FROM FACTOR PRICES EQUALIZATION TO OUTPUT PRICES EQUALIZATION

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Diterima 29 April 2011/Disetujui 7 Juni 2011

Abstract: This paper is addresses to see how the impact of the factor price equalization in product prices equalization. According to Heckser-Ohlin (H-O) model, trade in goods will cause the absolute and relative prices of factor between counties to move toward equality. If free trade occurs, factor prices between countries will not different when countries producing the same mix of product with the same technologies and the same product price must have the same factor prices. Product prices equalization will occur when the countries have same set unit value isoquant (UVI) and, as well under CRS condition MP_L and MP_k are constant along expansion paths of each industries

Keyword: H-O, *factor prices equalization, product prices equalization, CRS condition.*

The pattern of comparative advantage analysis which based on the factor abundance theory have been developed by Eli Heckser (1919) and further elaborated by Bertil Ohlin (1933) (Bowen, *et al,* 1998) The trade of theirs is often referred to as the Heckscher-Ohlin Model. In the H-O model, there are nine strict assumption (Widodo, 2010).

First, there are two countries (let's say A and B), two homogenous goods (let's say x and y) and two homogenous factors of production (let's say labor L and capital K) whose initial level are fixed and assumed to be relatively different for each country. This assumption is frequently presented as the 2x2x2 model. *Second,* technology is identical in both countries: that is, production function are the same in both countries. *Third,* production function are characterized by constant return to scale (CRS) for both commodities x and y, in both countries A and b. This means that when each factor of production is increased by n times, output will also increase by n times.

Fourth, the two commodities have different factor intensities, and there will be reserval of factor initensities for any factor price ratio. *Fifth*, taste and preference (utility function) are the same in both countries. In addition, there are homothetic tastes and preferences. *Sixth*, market are under perfect competition in both countries. *Seventh*, factor of production are perfectly mobile within each countries and immobile between two countries. *Eight,* transportation cost are zero. *Ninth,* there is no trade barrier and no trade policy restriction on the movement of goods between the two countries.

According to H-O model, a country will tend to be net exporter of goods whose production is intensive in those factors that are relatively inexpensive (abundant) in autarky and net importer of goods whose production is intensive in those factors that relatively expensive (scarce in autarky). Under some assumption, trade in goods will cause the absolute and relative prices of factor between counties to move toward equality. Complete equalization will be achieved if both countries continue to produce both goods in trading equilibrium (Bowen, *et all*, 1998, pp. 148). Samuelson (1949) rigorously proved that free international trade will lead to both relative and factor price equalization. The factor price equalization (FPE) predict that countries producing the same mix of product with the same technologies and the same product prices must have the same factor prices (Leamer, 1995).

Across similar economies, marginal and average productivity of labor will be equal in the production of each commodity. If one economy accumulates additional physical capital, the output mix will

change, but the capital-tolabor ratio in each industry will be unchanged (Burgman and Geppert, 1998)

This paper is addressed to see does output price equalization will occur with the assumption that occurred factor price equalization. If the factor price equalization occurs, with assumption market are perfect competition, producers of goods will set prices equal to average cost (*P=AC)*. This implies that output prices are a reflection of the cost of inputs (capital and labor) must be spent to produce one unit of product. In addition, according to *walras law* with market clearing process, equilibrium in input (factor) market will also balancing the output market. So that, if price in input market are balance, output price will also balanced.

Previous Studies

Several studies have been conducted to prove whether the factor price equalization is really occur.

Mochtari and Rassekh (1989, see Rassekh and Thompson, 1993) select 16 OECD countries over period 1961-84 to test the propotition that international trade influence factor price. They show that during the sample period trade significantly increased, while both *w* and *k* converged. The increase in trade and convergence of *k* both contribute to explaining convergence in *w*.

Burgman and Geppert (1998) was tested factor price equalization in six industrialized nations. Using cointegration approach, they found that indices labor cost per unit of manufacturing output are indeed cointegrated. These result support the hypothesis that factor prices posses a long-run equilibrium relationship.

O'Rourke, *et al* (1996) examine dramatic historicaly episode of factor price convergence in the late nineteenth century. Their focus are convergence between Old World and New, and the analysis centers on land and labor. They use econometrics and simulations to identify pro-convergence forces which include commodity price convergence, factor accumulation, and factor-saving biase. The results confirm the empirical relevance of standard trade models in explaining the evolution of factor prices in the late-nineteenth century world economy. While factor markets were becoming in-creasingly integrated during this period, trade and technological change acted as substitutes for factor migration in driving the world economy toward factor price equilibrium

The late-nineteenth century trade boom saw the convergence of commodity prices, and the factor-price-equalization theorem predicts that some of the factor-price conver-gence should have been driven by commodity-price convergence. It turns out that Heckscher and Ohlin were right, but more right for Anglo-America than for other participants in the convergence process.

The Development of Hecksher-Ohlin Trade Theory

Heckscher-Ohlin (H-O) theory is based on two phenomenal article, i.e. an article in 1919 titled "The Effect of Foreign Trade on the Distribution of Income which was written by Eli Heckscher and the theoretical part of a book written by Bertil Ohlin in 1933 with the title "Interregional and International Trade". In their articles, Hecksher (1919) and Ohlin (1933) show how differences in the relative availability of production factors will influence the nature of comparative cost differences between countries in autarky condition and explain how these differences not only affect international trade patterns, but also on price of production factors and the allocation of production factors in producing goods and services (Baldwin, 2008).

In his 1919 article, Heckscher argues that free trade can equalize factor price, but Ohlin rejects this conclusion both in his 1924 PhD thesis and 1933 book. He argues that free trade merely tends to equalize factor prices. Further developments in H-O theory presented by Samuelson (1948). He points out that Ohlin's reasoning in reaching his conclusion is not very satisfactory, and Ohlin does not state which theoretical assumptions would be necessary for factor price equalization to occur (Baldwin, 2008).

Samuelson use a graphical versions of Ohlin's model by modifying the Bowley-Edgeworth box diagram and using a graphical depiction of a country's production possibilities frontier in explaining the Stolper-Samuelson theorem (Baldwin, 2008). Stolper and Samuelson (1941) diagrammatic analysis depicts the optimal set of distributions of given total quantities of two goods between two consumers who have different sets of indifference curves that do not intersect. The Stolper-Samuelson diagrammatic demonstration of the theorem are shown in figure 1 and 2 (Baldwin, 2008).

Stolper-Samuelson Theorem

In Figure 3.1, point O_2 indicates the total quantities of capital (K) and labor (L) in the economy that can be distributed between the production of good 1 and good 2. The slope of the dashed diagonal line, i.e. O_1BHO_2 is a capital/labor (K/L) endowment ratio for the country. Both of isoquant curve (y_1 and $y_1'y_1'$) indicates combination of capital and labor that yield equal outputs of good 1, with the output of good 1 being greater on the $y_1'y_1'$ than on y_1 along any constant K/L line. As well as isoquant curve y_2 and $y_2'y_2'$, which are convex to their origin O_2, both of isoquant curve show combination of capital and labor that yield equal outputs of good 2. If we measured from O_2 as the origin, the output of good 2 on the $y_2'y_2'$ is greater than on y_2 isoquant along any constant K/L line. The curve O_1NMO_2 or sometimes referred as "the pareto efficiency locus", shows the maximum output level possible for each good, given a particular and feasible output level for the other good.

Point O_1 in figure 1, show that all of the country's capital and labor are employed in producing good 2, and point O_2, show that all of the capital and labor are employed to the production of good 1. Both goods are produced at points N and M on the Pareto efficiency locus with more of good 2 and less of good 1 being produced at N than at M. A Pareto efficiency line that lies along the diagonal line indicates that the capital/labor rasio used in producing the two goods is the same. But, if the Pareto efficiency locus (O_1NMO_2) lies below the diagonal line (O_1BHO_2), good 1 will be produced using capital less intensively than good 2 at all point on the optimal production curve. Otherwise, if O_1NMO_2 lies above the diagonal line, good 1 is the capital-intensive good.

Assume that the production function is a homogeneous production function, i.e. the slopes of the isoquants (the technical rate of substitution) for good 1 or good 2 ($\Delta K_1/\Delta L_1$ or $\Delta K_2/\Delta L_2$) that holding the output of good 1 or good 2 constant, are the same along a constant capital/labor proportion line (the line O_1N in figure .1). The absolute marginal productivities of each factor are also assumed fixed along such a line representing equal amounts of output of the good. Moreover, increasing in the capital/labor ratio used in producing a good can decrease a marginal productivity of capital in good's production and increases the marginal productivitity of labor.

Figure 2 shows the production possibilities curve ($PNMP'$) that depict the output of the two goods along the production possibilities curve that indicate the country's optimum production level. According Baldwin (2008), if the isoquant systems for good 1 and good 2 are not equal, a representation in good 1 and good 2 output space of the quantities produced (in figure 2, denoted as y_1 and y_2) along the Pareto effi-

Figure 1. Stolper-Samuelson Box Diagram (Baldwin, 2008)

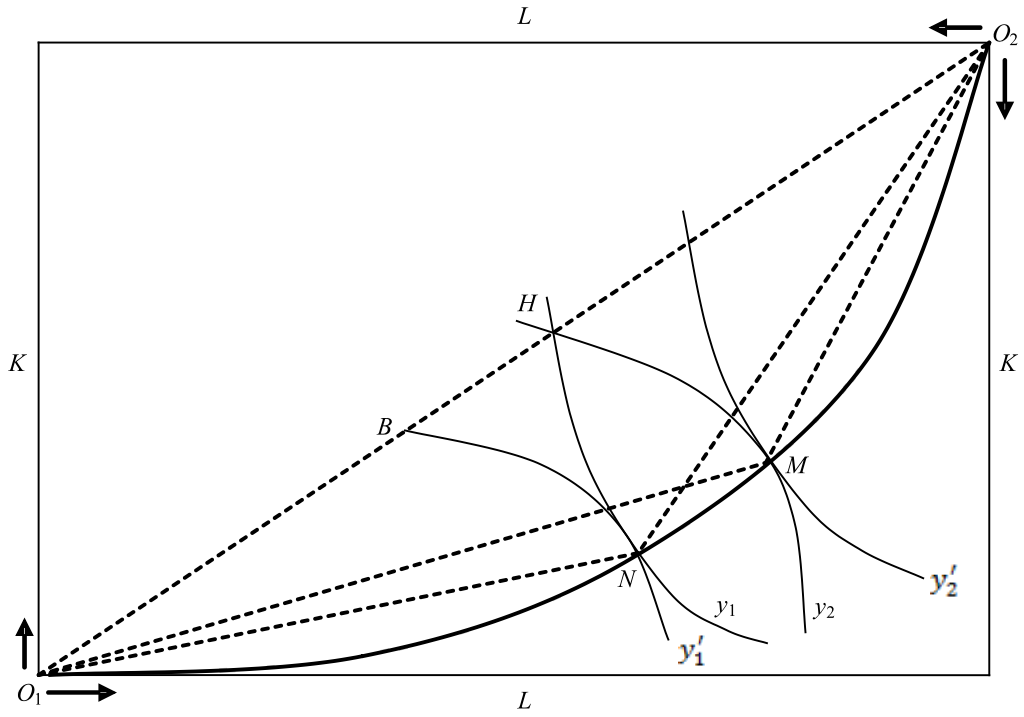
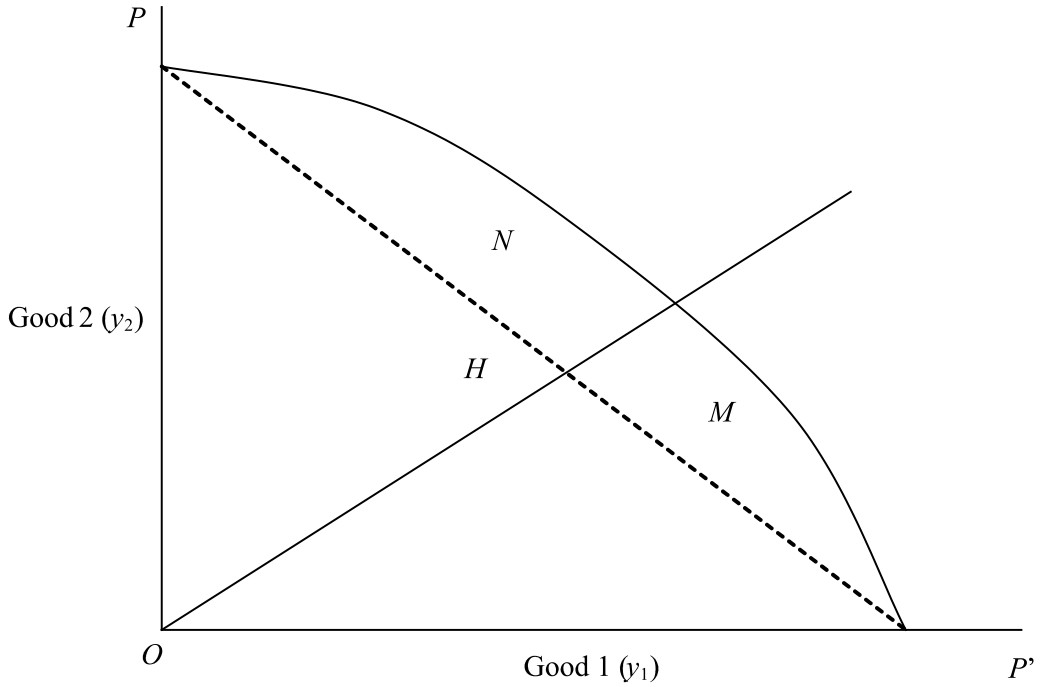


Figure 2. Production-possibilities Curve (Baldwin, 2008)



ciency locus (O_1NMO_2) in figure 1 yields a production possibility frontier that is concave to the origin (e.g., the curve *PNMP*') in figure 2). But, however, if the isoquant systems for the two goods are identical, their locus of tangencies lie along the diagonal line (donated as O_1BHO_2 in figure 1), and this is represented by the line *PHP*' in figure 2.

Baldwin (2008) states that, this latter line indicates a constant marginal opportunity cost of producing each good in the sense that a small increase in the output of one good involves a given constant decrease in the output of the other good. In other words, as the output of one good is increased, an increasing amount of the other good must be forgone to obtain an additional unit of the first good. Then, the Stolper-Samuelson theorem follows in the straightforward manner from these various relationships.

The Stolper-Samuelson theorem stressed that the optimal capital/labor ratios used in producing given quantities of each good change in the same direction as the output of one good change in the same direction as the output of one good increases and the other decreases (Baldwin 2008). In other words, an increase in price of the labor-intensive product causes an increase in the real-wage rate and a reduction in the real return to capital (Leamer, 1995).

From Factor Prices Equalization to Product Prices Equalization

According to figure 1, Baldwin (2008) states that because the output of good 1 or good 2 remains unchanged (fixed) in a movement along any good 1's or good 2's isoquants, respectively, (minus) the slopes of the isoquants equal the ratio of the marginal productivities of the two factor. Thus

$$-\left(\frac{\Delta K_1}{\Delta L_1}\right) = \frac{MP_{L1}}{MP_{K1}} \quad \text{..... (1)}$$

$$-\left(\frac{\Delta K_2}{\Delta L_2}\right) = \frac{MP_{L2}}{MP_{K2}} \quad \text{..... (2)}$$

where MP_{L1} and MP_{L2} are the marginal productivities of labor for good 1 and good 2, respectively, while, MP_{K1} and MP_{K2} are the marginal productivities of capital for good 1 and good 2, respectively. Since the price of each factor equals the value of its marginal product under perfectly competitive market conditions, the following condition holds:

$$w = p_2 MP_{L2} = p_1 MP_{L1'} \quad \text{..... (3)}$$

$$r = p_2 MP_{K2} = p_1 MP_{K1'} \quad \text{..... (4)}$$

where w and r are the wages of labor and the return to capital, respectively, while, p_1 and p_2 are the price of good 1 and good 2, respectively.

In other words, equation (3 and 4) also say that factor price equalization occur. Leamer (1995) states that factor price equalization occur when countries producing the same mix of product with the same

technologies and the same product price must have the same factor prices. Since factor prices are aqual, price of labor (*w*) in country 1 (*w*) will be equal to wage in country 2 (w_*). As well, price of capital (*r)* will be equal, $r=r_*$

Proposition 1. If free trade occurs, factor prices between countries will not different when countries producing the same mix of product with the same technologies and the same product price must have the same factor prices

Equation (3) and (4) can be explored in more detail to see whether the factor prices will cause product prices equalization.

$$w = p_2 MP_{L2} = p_1 MP_{L1}$$

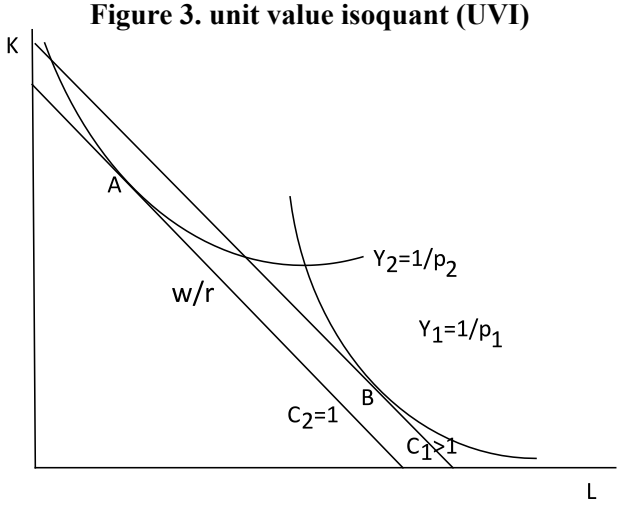
$$r = p_2 MP_{K2} = p_1 MP_{K1'}$$

$$w/r = MP_{L1}/MP_{K1} = MRTS_1 = \text{the slope of } UVI{:}\, y_1 = \frac{1}{p_1}$$

$$= MP_{L2}/MP_{K2} = MRTS_2 = \text{the slope of } UVI{:}\, y_2 = \frac{1}{p_2} \quad \text{..... (5)}$$

Thus, in the home country, a common isocost curve is tangent to both unit value isoquant (UVI_s), is described in figure 3. Arbitrary factor price result in specialization in one commodity.

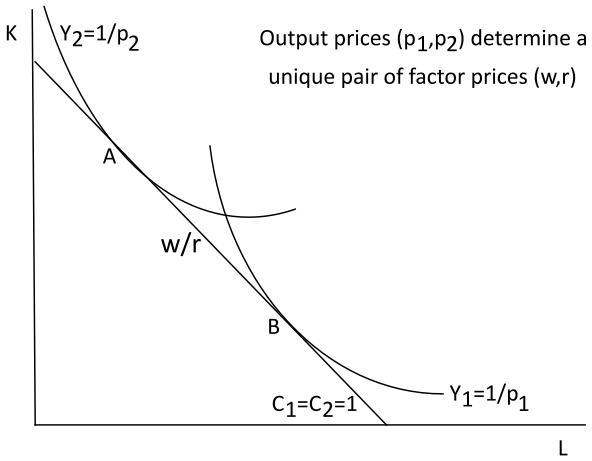
Figure 3. unit value isoquant (UVI)



An arbitrary pair of factor prices (w,r) cannot prevail, because it causes the economy to specialize in one good. For instance, given the factor prices represented by the slopes of the two isocost curves, industry 2 survives at point A ($p_2y_2 = c_2$) The tangency points (both A and B) the production costs at points 1 and 2 will differ. For example, $C_1 > C_2 = 1$. Thus, firms will produce only commodity 2, which costs less but yields the same revenue. That is, the country specializes in good 2.

Thus, for given pair of output prices (p_1,p_2), there exist unique pair of factor prices (w,r). This implies that a pair of output prices completely determines of factor prices.

Figure 4. Common isocost curve



The same is true in foreign country

$$w^* = p_2^* MP_{L2}^* = p_1^* MP_{L1}^* \quad \text{..... (6)}$$

$$r^* = p_2^* MP_{K2}^* = p_1^* MP_{K1}^* \quad \text{..... (7)}$$

No barrier to trade and no transportation cost imply:

$$p_1^* = p_1 \text{ and } p_2^* = p_2 \quad \text{..... (8)}$$

(free trade implies output prices equalization.) Thus:

$$w^* = p_1^* MP_{L2}^* = p_1^* MP_{L1} \quad \text{..... (9)}$$

With identical technologies, both countries have same isoquant maps. This and the assumption perfect competition, home country and foreign country have the same set of unit value isoquant. No factor intensity reserval that expansion paths (k) are unique in each country, and the two countries have the same expansion paths (k) as shown in figure ($k_1=k_1^*$ *and* $k_2=k_2^*$).

Figure 5. Expansion Curve

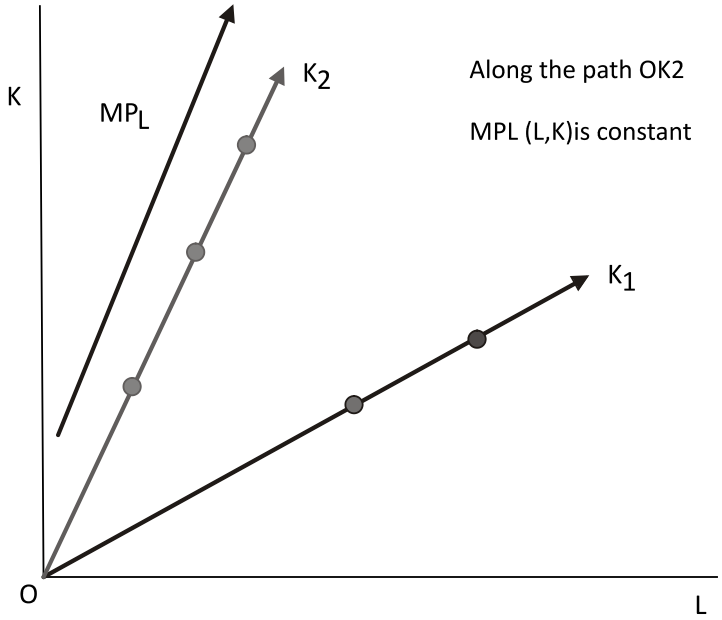
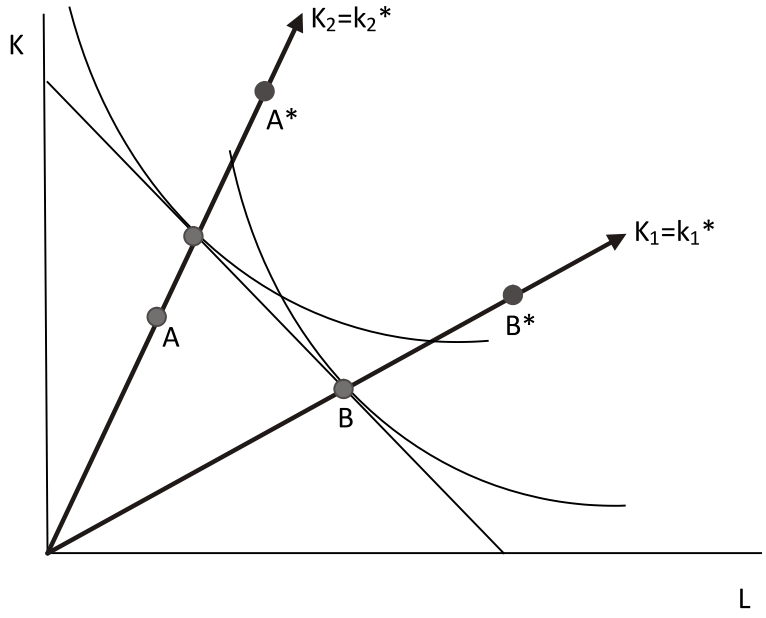


Figure 6. Effect of CRS on Marginal Product



Marginal product of each input depends on the amounts of K and L. However, CRS industries, MP_L and MP_k are constant along expansion paths of each industry. The following diagram MP_L maintains constant height along the expansion curve Ok_2.

Proposition 2. Product prices equalization will occur when no trade barriers, no transportation cost (free trade) and the countries have same set unit value isoquant (UVI).

Proposition 3. Product prices equalization will occur, as well under CRS condition MP_L and MP_k are constant along expansion paths of each industries.

Conclusion

Based on theoretical analysis with the assumption that is there, factor prices equalization occurs when all the assumptions in Hekcser-Ohlin theorem is fulfilled. Factor prices between will not different when countries producing the same mix of products with the same product technologies. Besides affecting factor prices equalization, trade also will have an impact on product prices of equalization. Product

price equalization will occur as a result of similarity in factor (input) price between countries that do trade. With a similarity input prices andon the conditions of perfect competition and the absence of transportation costs, product prices (output) will be equal to the factor price (input). In addition, the first conditions must be met to achieve product price equalization is the countries have same set the unit value isoquant (UVI). Product prices equalization will occur when under CRS condition MP_L and MP_k are constant along expansion paths of each industries. This paper is only a theoretical analysis to see whether there is similarity in price of product in case of similarity in factor prices between countries. So that needs to be proven empirically to find out of the truth.

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