A Literature Review of Relevant Theoretical and Empirical Research on Exchange Rate Fluctuations and Their Impact on Trade Balance from the Perspective of Exchange Rate Pass-Through

Wen Lin[1,2,3], Dongyu Zhang[1], Yi Chen[5],Weixia Liu[1,2,3,4], Liping Lin[1,2,3,4]∗, Dachuan Zheng[1,2,3,4]∗

[1]Straits Institute of Minjiang University, Fuzhou, Fujian, China
[2]Internet Innovation Research Center of Minjiang University
[3]Institute for Higher Education Cooperation and Exchange across the Taiwan Straits of Minjiang University
[4]The Fujian College's Research Base of Humanities and Social Science for Internet Innovation Research Center, Minjiang University, Fuzhou, Fujian, China
[5]Department of Economic and Management of Minjiang University, Fuzhou, Fujian, China
*Corresponding authors.

Abstract:

Between COVID-19 and the ongoing trade friction between China and the United States, the domestic and international economic situations have become much more complicated. In this context, what is of vital importance is studying the impact of exchange rate fluctuations on trade balance from two perspectives, namely China's international balance of payments and maintaining the smooth operation of the domestic economy. Economists at home and abroad have done considerable research into the relationship between exchange rate fluctuations and trade balance. However, few studies to date have examined the relationship from the perspective of exchange rate pass-through. This paper reviews relevant theories about exchange rate pass-through (EPT in short) and its impact on trade balance, both at home and abroad. A literature review on empirical studies of the relationship between exchange rate pass-through (EPT) and trade balance is also conducted. After that, a brief conclusion of the literature is made. As a result, the findings of this research can provide a reference platform for future scholars who choose to study the relationship between exchange rate fluctuation and its influence on trade balance, from the exchange rate pass-through (EPT) perspective.

Keywords: Exchange rate pass-through (EPT), Exchange rate fluctuations, Trade balance.

I. INTRODUCTION

The influence of exchange rate fluctuations on trade balance was first introduced by the mercantilist Thomas Meng, who maintained that exchange rate fluctuations would cause changes in the trade balance. David Hume (1752) proposed the price-cash adjustment mechanism, believing that exchange rate fluctuations could automatically adjust the trade balance through the price-cash adjustment mechanism [1].With the development of numerous trade theories, there have likewise been many different theoretical viewpoints. Among these, the most representative are elasticity analysis, delay effect analysis, multiplier analysis, absorption analysis, and currency analysis. Each of these approaches discusses the relationship between exchange rate fluctuations and the balance of trading from different perspectives. The influence of exchange rate fluctuations on the balance of trading mainly depends on two factors. The first factor is the influence of exchange rate fluctuations on import and export (short for Expt. & Impt.) commodity prices, that is, the study of EPT. Second, changes in Expt. & Impt. commodity prices impact the balance of trading by changing the amounts of supply and demand. This study actually examines what conditions can be met by changing commodity prices to improve the balance of trading; that is, whether the Marshall-Lerner condition can be met in the long run and the possible "J-curve" effect phenomenon can be met in the short run.

II. REVIEW OF RELEVANT THEORIES ON EXCHANGE RATE PASS-THROUGH (EPT) AND ITS IMPACT ON TRADE BALANCE

The equilibrium of a commodity market is based on the law of purchasing power parity (PPP). As such, the law of PPP becomes the equilibrium basis of elasticity analysis. After exchange rate changes, the deviation of a commodity market from the law of PPP is also the manifestation of incomplete EPT. The elasticity of market supply and demand and firms' pricing behavior affect both the degree and speed of EPT, and thus the fluctuation of the trade balance. Therefore, from the perspective of EPT, the theory of PPP, EPT theory, elasticity theory and time-delay effect theory are the theories most closely related to the study of the impact of exchange rate fluctuations on trade balance[1].

2.1 Purchasing Power Parity (PPP) Theory

The 'law of one price' assumes perfect market competition, free trade and perfect capital flow. Under such assumptions, the transportation cost of tradable goods is zero; there is no tax, and there is also no uncertainty. The price of the same tradable goods should be the same in different

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[1] Also known as the "J-curve" effect theory, as explained later in this article in the literature review of the "J-curve" effect theory.

regions; this type of consistent relationship is the 'law of one price'[2]. In an open economy, the law of one price means that the prices of tradable goods in different countries, when measured by the same currency, are the same. The relationship between the price of tradable goods and exchange rates as described by the law of one price is the basis of the PPP theory [2]. If goods can be traded to any one of the two countries, the law of one price is established. Also, in the compiled price index of the two countries, all kinds of tradable goods are equal in weight. Therefore, scholars claim that, when PPP exists, all the countries' general price levels – when measured using the same currency calculations – are equal. The exchange rate depends on the ratio of the general price level between the two countries; this is the general form of absolute PPP. This means that the exchange rate depends on the ratio of the two countries' general price levels measured in different currencies, or the ratio of their purchasing power. Absolute PPP means that the real exchange rate, expressed as the ratio of the two countries' price levels, is equal to 1.

However, in real life, in trade between two countries, there are transaction costs, taxes, and other areas of uncertainty. For example, the calculation of price levels, the different weights of different goods, the price levels used for both goods and trade, and even the diameter and weight of goods being different all bring uncertainty to trade between countries. Therefore, using the same method to compare the price levels of all countries is difficult. Relative PPP refers to exchange rates that reflect relative price movements in two countries, although the rates may not necessarily reflect absolute price levels. Countries in which prices are rising faster (the price index is rising faster relative to the base) will see their currencies depreciate. Because price indices are more readily available, it is much easier to calculate relative PPP, and in such cases, the usefulness of the indices is greatly improved.

From the perspective of PPP theory, the possibility of arbitrage will not occur unless the absolute amount of deviation from PPP is greater than the cost of arbitrage. The existence of arbitrage costs plays a role in creating a "middle region". As long as PPP does not deviate from the "middle region", no arbitrage will occur. Although transaction costs, taxes, and the uncertainties mentioned earlier cause deviations from the law of PPP, the deviations are not systematic. After the positive bias and negative bias are offset, PPP can still be regarded as a useful reference point. If there is no systematic deviation in PPP, then the real exchange rate tends to be unchanged. In addition, the impact of nominal exchange rate changes on imports and exports is very short, and the market's adjustments in terms of imports and exports are still relatively effective. However, in reality, in order to adjust a trade balance through an exchange rate policy, the government can restrain domestic inflation by implementing tight monetary and fiscal policies, while simultaneously carrying out exchange rate depreciation. This will help

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[2] Goods for which the price differences between regions can be eliminated or reduced through arbitrage are called tradable goods. Conversely, goods for which the price differences between regions cannot be eliminated or reduced by arbitrage are said to be non-tradable.

maintain a long-term undervaluation of the real exchange rate, which in turn will lead to a systematic deviation from PPP. In addition to the government's macro policies, the "Balassa-Samuelson effect" can also lead to systematic deviations from PPP[3].

The impact of exchange rate fluctuations on trade balance mainly depends on the degree and length of deviation of Expt. & Impt. commodity prices from PPP. If the law of one price is always valid, exchange rate fluctuations are completely offset by commodity price fluctuations of the same proportion. Also, the impact of exchange rate fluctuations on import and export is neutral.

2.2 Exchange Rate Pass-Through (EPT) Theory

2.2.1 Exchange rate pass-through (EPT) theory

The concept of EPT is closely related to commodity prices. After economists studied the macro effects of the reply of export and import commodities to the rate of exchange fluctuations, they proposed this concept of EPT [3-5]. Essentially, exchange rate fluctuations are accompanied by adjustments to import and export commodity prices and domestic consumer prices in the commodity price pass-through process. As such, the adjustment pressure of commodity price differences will impact the fluctuations of Expt. & Impt. quantities and thus the fluctuations in trade balance. Therefore, price adjustments of Expt. & Impt. goods will not only affect the change in trade balance; the relative price adjustment of domestic tradable goods and non-tradable goods will also be affected.

Studies of the pass-through theory of Expt. & Impt. prices of exchange rates generally examine the influence of exchange rate fluctuations on either import local currency prices or on export foreign currency prices, all from the perspectives of import or export. Based on the local equilibrium framework in which foreign export supply equals domestic import demand, some economists have used the elastic analysis method to deduce a country's import EPT elasticity and export EPT elasticity. When studying EPT, some economists have replaced supply side factors with cost and demand side factors with cost addition, and expressed EPT elasticity as a function of cost and addition. This approach is convenient for the study of EPT from the perspective of firm market pricing [6-8]. According to different assumptions, economists will construct different models and get different formulas of EPT elasticity.

When the domestic market supply is taken into account, if domestic and imported goods are completely substituted and if there is no difference between Expt. & Impt. prices and domestic

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[3] The Barassa-Samuelson effect refers to the phenomenon whereby the higher the economic growth rate of a country is, the higher the real wage growth rate will be, and the faster the real exchange rate rises.

consumer prices in equilibrium, then the Expt. & Impt. price pass-through of the exchange rate is equal to the domestic consumer price pass-through of the exchange rate. If domestic goods and imported goods are not completely replaced, a price difference will exist, but the pass-through elasticity of the exchange rate will be different if different model assumptions are used. When goods are supplied in both the foreign domestic markets, and the domestic and imported goods can be completely replaced, the import price pass-through elasticity of the exchange rate is equal to the domestic consumer price pass-through elasticity of the exchange rate. In this case, for research purposes, the domestic consumer price can be used to replace the import price. Therefore, when studying country-specific EPT, this paper conducts an approximate study based on such a substitution [9-11].

2.2.2 Analysis of influencing factors of incomplete pass-through of exchange rate and its impact on trade balance

(1) Analysis of the main influencing factors of incomplete pass-through of exchange rate

Because the market is not perfect, given the various transaction costs, taxes, and existence of uncertainty factors, this makes it hard for the law of one price and PPP to be established. The corresponding fluctuation of exchange rate changes makes it difficult to trigger the Expt.&Impt. commodities, which, when import prices increase (decrease) to an extent that is less than the degree of currency devaluation (increase) (direct quotation), an incomplete pass-through of exchange rate occurs.

The micro factors of incomplete EPT mainly include market structure and industrial organization, analyzed from the perspective of demand [3, 5].According to the analysis of sunk cost from the perspective of supply [12, 13, 5], researchers believe that, because of the existence of sunk cost, each manufacturer will maintain the current situation within a certain price range, especially when there is little change in the exchange rate. Manufacturers are not sensitive to exchange rate changes and will not easily enter or exit a certain market. From the manufacturers' perspective, they hold market shares and have certain expectations. In an economic environment where changes occur frequently (but are short-lived), exchange rate changes are unlikely to be passed on and added to import prices [5, 14]. This approach is greatly related to whether the exchange rate changes expected by manufacturers are temporary or lasting.

One of the main macro factors of an incomplete pass-through of exchange rate is economic openness. The degree of economic openness is positively correlated with the degree of the pass-through of exchange rate [15]. The higher the degree of openness is, the shorter the pass-through of exchange rate changes to the final consumer price will be. In an exchange rate

system, whether referring to a floating exchange rate system or fixed exchange rate system, manufacturers tend to be less sensitive to exchange rate fluctuations. Therefore, as the exchange rate volatility increases, the pass-through degree of exchange rate fluctuations to import prices presents a downward trend. Monetary policy also affects the degree of EPT. In a low-inflation environment, the pass-through of exchange rate changes to consumer prices of a country presents a downward trend [16]. In a high-inflation environment, the level of EPT flexibility is usually relatively high. EPT is also generally synchronized with an economic cycle. When an economy falls into recession, enterprises will reduce profits instead of passing along the exchange rate costs by adding them to the price of products [17]; the level of EPT flexibility is also low. Devereux believed that, when exchange rate volatility increases, exporters will be more likely to transfer that exchange rate volatility to export commodities. Therefore, a positive relationship exists between exchange rate volatility and the EPT effect [18]. Through empirical research, Frankel concluded that GNP is also one of the factors affecting the pass-through effect of exchange rate and that a negative relationship exists between the two [19].

(2) Incomplete pass-through of exchange rate and trade balance

In an elasticity analysis, an important theoretical assumption regarding whether exchange rate fluctuations can adjust trade balance is that changes in world market prices and exchange rate fluctuations can be completely passed on by adding the costs onto Expt. & Impt. prices. If the EPT fluctuation to Expt. & Impt. prices is incomplete, the effectiveness of an exchange rate policy will be weakened or even invalid. Therefore, an incompleteness of EPT will have an impact on the effect of an exchange rate policy in terms of adjusting trade balance. Many governments hope to promote the improvement of the country's trade balance through the devaluation (appreciation) of domestic currency. Taking the devaluation of domestic currency as an example, after the devaluation of the exchange rate, the price of imported goods expressed in local currency will rise. If the import demand is flexible with regard to price changes, the import demand will decrease. At the same time, after the devaluation of the local currency, the price of export commodities expressed in foreign currency will fall; if the foreign demand for domestic exports is flexible, export levels will rise. However, due to the incompleteness of EPT with regard to import price, import price cannot reach the expected increase. Therefore, the mediation effect on import quantity becomes smaller, thus reducing the effect of exchange rate policy on improving trade balance. Similarly, after the devaluation (appreciation) of domestic currency, the export price expressed in the currency of the export destination decreases to a lesser degree than the devaluation of domestic currency. This, in turn, leads to the failure of export prices to achieve the expected reduction; the adjustment of export quantity also fails to reach the expected level.

2.2.3 Import and export (Expt. & Impt.) elasticity theory

The generation stage of the core idea of "elasticity theory" took place from the early 1920s to the late 1940s, highlighted by Robinson's (1937) systematic elastic analysis of trade balance adjustment[4]. During this period, Bickerdike, Marshall, and others did groundbreaking work. Lerner and Metzler also made important supplements to the final formation of the core idea of "elasticity theory". One of the main issues discussed during this period was to determine the conditions under which a depreciating exchange rate would improve a country's trade balance, ultimately known as both the Marshall-Lerner condition (the M-L condition) and the "Bickerdike-Robinson-Metzler condition" (the B-R-M condition).

According to the elasticity theory, under the assumption that there is no capital flow (i.e., the balance of international payments is equal to the balance of trade), the supply of traded goods is completely elastic, and the initial balance of trade payments and the total income remains unchanged. The premise that exchange rate depreciation can improve the trade balance is the Marshall-Lerner condition (Lerner, 1944), that is: $-\eta_x - \eta_m > 1$, where, η_m and η_x , respectively, represent the country's import demand elasticity and export demand elasticity. However, when the Marshall-Lerner condition is established, depreciation can improve the trade balance, but the trade terms deteriorate. This deterioration of the trade terms reduces the country's relative income. When the marginal propensity to consume is less than 1, the decrease of the country's expenditure is less than the decrease of that country's income. That is to say, the country smooths consumption through the increase of imports. This is the Lausen-Metzler effect[5]. As can be seen, if the Lausen-Metzler effect exists, devaluation may not improve the trade balance when the Marshall-Lerner condition is also established[6].

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[4] Robinson proposed that the elastic analysis of the system was based on Marshall's study of the elastic problem. As early as 1923, Marshall extended the price elasticity theory of supply and demand in microeconomic analysis to the field of international trade in his book 'Money, Credit and Commerce', which put forward the concept of the elasticity of import and export demand, and preliminarily discussed the relationship between exchange rate fluctuation and trade balance under different conditions of the elasticity of import and export demand.

[5] Term of trade T is the ratio of export commodity prices P_d to import commodity prices P_f , i.e. $T = P_d / P_f$, where, P_d , P_f are the domestic and foreign export commodity prices, respectively, expressed in local currency. When the export price of each country is consistent with the domestic price, the export commodity price P_d can be expressed by the domestic price index P , and the import commodity price P_f can be expressed by the foreign price index P^* . When the foreign price index P^* is converted into the local currency price RP^* according to the exchange rate, then $T = P / RP^*$, and the real exchange rate $Q = RP^* / P$. Therefore, the trade terms are the reciprocal of the real exchange rate, the real exchange rate depreciates, Q rises, T falls, and the trade terms deteriorate.

[6] In this case, the Marshall-Lerner condition becomes: $-\eta_x - \eta_m > 1 + m_d + m_f$, where m_d , m_f are the marginal import

The Marshall-Lerner condition is a simplified form, in which exchange rate changes are fully passed on through Expt. & Impt. prices, when the elasticity of domestic and foreign export supply is infinite. However, in practice, since the elasticity of domestic and foreign export supply cannot be infinite, the EPT is incomplete. In this case, the premise that exchange rate depreciation can improve the trade balance is the Bilkendike-Robinson-Metzner condition (Metzler, 1948), which can be shown as: $\dfrac{\eta_x \eta_m (1+\varepsilon_x+\varepsilon_x) - \varepsilon_x \varepsilon_m \left(1+\eta_x+\eta_m\right)}{(\varepsilon_x-\eta_x)(\varepsilon_m-\eta_m)} > 0$, where, ε_m and ε_x, respectively, represent the elasticity of import supply and export supply. This is far more complex than the Marshall-Lerner condition $-\eta_x-\eta_m > 1$, which occurs when the elasticity of Expt.&Impt. supply is infinite.

The Birkendyke-Robinson-Metzner condition, $-\eta_x-\eta_m > 1$, is equivalent to the Marshall-Lerner condition when the elasticity of Expt.&Impt. supply is infinite. That is, $\varepsilon_x \to \infty, \varepsilon_m \to \infty$. As can be seen, the Marshall-Lerner condition is stricter than the Birkendike-Robinson-Metzner condition, and is in fact a special form of Birkendike-Robinson-Metzner condition.

If the income effect is considered on the basis of the Marshall-Lerner condition, Harberger proves that the relationship between the depreciation of a country's currency and the improvement of its trade balance should be modified as: $-\eta_x-\eta_m > 1+m_d$, where m_d is the country's marginal propensity to import.

If considering the international economy between mutual effect, a country's currency devaluation can improve the trade balance condition, in that a country's Expt.&Impt. demand elasticity is greater than the sum of one plus the sum of foreign and domestic marginal propensity to import, namely: $-\eta_x-\eta_m > 1+m_d+m_f$. This formula is called the Harberger conditions; among them, m_d and m_f, respectively, represent the domestic and foreign marginal propensity to import. As can be seen, the Harberger condition is stricter than the Marshall-Lerner condition.

2.2.4 J-curve effect theory

The J-curve effect and the Marshall-Lerner condition are twin concepts. The J-curve effect

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propensity of the country and the foreign country, respectively.

refers to the fact that, due to the inelasticity of Expt.&Impt. demand in the short term, the demand does not change much. Therefore, the price effect of domestic currency depreciation (appreciation) will lead to a decrease (increase) of domestic exports, an increase (decrease) of imports, and the deterioration of the trade balance. Then, over time, demand begins to adjust, and the trade balance improves. If you plot time on the horizontal axis and the trade balance on the vertical axis, you will get a curve similar to the English letter "J"[7].

In reality, even if the economy satisfies either the Marshall-Lerner condition or the Birkendyke-Robinson-Metzner condition, the eventual improvement in the trade balance resulting from depreciation will often take either a long or short time. Moreover, the trade balance sometimes deteriorates further in the period following a devaluation.

Exchange rate depreciation is realized through both a direct price effect and indirect quantity effect. The direct price effect is reflected in the decrease in foreign currency prices for exports and the increase in local currency prices for imports, so the trade balance will deteriorate in the short term. After the real exchange rate changes, the price effect occurs quickly. However, exchange rate fluctuations can also produce quantitative effects; that is, an increase in export quantity and a decrease in import quantity. The quantity effect has very slow response to changes in relative prices. When the Marshall-Lerner condition or the Birkendyke-Robinson-Metzner condition is met, exchange rate depreciation will eventually, in the long run, improve the trade balance. It is precisely because the price effect and the quantity effect are produced in turn that the phenomenon of the J-curve effect occurs. When exchange rates appreciate, a reverse J-curve effect exists.

The J-curve effect is one of the main theories used to explain the influence of exchange rate fluctuations on trade balance. The J-curve effect shows that the short-term impacts of exchange rate fluctuations on trade balance are different from the long-term impacts. A period of time is required to improve the trade balance by means of exchange rate depreciation, and the length of time depends on the lag structure. The two main factors that affect lag structure are currency contract and EPT. The former is related to the number of contracts signed before the exchange rate change and the designated payment currency. The latter is related to the composition of goods in the Expt.&Impt. trade.

An American economist, S.P.Magee, initiated the study of the J-curve effect, and divided this process into three steps: 1) the stage of the trade contract before depreciation, 2) the stage of EPT

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[7] The use of the J-curve effect category originated due to the devaluation of sterling in 1967. At that time, the British government devalued sterling to improve the trade balance. However, after the devaluation of sterling, Britain's trade balance did not improve immediately, but the trade deficit was eliminated until 1970. Since then, the relationship between changes in the UK trade deficit and the depreciation of sterling has been called the J-curve effect.

after depreciation, and 3) the lag stage of Expt.&Impt. quantity adjustment [20]. According to Magee's research, commodity prices do not adjust due to changes in currency value during currency contracts. In the EPT period, when new trade contracts are signed, commodity prices will adjust accordingly, based on the changes in the value of the currency after devaluation. That is, the price of import commodities in the depreciating country rises, the price of exports falls, and the demand for imports and exports changes accordingly. Here, price adjustment and demand adjustment jointly determine the changes in trade balance. On the one hand, after an exchange rate adjustment, Expt.&Impt. prices adjust slowly, resulting in the J curve effect phenomenon. On the other hand, if the short-term price elasticity of Expt.&Impt. demand is low, the change in demand will be small in the short term, and the J-curve effect is likely to occur.

The factors that impact the J-curve effect mainly include the exchange rate system, degree of openness, the trade structure of a country and the commodity composition of the country's Expt.&Impt. trade. Meade believed that a country's exchange rate regime and degree of openness have a significant impact on the lag structure of the J-curve effect [21]. Generally speaking, the J curve effect of an exchange rate fluctuation is more obvious in countries with a floating exchange rate system and higher degree of economic openness. Bahmani-Oskooee believed that, in developing countries, relatively weak financial systems, closed economic operations, long-term and serious trade deficits and high import demand rigidity, among other factors, often lead to the weakening or deformation of the J-curve effect of exchange rate fluctuations[22][23]. The sensitivity of the Expt.&Impt. demand for finished products to exchange rate fluctuations is higher than that of Expt.&Impt. demands for primary products, showing an obvious "J-curve" effect. Meanwhile, the response of Expt.&Impt. demand for primary products to exchange rate fluctuations cannot support the J-curve effect.

III. LITERATURE REVIEW OF EMPIRICAL RESEARCH ON EXCHANGE RATE PASS-THROUGH (EPT)

In practice, many factors affect EPT, and the relationship between exchange rate fluctuation and trade balance is also very complicated. A large number of literatures examine the influencing factors of EPT, the estimation of EPT elasticity and the impact of exchange rate fluctuations on trade balance. These studies have been conducted from the empirical perspective of various countries.

3.1 Literature Review of Empirical Research on Exchange Rate Pass-Through (EPT)

From the literature review of empirical research on EPT, this study finds that the existing literature can be divided into two categories. One is to study the pass-through of exchange rate fluctuations to the prices of import. This category would include the pass-through degree of

exchange rate fluctuations to the total import prices, as well as the pass-through degree of exchange rate fluctuations to the import prices of specific industries and specific commodities in China. The other category is the study of the pass-through of domestic currency changes to domestic export prices. This category includes the pass-through of exchange rate changes to total export prices, and the pass-through of exchange rate changes to specific industries and specific commodity export prices.

The empirical research on EPT mainly includes empirical research on the estimation of EPT elasticity and empirical research on the causes of incomplete EPT. In terms of econometric models of EPT elasticity, theoretical analysis models mostly adopt the imperfect competitive market structure model of Dornbusch and Rudiger to analyze the ability of enterprises to "price according to the market"[3]. In their empirical analyses, some scholars use Ohno and Marston to explain the response of prices to exchange rate fluctuations [24, 25]. They believed that different manufacturers face different demand curves and that, after exchange rate fluctuations, each vendor adjusts according to their respective market share and the extent to which their products vary. Other economists, such as Knetter [26] and Menon [9], also analyzed firms' "market-based pricing" ability on the basis of Dornbusch's (1987) research. By analyzing the pass-through elasticity of import prices to exchange rates, Menon and Eleanor believed that the degree of EPT is different in different industries, so they analyzed the EPT problem based on the division of industry categories [8, 9]. Therefore, in the empirical analysis of EPT elasticity, all firms adopt a cost-plus analysis. The difference lies in the different perspectives of analyzing different enterprises' ability to "price according to the market". Since the late 1990s, investigations on EPT elasticity have focused more on the influence of macroeconomic systems. For example, Campa and Goldberg used coefficients to estimate the short- and long-term EPT elasticity in their dynamic model of import EPT elasticity for 25 OECD countries [7]. Chinese scholars have also carried out empirical study on the estimation of EPT elasticity. Yong Xiang Bu found that, out of nine of China's products, namely crude oil, raw coal, cotton, cotton yarn, cashmere, color TV sets, electric fans, leather shoes, and watches, five kinds of products pass flexible exchange rates of between 0.2 and 0.3. Three kinds of products have exchange rate elasticity of between 0.4 and 0.5; only one product has exchange rate elasticity of more than 0.5[27]. Zhongzhou Luo made an empirical analysis of the export price pass-through elasticity model of exchange rates. The study concluded that the short-term and long-term export price pass-through elasticity of the yen exchange rate has been -0.4956 and -0.6583, respectively, since Japan entered the floating exchange rate [28]. Tianding Zhang empirically used the international input and output data released by the WIOD from the perspective of the vertical division of labor. The results show the differences in the EPT effect between China's overall import price and the import price of the manufacturing sector [29].

Foreign currency not being fully transferred is the reason behind many empirical studies. These studies are mainly from the perspective of manufacturer price decision-making behavior, imperfect competition, industrial organization, sunk cost, rate expectations, market share, the cost of economic openness, exchange rate systems, monetary policy, the economic cycle, and random shocks. Essentially, these studies empirically examine the macro and micro factors that influence exchange rate transmission. Furthermore, the limited effect of exchange rate fluctuation on international trade is often discussed. In terms of measurement technology, the single-equation OLS regression method was adopted in the early stage, including in studies by Toshiko Tange [30] and Manuchehr Irandoust [31]. The pricing behavior of Japanese and German enterprises with regard to export goods was analyzed, based on a local equilibrium model. The study shows that Japanese and German exporters experience price discrimination in both domestic and foreign markets. Kotabe and Duhan found in their study that Japanese exporters attach more importance to market share, while American exporters attach more importance to profit [32].

With the development of time series co-integration analysis technology, most studies now test the long-term co-integration relationship between exchange rate fluctuations and Expt. & Impt. prices by establishing a VAR model and using the Johansen estimation method. Such studies include Sushanta Mallick and Helena Marques [33] et al. Their research shows that, after India implemented a trade liberalization policy and floating exchange rate system, the pass-through of export commodity price to exchange rate fluctuation was incomplete. Hakura and Choudhri constructed a VAR model and used the vector auto-regression method to conclude that exchange rate fluctuations in most countries have a large pass-through coefficient on import commodity prices but only a small pass-through coefficient on export commodity prices [34]. The Bayesian threshold VAR method was adopted to analyze the data of Mexico and Canada. The study showed that, although the national conditions of the two countries were quite different, the EPT coefficients of both countries increased significantly in the period of rapid economic growth. Some researches on the price pass-through effect of exchange rate fluctuations in Europe have analyzed by constructing Bayesian VAR models. Those studies concluded that the price pass-through effect of exchange rate also changed in line with the changes of various economic shocks [35, 36]. Earlier, Chinese scholars used a VAR model to analyze the pass-through effect of RMB exchange rate fluctuations on the price index and import commodity prices under different economic backgrounds [37-41].

Since the development of panel data technology, researchers have used panel data analysis methods to test specific types of country EPT. Such studies include Campa and Goldberg [7], and Jose Manuel Campa and Jose M. Gonza [42]. Bussiere [43] systematically studied the nonlinearity and symmetry of the EPT effect in G7 countries, based on panel data estimation and

a country-by-country estimation. Shintani et al. [44], by establishing a STR model, found a non-linear positive correlation between the pass-through degree of exchange rate and the inflation rate. Caselli and Roitman [45] studied the relevant data of 28 emerging countries and found that a relationship exists between exchange rate depreciation and EPT coefficient.

By constructing China's import price index and using the co-integration technology and error correction model, domestic scholars proved that import prices are sensitive to exchange rate fluctuations. In addition, the impact of exchange rate fluctuations on import prices is greater than the impact on consumer prices [46]. Alternatively, from the perspective of EPT, an exchange rate index and trade price index were constructed, and different commodity EPT elasticity was obtained[47, 48]. In another study, comparing the data of provinces after the implementation of the 'One Belt One Road' initiative, an upgraded import-weighted effective exchange rate index was constructed [49]. Yujiang Bi and Zhongdi Zhu constructed an empirical model of EPT research suitable for China's national conditions. In addition, the empirical study of subdivided industries showed that the pass-through of the RMB exchange rate to export prices was not complete, and differences were found in pass-through degree among different commodity categories [50].

3.2 Literature Review of Empirical Research on the Impact of Exchange Rate Fluctuations on Trade Balance

As for the impact of exchange rate fluctuations[8] on trade balance, scholars at home and abroad mainly have the following three views: (1) Exchange rate fluctuations have a positive impact on trade balance[9]. (2) Exchange rate fluctuations have a negative impact on trade balance. (3) Exchange rate fluctuations have no impact on trade balance. Empirical studies have also drawn inconsistent conclusions on whether exchange rate depreciation can improve the trade balance. However, most empirical research conclusions support the argument that exchange rate depreciation can improve the trade balance.

From the literature review analysis of the impact of exchange rate fluctuations on trade balance, most of the studies included thus far are based on the elastic analysis of balance of payments, as well as whether the Marshall-Lerner condition is satisfied. These two criteria are regarded as the primary basis for judging the effectiveness of an exchange rate policy[10].

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[8] Exchange rate fluctuations include exchange rate depreciation and exchange rate appreciation. In order to facilitate both theoretical and empirical analyses, this paper refers to the impact of exchange rate fluctuations on trade balance, unless specifically stated otherwise.

[9] The term 'positive impact' means that exchange rate depreciation can improve the trade balance, while exchange rate appreciation worsens the trade balance. The negative impact is the opposite; that is, exchange rate depreciation worsens the trade balance, and exchange rate appreciation improves the trade balance.

[10] That is, if the absolute value of the sum of the price elasticity of import and export demand is greater than 1, the depreciation

Therefore, from a theoretical perspective, elastic analysis is the common basis of these studies; the incomplete substitution model between the two countries is also the basic research model of analysis.

However, the literature reviewed above has great differences in terms of the establishment of models, selection of variables, measurement methods, and the selection of research objects and periods.

First, great differences exist in the established econometric models. Some studies estimate the Expt. & Impt. equations separately and then look at whether the absolute value of the sum of the Expt. & Impt. demand elasticity is greater than 1. This approach is taken to judge whether the Marshall-Lerner condition is satisfied. Other studies directly estimate the relationship between trade balance, real exchange rate and real income at home and abroad. They also judge the impact of exchange rate fluctuations on trade balance. The advantage of setting the estimation equation in this way is that structural parameters are not identified, and the calculation is thus simplified [51].

Second, the variables selected by the model are different. In particular, the key variable in the model is the exchange rate. Some literatures, such as Mohsen Bhamani-Oskooee [52], have adopted the nominal exchange rate. Some studies, such as Rose [51] and others [53]), use the effective exchange rate. Some studies, such as Rose and Yellen [54], use the real exchange rate. Different variables are used because of the different bases for modeling. For example, most models based on the definition of elasticity adopt nominal exchange rates. However, models based on microeconomic theory often use the real exchange rate in the model, because the theory emphasizes the relative price of commodities. An effective exchange rate is more suitable for use as a foreign trade exchange rate, which is usually weighted by trade volume and used in studying the elasticity of exchange rate fluctuations on aggregate trade.

Third, the methods of conducting an econometric analysis are different. In early literatures, the traditional ordinary least square method was used to estimate the parameters of the equations. Since the 1980s, with the development of the co-integration theory, co-integration analysis methods have been widely used in literature. These methods include the Engel-Granger co-integration analysis method, Joansen-Juselius co-integration analysis method and vector error correction model method. In order to test the J-curve effect, the autoregressive distributed lag model proposed by Pesaran and Shin (1995) was used to set the equations in recent literatures. The J curve effect is also analyzed by impulse response function.

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of domestic currency can improve the trade balance.

Fourth, the conclusions are inconsistent. According to the above literature analysis, no unified conclusion exists on whether exchange rate fluctuations can improve a country's trade balance. In addition, differences in model settings, estimation methods, samples and sample data frequency may lead to differences in research results. Therefore, the analysis of the impact of exchange rate fluctuations on trade balance seems to be more like a test of experience.

Most of the early empirical research on the J-curve effect did not consider the impact of monetary and fiscal policies. Also, these studies did not distinguish between the long-term and short-term impact on trade balance, and they directly used horizontal data, which may lead to "regression fallacy"[11]. More recent empirical studies have not only considered the impact of monetary and fiscal policies, but they have also considered long-term and short-term impacts. In addition, the data used in these studies are stable, so the conclusions are more credible.

In conclusion, from the literature review of the influence of the above exchange rate fluctuations on trade balance and the influence of the US dollar exchange rate fluctuations on the US trade balance, one can see that, due to the differences in model setting, variable selection, sample interval, data frequency and measurement method selection, existing studies on the impact of exchange rate fluctuations on the trade balance and the impact of US dollar exchange rate fluctuations on the US trade balance have not yet reached a consistent conclusion. Therefore, it is necessary to conduct an in-depth study on the impact of exchange rate fluctuations on the US trade balance.

III. CONCLUSIONS

From the perspective of relevant theoretical reviews, the Marshall-Lerner condition (M-L condition) and Birkendyke-Robson-Metzler condition (B-R-M condition) theorize that exchange rates affect Expt. & Impt. through commodity prices and thus affect the trade balance. However, the Marshall-Lerner condition holds that the real exchange rate affects the trade balance. When the nominal exchange rate change is completely passed on to the real price of a country's exports, and when the real exchange rate is expressed by the real price of the country's goods, the nominal change in the exchange rate change is equal to the change in the real exchange rate. Therefore, it can also be said that the Marshall-Lerner condition deals with the elastic condition of the full pass-through exchange rate and the impact of nominal exchange rate fluctuations on trade balance.

Theoretically, the impact of nominal exchange rate fluctuations on trade balance involves

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[11] Engle and Granger (1987) pointed out that a causality test and regression analysis of non-stationary sequence variables may lead to the wrong conclusions; this is called "regression fallacy".

EPT and the Marshall-Lerner condition. With regard to the Marshall-Lerner condition of the impact of exchange rate fluctuations on trade balance, existing research is relatively complete. The theory is rigorous, and the conclusion is clear. Existing research on EPT generally only studies the reasons for incomplete EPT and the size of EPT elasticity. As for the impact of the speed and degree of EPT on trade balance, few people have studied this perspective. Moreover, many different opinions and debates exist on the EPT theory. In reality, the research in this area is far less perfect and rigorous than the theoretical research on the Marshall-Lerner condition. Therefore, the EPT theory and its influence on trade balance are worthy of in-depth study.

From the perspective of empirical research, many empirical estimates have examined the influencing factors of EPT and EPT elasticity, both at home and abroad. However, few studies have analyzed the impact of EPT on trade balance; some of these studies focus on a certain point. For example, Dixit and Krugman (1989) analyzed the limited impact of exchange rate fluctuations on trade balance, as caused by incomplete EPT from the perspective of precipitation costs. However, most such studies examine EPT elasticity. They only briefly discuss the impact of EPT on trade balance, which is not systematic, and there are many controversial findings.

Theoretically, because the pass-through elasticity of the exchange rate of different commodities is different, exchange rate fluctuations have different impacts on trade balance. Exchange rate fluctuations and trade balance are generally believed to have a certain deterministic connection. However, in practice, the relationship between them may be complicated and uncertain, due to the influence of many uncertain factors[12]. When talking about the fluctuation or adjustment of a country's exchange rate, people often refer to the nominal exchange rate. In practice, what consumers, manufacturers and policy makers directly observe is the nominal exchange rate, rather than the real exchange rate. Therefore, studying the nominal exchange rate is closer to reality and has greater policy significance than studying the real exchange rate. Thus, Bahmani-Oskooee and Brooks et al. (1999) believed that aggregate analysis was an insufficient method with which to estimate the relationship between exchange rate and trade balance. The study maintained that bilateral data should be used for empirical analysis. Currency movements cause a country to find different trading partners. Creating bilateral exchange rate variations between one country's currency to their trading partners' currencies devaluations may also correspond to the appreciation of another trade partner. Therefore, a weighted smoothing out of the effective exchange rate will be the conclusion of the relationship between exchange rate and trade balance. In addition, in the aggregate analysis, the influences of different directions cancel each other out, and some

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[12]As summarized in the relationship between exchange rate fluctuation and trade balance, exchange rate fluctuations may have a positive or negative impact or influence, but they are not more significant than trade balance.

useful information is lost. This also leads to errors in the aggregate analysis. Therefore, a country-by-country analysis can reflect the impact of exchange rate changes on bilateral trade balance in a more specific way, thus having more policy significance.

According to empirical research experience, the relationship between exchange rate fluctuations and trade balance has special changes or even anomalies in different periods. Therefore, it is very important to conduct specific analyses by stages, countries or appropriate samples, according to specific situations. When analyzing samples, it is better to use previous experience and compare those sample data with total volume data, commodity classification data or country classification data.

ACKNOWLEDGEMENTS

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