which in turn has an impact on total factor productivity. The empirical study found that the TFP level of China's manufacturing industry has increased by 0.94% as a result of China's accession to the WTO<sup>[25]</sup>. Mao Qilin and Xu Jiayun (2014) examined the impact of Outward Foreign Direct Investment (OFDI) on Chinese firms' independent innovation from 2004 to 2009. They found that OFDI can enhance firms' independent innovation and contribute to the enhancement of their total factor productivity<sup>[26]</sup>. Cao Wei (2020) found that exchange rate appreciation improved the TFP of manufacturing enterprises by reducing the cost of imported intermediate goods. This forced export enterprises to upgrade and eliminate outdated production capacity<sup>[20]</sup>.

Some researchers have discovered that the exchange rate can hinder the growth of TFP by investigating how it impacts TFP. Zong Weihao (2009) concluded in their study that the impact of RMB real effective exchange rate appreciation on total factor productivity growth through trade structure and constraints of finance is weak and negative<sup>[27]</sup>. Zhang et al. (2015) analyzed the relationship between the market competition structure from the perspective of market competition mechanisms using the microenterprise data at the industry level. They argued that exchange rate appreciation would significantly increase the productivity of non-export enterprises in industries with weak domestic competition through the effect of import competition, and reduce the productivity of domestic export enterprises through export market shock as well<sup>[28]</sup>.

#### 4. Research on the impact of exchange rate volatility on total factor productivity

Some researchers have studied the relationship between exchange rates and total factor productivity by examining exchange rate volatilities. Rogoff (2006) conducted an empirical analysis based on the data of 83 countries from 1960 to 2000. The results of the study showed that real exchange rate fluctuations have a significant impact on long-term productivity growth rates, which mainly depend on the level of financial development of a country<sup>[29]</sup>. Diallo and Ibrahima Amadou (2012) examined the relationship between fluctuations in the real effective exchange rate and total factor productivity growth in 74 countries from 1975 to 2004. They utilized panel data, variable regression, and threshold effect estimation methods. The results show that fluctuations in the real effective exchange rate have a negative impact on total factor productivity growth. These fluctuations have a significant impact on developing countries<sup>[30]</sup>. R. Kausar and K. Zulfiqar (2017) investigated the impact of real exchange rate fluctuations on long-term productivity growth in a selected group of Asian countries using the panel ARDL method from 1985 to 2015. The study finds that exchange rate volatilities have a significant negative impact on productivity growth, and this effect is influenced by the level of financial development and government burden<sup>[31]</sup>. Liu Qinqing (2007) argues that appreciating the exchange rate within a certain range can enhance the total factor productivity of enterprises. Consequently, the exchange rate appreciation will drive industrial upgrading in enterprises, ultimately leading to an increase in total factor productivity. However, it also indicates that if the exchange rate rises beyond this range, the total factor productivity of enterprises may be reduced<sup>[32]</sup>. Du Jiang, Yuan Changju, and Yi Jin (2013) proved through empirical research that exchange rate fluctuations have an effect on total factor productivity. They found that the impact of these fluctuations is independent of the absolute level of the exchange rate<sup>[33]</sup>. Mao Risheng (2017) utilized the effective exchange rate index of the manufacturing industry to investigate the influence of exchange rate fluctuations on the efficiency of enterprise resource allocation. They found that the appreciation of the real effective exchange rate of RMB would significantly improve the efficiency of enterprise resource allocation<sup>[34]</sup>. Yang Wenpu (2019) studied the impact of exchange rate fluctuations on firm productivity from the perspective of financing constraints. He argued that an increase in exchange rate fluctuations would elevate the risk of export trade for export firms. This heightened risk could lead to a reduction in innovation investment, hindering efficiency improvement. As a result, the volatilities of exchange rates have shown a significant negative impact on the improvement of total factor productivity of export firms<sup>[21]</sup>.

#### 5. Conclusions

The concept of new qualitative productivity suggests that China's economic development prioritizes enhancing efficiency, and the enhancement of total factor productivity should be the primary driver of China's economic growth. The research on total factor productivity in academic circles can be likened to a vast sea, and the factors influencing total factors have been thoroughly investigated from macro to micro levels.

The Balassa-Samuelson effect has sparked scholars' interest in investigating the connection between exchange rates and productivity. Both domestic and international scholars have conducted empirical studies to explore whether economic development aligns with the Balassa-Samuelson effect. The majority of scholars believe that there is a correlation between exchange rates and productivity as proposed by the Balassa-Samuelson effect. Due to the challenging conditions required for the Balassa-Samuelson effect to form, scholars both domestically and internationally have extended the model from various viewpoints, leading to variations in empirical analysis results.

Scholars at home and abroad have made significant achievements in researching the impact of exchange rate levels on total productivity. The impact of exchange rate levels on total factor productivity can be broadly categorized into two groups. Firstly, exchange rate appreciation significantly enhances total factor productivity. Secondly, some believe that exchange rate appreciation hinders the growth of total factor productivity, or that there is no significant correlation between the two. The perspective of studying the impact of exchange rate levels on total factor productivity is quite comprehensive, with numerous results obtained ranging from the macro level at the national level to the micro level at the enterprise level. Since the exchange rate does not directly affect total factor productivity, scholars at home and abroad have investigated the channels through which the exchange rate influences total factor productivity. In general, trade, foreign direct investment, and credit constraints are the main channels through which the exchange rate affects total factor productivity. A more in-depth analysis reveals that the exchange rate influences enterprise total factor productivity by altering the structure of the export industry, R&D investment, and the composition and quality of imported goods.

There are relatively few studies on the impact of exchange rate fluctuations on total factor productivity. However, most of the studies suggest that an increase in exchange rate fluctuations negatively affects the improvement of enterprise productivity. Additionally, the level of financial development plays a certain role in the impact of exchange rates on the total factor productivity of enterprises.

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