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The Influence of International Mobility of Production Factors on Cassel's Exchange Rate Model

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The Theory of Purchasing Power Parity on exchange rate proposed by Cassel, the Theory of Relative Purchasing Power Parity in particular, has been endowed with priority and significance in the exchange rate theory, and widely deemed as the most scientific theory of determining theoretical exchange rate. It has been almost a century since the theory was first put forward, during which the international economic relations has gone through dramatic transformations, especially after World War II. Among those transformations, the most distinguishing one is the free mobility of factors of production in economic globalization. The issue under discussion is the potential influence of the dramatic transformations of the international economic relations, i.e., the effect of the free mobility of production factors in the economic globalization, on Cassel's Exchange Rate Model.

The Operating Environment of Cassel's Model

The idea of purchasing power parity has come into being long before Cassel.

Nevertheless, as a theoretical system, the Theory of Purchasing Power Parity has not been officially brought forth until 1916 by a Swedish economist, Cassel. It is applied to fix the rate of converting currencies among various countries, i.e., the exchange rate. The logic foundation of the Theory of Purchasing Power Parity is that the same commodity possesses the same price, which is supposed to be identical in every country. Yet the title (unit) of currencies of different countries is distinct, and so is the amount of money in pricing. Consequently, the converting rate is confirmed according to the difference among the amount of currencies.

According to the theory of purchasing power parity, it can be described as:

$$E = \frac{P_a}{P_b} \quad (1)$$

E is the exchange rate, P_a is the price level of country A, and P_b is that of country B. P_a and P_b are universally held as aggregate price level, including both tradable goods and non-tradable goods. In Cassel's mind, tradable goods include exports but imports. In this case, P_a and P_b are the price level corresponding to Gross Domestic Product. ¹

Equation (1) is a generalized outline of the model, upon which, in terms of the Theory of Relative Purchasing Power Parity, a simplified hypothetical model is established as considering P_a and P_b as price indexes:

$$E = E_0 \frac{P_a}{P_b} \quad (2)$$

The report period exchange rate is supposed to be equal to the product of the base period exchange rate and the quotient of the price index of country A in report period dividing that of country B.

The long term is likely not five or ten years, but twenty years or longer. ² Over such a long period, a great many of mechanisms having effects on the fluctuations of exchange rate may dissolve. Consider the impact of the amount of currency on its purchasing power. The oversupply of currency is going to trigger off the price inflation and weakening of purchasing power, and vice versa. However, in the long run, the oversupply of currency in a certain period is going to be counteracted by the undersupply. As for the long term, the supply and demand of currency is at equilibrium, which is not realistic to produce virtual impact on the theoretical exchange rate determined by purchasing power parity. Again in the case of international payment, for any country, the exports make up for the requirement of imports, meaning that the export supply always corresponds to the import demand, and

¹ See also Chen Dai-sun and Li Yi-ning's *The History of International Financial Theories*, China Financial Publishing House, 1991, 186; Laurence S. Copeland's (Britain) *Exchange Rates and International Finance*, China Financial Publishing House, 1992, 73.

² See also Laurence S. Copeland, *ibid*, 72-78.

the trade surplus of a given period is bound to be offset by the trade deficit of the next one. Therefore, the foreign trade and international payment of a country is going to be equalized over a long period, and the influence of international payment on the purchasing power of the currency and exchange rate can be disregarded. It may also happen to other elements with short-term effect on the purchasing power of currency and exchange rate.

Nevertheless, the prerequisite is to ascertain its fundamental operating environment. In other words, Cassel's model works in given surroundings and it must be modified if the surroundings are changed. Only in this way can the model live up to its name.

The development of productivity and the international division of labour were both relatively undeveloped from the birth of the Theory of Purchasing Power Parity to the dawn of World War II. The national economies were evidently insular and isolated, the production factors were lacking of mobility among nations and the commodity exchange nearly consisted of the whole international economic contact. In respect of international trade, it was left behind the industry production of the world.

The relative isolation of national economy and the immobility of production factor definitely lead to, what Marx commented, the commodity exchanges among countries were directly based on international value rather than on production price inside a national economic entity due to the absence of conditions to form an international production price.¹ Obviously, the more important distinction lies in the remarkable variation of the effect of Law of Value in the world market. In a national economic entity, there exists the competitive mobility of factors of production inside and among sectors. This results in the same value of the identical commodity and the same profit for the equivalent profit in various sectors. As Marx stated, what competition primarily brings about in a sector is to make the variety of individual values of a commodity into a same market value and price, but the competition of capitals of different sectors only can form a production price equalizing the profit margin of different sectors. Compared with the course before, it calls for a capitalist relation of production at a higher level.² Whereas the capitalist relation of production was not popularized around the world, neither can it achieve the same high level in different countries. So there was not competitive mobility of the production factors among countries. As long as the country with higher productivity is not compelled to lower the commodity price to its value because of competition, the national labour of higher productivity is still highly intensive laboring in world market, which is capable of producing more value in the same period and thus more currency compared with the national labour of lower intensity.³ As a result, the application of the Law of Value has been dramatically transformed. In the world market, only can equivalent commodity exchange for equivalent currency, neither can capital for profit. And only Marx's

1 See also Yao Zeng-yin's *An Introduction to International Trade*, Renmin Press, 1987, 210, 248.

2 See also Marx's *Capital*, 3rd Volume, Renmin Press, 1975, 201.

3 Marx, K. *Capital*. 1st Volume. Renmin Press. 1975. 614.

International Value Theory constitutes the scientific base of the theory of Purchasing Power Parity.

The theory of Purchasing Power Parity is set up on the foundation of the hypothesis of the Law of One Price (LOP), namely, the price of a commodity is the same in every country while pricing with the same currency. Even though pricing with different currencies, it remains the same despite different currency amount, since the diverse amounts represent equal amount of value. It is evident that the value of the currency means the value represented and priced by the currency, not the value of the currency itself. And it is definitely not related to the amount of the currency.¹ As above noted, because the Purchasing Power Parity reflects the long-term trend of fluctuation of exchange rate, the supply and demand of both currency and commodity are balanced in the long run, the price is correspondent to its value as well, the long-term/theoretical exchange rate merely indicates the contrast among different currencies, or the contrast of value represented by currencies; currency is the symbol of value, and the value signified by currency is price, i.e., the price of the commodity. In short, the theoretical exchange rate is the contrast of prices of identical commodity in different countries, and it is what the theoretical exchange rate model attempts to deliver.

It can be observed that the effect of productivity of labour is neglected in theoretical exchange rate and even its model. It must be clarified the productivity of labour here is in a broad sense, covering the same scope with the gross production rate in the West.

Presumably, during T_0 period, the labour productivity of country A is L_{a0} , that of country B is L_{b0} , the output per unit time of country A is Q_{a0} , that of country B is Q_{b0} , and the labour productivity of the two countries is equal, namely, $L_{a0} = L_{b0}$ and $Q_{a0} = Q_{b0}$; and assume that during T_1 period, the labour productivity of country A has doubled to L_{a1} while that of country B is unchanged at L_{b1} ; in the per unit time of T_1 , the output of country A is Q_{a1} , that of country B is Q_{b1} , and $L_{a1} = 2L_{b1}$, $Q_{a1} = 2Q_{b1}$. On account of the isolation of national economies, i.e., the lack of mobility of production factors in the world market, despite the same time for country A to produce output twice as that of country B, the two countries do not get equivalent value thereafter. The double labour productivity of country A in T_1 period compared with country B implies no more than the double value of country A to that of country B in the same period, or the double amount of currency of country A to country B. The price of the commodity in the world market is determined by the national value of the country which chiefly serves it, yet no matter which country is the main supplier, the consequence remains unchanged. Thus, as the free mobility cannot be

¹ The commodity here is of the same sort or sorts; to be more specific, it is corresponding to the price level of GDP of every country.

realized, the distinction of labour productivity of different countries is reflected by the difference of amount of commodities and that of profit margin, not the difference of commodity price. Namely, in the world market, the labour productivity has impact on the amount of commodity and the profit margin of capital instead of the commodity price or exchange rate.

That proves what the Theory of Purchasing Power Parity abandons is the Quantity Theory of Money rather than Marx's Labour Theory of Value, and his International Value Theory is the foundation of the Theory of Purchasing Power Parity.

The Transformations of the Operating Environment of Theoretical Exchange Rate Model

The advancement of science and technology after war has tremendously impinged on the development of productivity. The revolution of science and technology is reestablishing the international division of labor, the traditional natural and geographic conceptions as well as the conventional standards of economies of scale. The strengthening productivity of the revolution has broken through the national economic boundaries, acted increasingly global, and been turning into the genuine global productivity, equipping the internationalization of capital with prerequisite.

Capital is automatically international. "The real mission of capitalism is to found a world market, at least a framework, and the production based on the market," observed Marx.¹ Although he did not allude to the internationalization of production, but the improvement of socialization of production and the internationalization of capital, he exposed the overspreading nature of capital. "The necessity of continuously expanding outlets drives the capitalists around the world. They are obliged to settle down everywhere, start business everywhere, and weave network everywhere."² Until now, the nature of capital expansion is invariable, the desire to expand is stronger and the only difference lies in that there are more reasons to drive it around: in addition to exploring new markets, much more has been added to the list, such as raising total output, utilizing the comparative advantage of a given aspect of another country, reducing costs and risks, and achieving monopoly, and so forth.

In essence, the economic globalization is the worldwide expansion occurring to capital and a result of the development of international economic integration in a certain stage, closely correlated to the booming of multinationals after war. The capital export after war is characteristic of the exuberance of private foreign direct investment. Consider multinationals as vehicles of private foreign direct investment, it is often accompanied with

1 Marx, K. To Engels. The Complete Works of Marx and Engels, 29th Volume. 348.

2 Marx, K. and Engels, F. The Communist Manifesto. *ibid.* 254.

the flowing and allocation of factors of production around the world. The growth of multinationals after war engenders a good many changes, the most important of which is the capital internationalization built on the production internationalization going with the international circulation of production factors.

Apart from the capital's nature of international extension, the World Trade Organization (WTO) officially commencing operation at 1995 constitutes a catalyst of promoting international flowing of factors. For the sake of institutional guarantee, WTO incorporates not only the trade of tangible goods, which is already under control at GATT time, into its management, but also agricultural products, service products, intellectual property protection, and international investment which has never been touched by GATT.

The substitutability between the international mobility of factors and the international trade does not amount to the premise that the frequent exchanges of factors would strike on international trade, or hinder its development. On contrary, the direction of factor flowing is exposed to the inhibition of the difference of endowment of resources or that of comparative advantage. The factor mobility is able to accelerate the deepening of international division of labour, the development of international trade and the spread of global market. It is difficult to split foreign direct investment of multinationals from the international mobility of factors, which is carried out via global market, and the distinction of commodities and production factors is hard to realize for the commodities themselves are raw materials, components, and machinery equipments. Given the obstacles, the growth of international trade and the expansion of world market are in favor of the international mobility of factors on the whole.

As Marx stated: "the domestic or national circulation of commodity is separated from their common world market."¹ In our eyes, now the statement functions as well and the national and international market still coexist with each other. Nevertheless, the hedge between nations is dramatically chopped away, and its aftermath is quite limited. It is ascribed to the fact that the progress of science and technology has stimulated the productivity growth, the international division of labour has deepened, the connections among nations have been enhanced, and meanwhile, many nations have enforced the open-up policy in order to develop economy. Furthermore, the establishment of WTO has prompted and protected the factor mobility to some extent, as the international economic integration, the regional economic integration in particular, blurs the boundaries of national and international markets.

The extensive and frequent mobility of production factors and commodities among countries has not only taken the individual national economies into a close and dependent relationship, but also brought inevitable impact to the world market price.

Price is value symbolized by currency, and the world market price is the international value

1 Marx, K. *Capital*, 1st Volume. Beijing: Renmin Press. 1975. 144.

of commodity symbolized by currency. It deserves more attention whether the price is directly base upon international value or international production price in general cases. There has been a debate and two viewpoints long ago of the issue: one is on the basis of international value, and the other is on international production price.¹

The discrepancy above approximately can be traced back to one origin, whether the production factors being able to exchange competitively and freely among nations. Two points need to be clarified to answer the question. First is the periodization. In different periods, there are different international economies, different levels of production growth and local adjustment of international economic relations, all effecting influence on the international mobility of the factors. Second is the mobility of factors among nations. It may take a long time to evolve from non-mobility to completely free and competitive mobility, and accordingly, the transformation from international value to international production price cannot be made at one stroke.

The development of science and technology after war was so amazing that the effect has penetrated into every country and every aspect of social life, resulting in the dramatic advancement of production and significant adjustment of international economic relations. Consider the following products. Firstly, a good number of important international economic organizations appeared, such as International Monetary Fund, World Bank, and General Agreement on Trade and Tariff (GATT), the World Trade Organization afterward, propelling the restoration of global economy after the world war and the advancement of trade liberalization. Secondly, the foreign investment via multinationals is rather active. The external expansion of the U. S. multinationals in the 1950s, the springing-off of the international organizations of other developed countries in 1970s, and the emergence of the global corporations of the underdeveloped countries in the 1980s, all of these induced fits of sea waves of foreign investment. The capital, labor and patented technology flew to every corner of the world, and the capitalist production relation has been surprisingly extended and developed. Thirdly, it enabled the trade liberalization and international mobility of the factors that the underdeveloped have shifted to open-up policy and economic development after the acquisition of political independence. Fourthly, the trend of regional economic integration has given rise to many regional economic integration organizations (REIO) in both developed and underdeveloped countries. Inside the regions of varied scales and degrees of integration, the degree of trade liberalization and mobility of factors were normally higher than the other regions of the world. The chief result of the adjustment of international economic relations was the expansion of the capitalist production and economic globalization. Commodities, as well as labor, capital, patented technology, has been easier to mobilize around the world at present. The difference of labor productivities has generated the difference of return on factors, which in turn has brought

1 See also Yao Zeng-yin's *An Introduction to International Trade*, Renmin Press, 1987, 219—243.

about the international mobility of factors because of competition, thus the return of production factors in different countries was apt to be average.

The Modification of the Model

In the first place, let's assume, on an extrem occasion, namely, the international economic integration and globalization have both been realized, the world economy roughly works like a national economy while all the factors can be mobile, in which case the effect of the Law of Value on international economy very much resembles its function in a national economy.

Let's again assume that the productivity of country B is higher than that of country A, so the profit margin of country B is higher as well, the higher return on capital leads to the flowing of capital from country A to country B, and the return on capital in country B is going to decrease due to the increasing of capital. Conversely, the return on capital of country A is going to increase due to the decreasing of capital, ultimately contributing to the equalization of profit margin and a unified production price, i.e., the international production price. The market price of the commodity in the world market is going to be based upon the international production price, not on the international value. It makes a radical distinction with the non-mobility of factors, under which circumstance only equivalent commodity procures equivalent currency, but equivalent capital is not able to gain equivalent profit. Whereas, the equivalent commodity can obtain equivalent currency, so can capital get profit. Furthermore, in the topic, the most important distinction is the effect of variation of productivity. As above-mentioned, on the condition of non-mobility of factors, the variation of productivity has no influence on the international value, price, or exchange rate, but if the factors are free to mobilize, the variation is taking impact on the international production price, world market price, and exchange rate among countries.

From the theoretic viewpoint, in a sector of a national economy, the improvement of productivity is going to increase the amount of products, i.e., the value in use, yet decrease the amount of value per unit. Because price depends on value, the price of the commodity is going to fall off, too. The direction and degree of change of productivity in every sector is various, so is that of its commodity. And the exchange ratio of commodities among sectors is going to change, namely, the comparative value and price are going to change.

Marx has thoroughly described the effect of variation of productivity on the individual values of the two exchanged commodities and the way of realizing the equivalent exchange in the instance of productivity variation in the relative form of value in *Capital*. As pointed out, the virtual variation of amount of value cannot be explicitly, or totally, reflected by the comparative value due to the change of productivity. Assuming the amount of commodity unchanged, the comparative value may be diversified. Even though the value of the

commodity has changed, the comparative value may remain the same, and the amount of value of the commodity and its comparative value is not necessarily identical.¹

Given only two sectors in national economy, sector A and sector B, the index of labour productivity of sector A is L_a , and the commodity price index is P_a , and that of sector B is respectively L_b and P_b . In terms of explanation above, the relations of productivity and price of the two sectors can be expounded as follow:

$$P_a = \frac{P_b L_b}{L_a} \quad (3)$$

Namely, the theoretical price index of sector A equals the product of the price index of sector B and the quotient of the labour production index of sector B dividing that of sector A. Naturally, the base period is supposed to be appropriately selected, and P_a must conform to value, or it is the relative price conforming to comparative value, i.e., the theoretical price or comparative theoretical price.²

On the condition of the international economic integration, economic globalization and free mobility of factors, the world economy is, to a large degree, a national economy. It is necessary to ascertain whether the price is reasonable, or corresponds to the value with regard to both the equivalent exchange of international commodity and theoretical exchange rate determination. In order to achieve the goal, the conformation of variation of price to that of its value must be ensured to realize the correspondence of development of the aggregate price level to that of the corresponding productivity. Namely, the evolvement of the relative price level is supposed to be consistent with the change of relative productivity. Consequently, the comparison of productivity is bound to be introduced into the price comparison. The price comparison is out of rationality otherwise. Let's adapt the relations between the two sectors in equation (3) to that of two countries. If the proper base period is chosen, the theoretical price index of country A should be equal to the product of the price index of country B and quotient of labour production index of country B dividing that of country A.

Put the relation into equation (2):

$$E = E_0 \frac{P_a}{P_b} = E_0 \frac{\frac{P_b L_b}{L_a}}{P_b} = E_0 \frac{L_b}{L_a}$$

namely,

$$E = E_0 \frac{L_b}{L_a} \quad (4)$$

1 Marx, K. Capital [M] (1st Volume). Beijing: Renmin Press, 1975, 67—69.

2 See also Ren Zhi-jun's Value, Price and Price System- The Quantitative Study on Marx's Theories of Value for details, The Economist (5th edition) , 1995.

In the instance of free flowing of factors, according to the Theory of Relative Purchasing Power Parity, the exchange rate of base period should equal the product of the exchange rate of base period and the quotient of the productivity index of country B in the report period dividing that of country A .

Equation (4) sees a great difference with equation (2). The movement of exchange rate is only related to that of price, not to productivity in the case of non-mobility of factors, while under the circumstance of free mobility, it is related to that of productivity rather than price. How does that happen? As has been noted, when the economic integration and globalization are realized and the factors are free to mobilize, the difference of productivity of nations is inevitably leading to the difference of return on factors, in turn resulting in the international flowing of factors and the equalization of return in every country. Instead of losing significance, the price in fixing the theoretical exchange rate is inaccurate. The improvement of productivity does not completely mean the decreasing price, and there are various decreasing extents in different countries. As a rule, the price inflation is accompanied with the raising productivity, and the raising degrees in different countries are not the same. The price (index) of determining the theoretical exchange rate is supposed to accord to value. Only the relative price established upon the relative labour productivity is according to value. In other words, only when $P_a = \frac{P_b L_b}{L_a}$ or $P_b = \frac{P_a L_a}{L_b}$, price is corresponding to value, and only when the theoretical exchange rate model is $E = E_0 \frac{L_b}{L_a}$, the calculated exchange rate may be reasonable.

The hypothesis of the new model is equilibrium, and the principal sectors of the macro-economy are all at equilibrium. The equilibrium in the monetary domain is highlighted. In the long run, or in the case of the macro-economic development, the equilibrium can be found.

But at any given time, the disequilibrium is the true operation of national economy, which means that the imbalance of supply and demand of currency is normal. Then is it possible to reflect the impact of the variation of the amount of currency on the theoretical exchange rate in the new model, equation (4), to demonstrate the frequent disequilibrium of currency?

Given the labour productivity, the currency is oversupplied, the price goes up and the domestic currency devaluates because of the excessive currency in circulation. Hence the oversupply of money definitely causes the increase of the exchange rate of the domestic currency;¹ for example, if the supply of money is twice of its demand, the price level doubles and the domestic currency devaluates by half and the exchange rate of the domestic currency doubles. In contrast, if the supply of money is less than demand, the money in circulation decreases, price level goes down and the domestic currency appreciates.

1 The statement of the exchange rate thereafter is based upon the direct quotation.

Thereby, the undersupply of money induces the decrease of the exchange rate of the domestic currency; for example, if the supply of money is only half of the demand, the price level goes down by half, the domestic money rises by one time, and the exchange rate of the domestic currency devaluates by half. That proves the certainty of the influence of the disequilibrium of monetary supply and demand on exchange rate: the excessive monetary supply and the rising price level correspond to the increasing exchange rate, and the short monetary supply and the descending price level to decreasing exchange rate. The necessity of introducing price into the new model asserts itself here:

$$E = E_0 \frac{L_b}{L_a} \bullet \frac{P_a}{P_b} \quad (4)$$

Adapt the equation above into:

$$E = E_0 \frac{P_a L_b}{P_b L_a} \dots\dots\dots (5)$$

It is supposed to be a rational model of the relative purchasing power parity.

P_a and P_b are respectively the price level of country A and B. In equation (5), answering for the above-mentioned inference, the exchange rate and price level change in the identical direction. Meanwhile, as the price level of country A and country B change in the same direction and with the same degree, the disequilibrium of monetary supply and demand, thus the change of price, has brought no effect on the theoretical exchange rate. All in all, the model can be paraphrased as: the exchange rate is directly proportional to the price level, and inversely proportional to the productivity.

There seems similarity between our model and Cassel's, but in reality radical distinction.

Now that the variable productivities of countries are considered to be identical at the time of lack in international mobility of factors, namely, $L_a = L_b$, the model in equation (5) can be cut off into:

$$E = \frac{P_a}{P_b}$$

This is just Cassel's model. He came across the era of no international mobility of factors, and his model failed in the theoretical support, still exhibited the tendency of real exchange rate in practice of that time. Obviously, it is not the Quantity Theory of Money fulfilled his model, but the deficiency of international mobility of factors that justified its validity in practice. Meanwhile, it illuminates the applied theory lack of theoretical foundation easily generates irrationality and the fallacy that the base of the Theory of Purchasing Power Parity is Quantity Theory of Money instead of Labour theory of Value.¹

1 For the above-mentioned, see Ren Zhi-jun's *The Scientific Foundation of the Theory of Purchasing Power Parity* in the 1st volume of *Economics of Shanghai School*, Shanghai University of Finance and Economics Press, 2003.

Conclusion

The modification of the model is purely hypothetical, the correctness of the new model is thereby up to the verification of empirical evidence which cannot be included in only one paper. Whereas it is able to point out that the influence of the transformation of the relative productivity on the evolvement of exchange rate has been brought into light. “The growth rate of productivity in one country constantly surpasses that of other countries, and despite the repeated fluctuation of exchange rate of its currency in a short period, the trend is going-up. A truth is that the growth rate of Japanese productivity after war has been higher than that of U. S. for decades, so the convertibility rate of Japanese yen to U.S. dollars inclined to rise.From 1960 to 1979, both the Japan-US manufacturing industry comparison and the individual industry comparison, Japanese productivity is always higher. On the other hand, in the period, the exchange rate of yen to dollar rises from 1 dollar=360 yens to 1 dollar=175 yens (October, 1978). The American economic reviewer Daniel Burstezn traced the cause of the rise to the absolute difference of productivity between Japan and U.S. in *Japanese Yen* published in 1988.¹ It is indicative of the necessity of modifying the original model because the real theoretical exchange rate deviates from the result of the original model, caused by the establishment of GATT and the growth of multinationals, the freer mobility of production factors among countries, and the commodity exchange following the international production price rather than the international value.

Nevertheless, the international economic integration and globalization just stand on the threshold, the mobility of factors is far from completely free, and the establishment of the new model takes the complete mobility of production factors among nations as presupposition. In light of this, to understand the real theoretical exchange rate, the old model is not wholly out of function, and the new one cannot be totally efficient, the new theoretical exchange rate is supposed to regard the exchange rate of the new model as the ceiling and that of the old one as the floor. The continuing development of international economic integration and globalization and the improvement of the international mobility of the factors are going to gradually substitute the international production price for the international value as the benchmark of international exchange. The theoretical exchange rate is shifting away from old model and to the new, which hopefully, is going to replace the old one.

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1 Xu, Shao-qiang. Theories and Policies of Foreign Exchange. Shanghai: Shanghai University of Finance and Economics Press, 1999, 175-176. As must be expounded, in the original version, the quotation above is used to explain the deficiency of Cassel's model, and in the present paper, it is considered as the evidence of the new model.

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