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General Trading Costs in Pure Theory of International Trade*

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ABSTRACT

We use the HOS model of international trade to find a link between trading (including domestic trading or retailing) costs and pattern of trade, not just its effect on volume of trade. Even if we use symmetric iceberg type trading costs, unlike conventional unit cost approach, we generate relative price effects and prove that higher trading costs in labor-abundant countries will restrict volume of world trade by working against factor endowment bias and conversely for the capital-abundant nation if the trading sector is labor intensive and vice versa. Asymmetric trading cost between goods may have paradoxical output effects. Relatively capital-abundant country will be worse off with increasing trading cost, whereas once engaged in trade the labor-abundant country may gain from further increase in trading cost.

Keywords: International Trade, Factor-intensity, General equilibrium

(JEL CL. No: F1, D5)

1. Introduction

The purpose of this paper is to formalize the notion of trading costs (including domestic trading or retailing)¹ in pure theory of international trade. We start from the basic Heckscher-Ohlin-Samuelson (HOS) model of trade and explicitly bring in a trading or retailing sector which processes trading or transaction in the economy. This type of trading cost is modeled as the typical “iceberg” type of cost whereby a fraction of the value of output to be transacted is lost in the process if there are no traders in the system. The cost we have in mind may not be necessarily related to international trade or transportation of goods across the borders. Even in autarky domestic trading or transaction costs can alter allocation of resources and hence can affect pattern of trade.

We highlight the total value of trade that is transacted in an economy which, by definition, must include total value of production in exportables and demand for the import competing good. Resources are needed to carry out trading and the lost value of output goes towards compensating the traders. Such resource costs may also include bureaucratic costs. The economy then divided into two segments, one where production takes place by using capital and labor a la the standard 2x2 model and the other where trading takes place also by using labor and capital. Therefore, it is essentially a 2X3 model of trade. Such a system is related to the earlier works by Jones and Marjit (1992), and Marjit and Beladi (1999) which draw from a well known policy paper by Gruen and Corden (1970).

Most of the existing papers in the literature assume unit cost structure to capture the idea of only international trading cost. Hence it is easily understandable that if there is any change in trading and/or retailing cost that would naturally affect the relative prices,

direction of trade and volume of trade. Compared to those papers the merit of our work is that instead of assuming unit cost we start with symmetric iceberg costs with effects on relative prices and consequent changes in relative supply. In a very interesting paper on transport cost, Falvey (1976) emphasized on who is going to specialize in producing transport service which is required only for international trade (not for domestic trade). His main focus was on location decision regarding transport industry and consequent impact on standard trade theorems. This paper serves as a major workhorse in transport costs or trade costs related literature. In another elegant paper Cassing (1978) focuses on contrasting the shipping cost model with a non-traded goods model to examine the robustness of Stolper-Samuelson and Rybczynski theorems. Both Falvey (1976) and Cassing (1978) introduced a different sector to capture the idea of transportation costs. While we also introduce a third sector, our primary focus is how general transaction costs can affect volume and pattern of trade in differently endowed nations. We also highlight interesting welfare results. Starting from symmetric iceberg type transaction costs in the production sectors, we generate important relative price effects. This is a key point of the paper.

Deardorff (2004) had also attempted to check the way through which the costs of trade, if it is large enough, affect the patterns of trade. Deardorff shows why and how trade cost does matter in selecting the trading partners and the goods to be exported and imported as well. But that was again international trading cost.

Whatever be the form and nature, trading costs adversely affect the volume of trade and limit the scope for international transaction have been amply demonstrated theoretically and empirically in several papers.² On the other hand the impact of

communication cost on the pattern of trade is analyzed in recent works of Marjit (2007), Kikuchi (2006), Fink, Matto and Neagn (2005) .

However, in this model our endeavor is to show that even in the absence of international trading or transportation costs domestic trading and/or retailing costs can affect the pattern of trade and the volume of trade as well. Our main objective is to internalize the concept of trading cost in an otherwise simple model of trade and emphasize the fact that trading as a separate activity uses resources like production related activities. Therefore, such cost should affect the pattern of trade and relative prices in a systematic way. The main results we derive in this context are as follows:

(1) Trading costs tend to increase the relative price of the labor intensive good in autarky.

Thus the volume of trade will be asymmetrically affected in a labor-abundant and capital-abundant country.³

(2) Asymmetric product specific trading costs may have paradoxical output and relative price effects. For example larger trading costs for capital intensive good may actually increase the volume of production in capital intensive sector. However, the same for the labor intensive good must reduce production of the labor intensive good.

(3) And perhaps, the most eye-catching outcome of this paper is that in the post-trade situation a decline in the trading costs may reduce welfare in a labor abundant country whereas welfare must go up for the capital rich nation.

The model is developed in the next section. Section 3 discusses the relationship between trading costs and the pattern and volume of trade. Section 4 talks about the welfare impact. Last section concludes.

2. The basic model

With this backdrop let us consider a world economy consisting of two economies: a home and a foreign economy. The variables of the foreign economy are denoted by asterisk. Foreign economy is considered in order to gauge the difference in relative price of foreign with that of home when trading cost changes. Our main focus is on the home economy.

Home economy is considered to be a perfectly competitive one producing two tradeable goods; capital-intensive good X and labor-intensive good Y . Traders are needed to complete the process of transaction from production to consumption. A part of the total resource is absorbed in the production of X and Y , and others get employment due to transaction or trading activities. This transaction related intermediation gives rise to trading costs. α_x is the fraction of good X and α_y is the same for Y that is lost due to trading cost. Therefore, $[\alpha_x P_X X + \alpha_y P_Y Y]$ represents the maximum total value of the goods that can be spent on those who are actually involved in trading activities. Let Z represent the sector and L_z, K_z are respectively labor and capital that are exclusively engaged in such operations. These factors are paid out of the difference between commodity price and material input cost of production. We assume competitive market for trading costs to be consistent with the otherwise standard specifications of the competitive general equilibrium model.

Foreign economy is characterized by similar variables but with an asterisk. Perfect competition prevails in all markets in both the countries and production functions for X, Y and Z are assumed to exhibit constant returns to scale (CRS) and diminishing marginal productivity (DMP).

The symbols and basic equations are in consistence with Jones (1965). To build the system of equations, we use following notations:

P_i = Price of i^{th} good, $i = X, Y$; w = Return to labor, L ; r = Return to capital, K ;

a_{ij} = Technological co-efficient; \bar{K} = Total supply of capital; \bar{L} = Total supply of labor;

L_Z = Labor engaged in trading activities; K_Z = Capital engaged in trading activities.

Let us assume commodity Y as the numeraire and set $P_X = P$.

Competitive price conditions are:

$$w.a_{LX} + r.a_{KX} = P(1 - \alpha_X) \quad (1)$$

$$w.a_{LY} + r.a_{KY} = (1 - \alpha_Y) \quad (2)$$

Full employment conditions are:

$$a_{KX}.X + a_{KY}.Y = \bar{K} - K_Z \quad (3)$$

$$a_{LX}.X + a_{LY}.Y = \bar{L} - L_Z \quad (4)$$

Had there been no sector doing trading intermediation in the RHS of equation (3) and (4)

we could have only \bar{K} and \bar{L} , respectively.

Production function for trading activity is denoted by

$$K_Z = \mu L_Z \quad (5)^4$$

μ is assumed to be constant. We are not considering factor substitution in the trading sector. This is assumed for computational simplicity.

Note that, trading cost is required not for production. Trading cost comes into the picture only when the produced goods are brought to the consumers. Here X is importable and Y is exportable. This means in the post trade situation the cost equation for the Z sector would be

$$[\alpha_X P(X+M) + \alpha_Y (Y)] = wL_Z + rK_Z$$

Using condition (5) this can be re-written as

$$[\alpha_X P(X+M) + \alpha_Y (Y)] = L_z(w + \mu r) \quad (6)$$

Any imported amount of X, i.e. M and export of Y must be taken into account while calculating the total trading cost. Where, $\alpha \in [0,1]$; a low α will mean lower the degree of trading costs and conversely. We start from autarky by using (6). In that case (6) boils down to

$$[\alpha_X P(X) + \alpha_Y (Y)] = L_z(w + \mu r) \quad (6a)$$

We can close the model by incorporating a homothetic demand function. This is,

$$\frac{X_D}{Y_D} = f(P); f'(P) < 0 \quad (7)$$

Here X_D and Y_D signifies demand for respective commodities.

Factor endowments of labor and capital are constant at \bar{L} , \bar{K} . With given prices and trading costs (P , α_X and α_Y) w and r can be determined from equation (1) and (2). Factor proportions in turn get determined from factor prices because of CRS assumption. Now, let us start from some L_z and K_z (for any given value of L_z , K_z can also be determined from (5)) such that $(\bar{K} - K_z)$ and $(\bar{L} - L_z)$ are positive. Then, given (w, r) and hence a_{ij} s (a_{ij} is constant because of CRS) and with a given value of L_z (and hence K_z) we can solve for X and Y from equation (3) and (4). This completes the solution of the model.

Moreover, we can also solve for L_z and K_z . With w and r determined the RHS of (6a) would be linear in L_z with slope $(w + \mu r)$. Given P with an increase in L_z LHS of (6a) must fall as productive⁵ resources are smaller in size now. This implies that new production equilibrium at the given price level would be on a lower production

possibility frontier⁶, yielding lower value of production. Thus LHS of (6a) is negatively sloping in L_z or K_z . Hence, we have figure -1 where L_{z0} (and hence K_{z0}) is determined. Now with L_{z0} or K_{z0} we can determine everything else in the system, in particular X and Y or $\left(\frac{X}{Y}\right)$.

3. A Price Effect on Supply

With a rise in P , w will fall and r will go up as per the Stolper-Samuelson theorem. Given L_z and K_z , this will make the labor constraint more and capital constraint less binding. Hence due to Rybczynski theorem X will go up and Y will go down⁷.

Now, let us look at (6a). What is going to happen to the RHS of equation (6a) that crucially depends on the value of μ . RHS would increase (decrease) if the value of μ happens to be greater (lower) than unity. However, due to the envelope property and also for the fact that trading cost is the same for both sectors, change in $[\alpha_x P(X) + \alpha_y(Y)]$ will be approximated by $dP.X$ which is greater than zero since P rises. Hence, the LHS in figure-1 will shift up. This is demonstrated in figure -2. If Z sector really uses more labor relative to capital ($\mu < 1$), due to an increase in P RHS of (6a) will fall and L_z (or K_z) will unambiguously increase. Therefore L_z will increase further curtailing Y and increasing X .

Thus a rise in P will raise $\left(\frac{X}{Y}\right)$, the usual supply-side response. By using the homothetic demand function we can close the model and can determine the equilibrium value of P . Figure-3 gives us the equilibrium autarkic price P_A . Nevertheless, when Z turns out to be more capital using, eventual effect on L_z or K_z depends on the relative strength of change in the LHS and RHS. Therefore, the supply side response is quite interesting. Relatively

labor-intensive Z would end up with higher supply of (X/Y) , the conventional response. This may take place even in case of capital-intensive Z if the effect on LHS is stronger than that of RHS. When two effects are exactly offsetting a rise in P will result in higher (X/Y) a la Rybczynski argument through more binding labor constraint and less binding capital constraint. On the other hand when L_z (and/or K_z) falls we need to weigh the first round Rybczynski effect with the second round offsetting effect on (X/Y) .

The underlying economic intuition is very easy to tackle with. The first round impact on (X/Y) is at a given L_z or K_z . Here (X/Y) must increase. As (X/Y) goes up, trading activity should also change. But which one would be used more in this so-called “unproductive” trading sector that would be determined by the specific type of production function that we assumed. How much labor and capital could be released and how much of those factors could be further employed for trading that is determined by the value of constant μ . This is the main driving force of our results in this paper. Nonetheless, let us assume that trading sector uses more labor relative to capital and thus L_z and/or K_z should go up consequent upon an increase in P and hence (X/Y) should rise further by curtailing Y and increasing X ⁸.

Let us introduce a foreign economy, represented by ‘*’. Say both domestic and foreign economies are similar in technology and preference. But the difference lies in factor endowments. Let the foreign economy be capital abundant. Hence, $(K/L)^* > (K/L)$. When both the nations are symmetrically affected by trading costs, according to HOS prediction, for a given P , $(X/Y)^* > (X/Y)$. This implies, $P_A^* < P_A$ (suffix ‘A’ denotes autarkic situation). It is apparent that greater is the difference between $(K/L)^*$ and (K/L)

and hence $(P_A - P_A^*)$, bigger will be the volume of trade or the size of so called “trade triangle”.

Here it is worth mentioning that as far as the domestic production, domestic exports and domestic imports are concerned, intermediation is done only by domestic labor and capital.

3. B Symmetric change in domestic trading costs

Suppose there is a change in trading costs in the home country owing to some reasons. Say both α_x and α_y rise. Therefore, both $(1 - \alpha_x)$ and $(1 - \alpha_y)$ fall in the home, the labor-abundant country. Note that from (1) and (2) given P there will be symmetric response in both the price equations, $\hat{w} = \hat{r} < 0$ [‘^’ denotes proportional change as in Jones (1965)]. Hence, $\left(\frac{w}{r}\right)$ does not change. However, there are two effects on LHS in (6a). Given $[PX + Y]$, an increase in trading cost has increased LHS. But as w and r fall, value of national income goes down. Hence given α_x and α_y , LHS should go down. The negative effect will vanish if we start from zero trading costs. To keep things simple we shall assume that initially $\alpha_x = \alpha_y = 0$ ⁹. Then the RHS falls at a given Lz (or Kz) as w and r fall. Therefore, Lz (or Kz) must increase lowering Y and increasing X .¹⁰ Subsequently a symmetric increase in α_x and α_y will lead to an increase in Lz (or Kz) and an increase in $\left(\frac{X}{Y}\right)$. This will reduce the gap between $\left(\frac{X}{Y}\right)^*$ and $\left(\frac{X}{Y}\right)$ for any given P . The autarkic price gap $(P_A - P_A^*)$ will also shrink and so will be the volume of trade. This is clearly demonstrated in figure-3.

Therefore as both α_x and α_y rise in a labor abundant country, relatively less labor compared to capital (since both productive L and K fall and Z is more labor using) is available for production related activities cutting back production of labor intensive good and increasing that of capital intensive one. It is also to be noted that there is no presumption as to which sector is more distorted by trading cost with α_x and α_y being the same. If trading intermediation requires more labor than capital, the labor-abundant country suffers much in terms of the good over which it has comparative advantage. The message is that resources that could otherwise be involved in producing X and Y are being engaged in intermediation activities. Therefore, the trading related transaction cost induced bias goes against the factor-endowment bias for a relatively labor-abundant country. Due to the same reason for a capital-abundant country's natural endowment bias is further strengthened by trading cost. Precisely that is why and how the relative price and volume of trade gets asymmetrically affected for labor-rich and capital-rich countries.

Equation (6) provides with the following expression

$$\hat{L}_Z = (\hat{\alpha}_x + \hat{P}) V\alpha_x + \hat{\alpha}_y V\alpha_y - \frac{\hat{w}.w + \hat{r}.\mu r}{w + \mu r} \quad (8)$$

Here $V\alpha_x = \frac{P\alpha_x(X+M)}{P\alpha_x(X+M) + \alpha_y Y}$ and $V\alpha_y = \frac{\alpha_y Y}{P\alpha_x(X+M) + \alpha_y Y}$

$V\alpha_x$ and $V\alpha_y$ are essentially the value share of trading cost in X and Y, respectively with respect to total trading cost. A closer look reveals that these are nothing but the share of X and Y that requires trading intermediation. Note that this includes both consumption and production and $V\alpha_x + V\alpha_y = 1$.

Using the elasticity of demand and setting $\alpha_x = \alpha_y = \alpha$ and setting $\hat{L} = \hat{K} = 0$ one can easily arrive at the following results.

$$\hat{P} = (-) \frac{1}{|\lambda| \sigma_b} (\lambda_{KZ} - \lambda_{LZ}) d\alpha \quad (9)$$

Here both $|\lambda| < 0$ because commodity X is capital intensive. Therefore, what would happen to the volume of trade due to an increase in trading or distribution cost that crucially depends on as to $(\lambda_{KZ} - \lambda_{LZ})$ is positive or negative, i.e Z requires more capital or not. When Z uses more labor $(\lambda_{KZ} - \lambda_{LZ}) < 0$, autarkic equilibrium price must decrease for both labor-abundant and capital-rich countries implying a decrease or an increase in the trade triangle for the countries, respectively.

Thus the following proposition is immediate,

PROPOSITION I : *An increase in trading costs tends to make the labor intensive good dearer in autarky because of less production. This in turn will reduce the volume of trade in a labor-abundant country but will enhance the same in capital-abundant country.*

QED

Proof: See appendix A for detailed mathematical proof.

3. C Asymmetric change in domestic trading costs

We can have some interesting outcome if trading costs do not change symmetrically. Two interesting papers in this connection deserve to be mentioned. One is by Chakrabarti (2004) and the other is by Bernard, Jensen and Schott (2006). There may be two different cases in our model: one is when trading cost increases in capital-intensive goods and the other when labor-intensive goods are disturbed by greater trading costs.

Say trading cost increases in X while that of Y remains constant. From (1) RHS goes down as $\hat{\alpha}_x > 0$. This leads to an increase in w and a fall in r since X is capital-intensive. Given L_z (and K_z), capital constraint will be more and labor constraint will be less binding. Therefore, production of Y will increase and that of X will fall following the standard Rybczynski effect. For a given L_z (and K_z), RHS of (6a) would increase if Z is using more labor than capital. LHS of (6a) also increases as α_x goes up. Hence the effect on L_z is uncertain. When trading cost increases only in X , for a given P and given trading cost for Y equation (8) comes down to

$$\hat{L}_z = \hat{\alpha}_x V \alpha_x - \frac{\hat{w} \cdot w + \hat{r} \mu r}{w + \mu r}$$

$$\hat{L}_z = \frac{\hat{\alpha}_x}{w + \mu r} \left[V \alpha_x (w + \mu r) + \frac{\theta_{KY}}{|\theta|} \frac{\alpha_x}{1 - \alpha_x} w - \frac{\theta_{LY}}{|\theta|} \frac{\alpha_x}{1 - \alpha_x} \mu r \right] \quad (10)$$

Whether the value of L_z would increase or not that is not unambiguous. L_z would increase iff,

$$\left\{ \left| V \alpha_x (w + \mu r) \right| + \left| \frac{\theta_{LY}}{|\theta|} \frac{\alpha_x}{1 - \alpha_x} \mu r \right| \right\} > \left| \frac{\theta_{KY}}{|\theta|} \frac{\alpha_x}{1 - \alpha_x} w \right| \quad (11)$$

Here the LHS of (11) is likely to be greater than the RHS. The intuitive explanation is very simple. The α_x may be tiny. If the volume of consumption of X is sufficiently large, $V \alpha_x$ must not be insignificant and at the same time Y is labor-intensive relative to X . Sufficiently large consumption of X implies that if trading cost goes up in X , it will require a major chunk of labor and capital to take care of this trading cost related intermediations. Note that as Z sector uses more labor than capital L_z would increase more than K_z . In that case production of Y should suffer and that of X should rise a la Rybczynski argument.

From the full employment conditions and assuming constant L and K we get,

$$\hat{X} = \frac{1}{|\lambda|} [(\lambda_{KZ}\lambda_{LY} - \lambda_{LZ}\lambda_{KY})] \hat{L}_Z \quad (12)$$

Therefore \hat{X} would be positive if condition (11) is satisfied and Z turns out to be more labor intensive than Y since $|\lambda| < 0$. The precise condition looks like $\frac{\lambda_{LZ}}{\lambda_{KZ}} > \frac{\lambda_{LY}}{\lambda_{KY}}$.

This is a bit different from the simple labor intensity assumption for Z what we assumed earlier. This condition implies Z must be most labor intensive among X, Y and Z.

Therefore the factor intensity ranking condition seems to be $\frac{\lambda_{LZ}}{\lambda_{KZ}} > \frac{\lambda_{LY}}{\lambda_{KY}} > \frac{\lambda_{LX}}{\lambda_{KX}}$, then only

X will rise. However, if $\frac{\lambda_{LX}}{\lambda_{KX}} < \frac{\lambda_{LZ}}{\lambda_{KZ}} < \frac{\lambda_{LY}}{\lambda_{KY}}$, then simple more labor using assumption of Z

is still valid but X would in fact fall. This possibility should not be ignored as still Z uses more labor than X which was our primary assumption. Hence the effect on X is ambiguous with the real possibility of an increase in output due to increase in trading cost in X. However, one can check that under the same condition $\hat{Y} < 0$ when $\hat{X} > 0$.

On the other extreme trading cost may increase only in Y. From (2) RHS goes down as $\hat{\alpha}_Y > 0$. This reduces w and increases r since Y is labor-intensive. This in turn, for any given L_z and K_z , lead to an increase in X and a fall in Y. For a given L_z and/or K_z , RHS of (6a) should go down as μ is less than unity. LHS of (6a) increases as α_Y goes up. Hence L_z should increase unambiguously. Then following Rybczynski theorem Y production should fall and that of X should increase. Under these circumstances, when trading cost increases only in Y, for a given P and given trading cost for X equation (8) can be modified as

$$\hat{L}_Z = \hat{\alpha}_Y V \alpha_Y - \frac{\hat{w} \cdot w + \hat{r} \mu r}{w + \mu r}$$

$$\hat{L}_Z = \frac{\hat{\alpha}_Y}{w + \mu r} \left[V \alpha_Y (w + \mu r) - \frac{\theta_{KX}}{|\theta|} \frac{\alpha_Y}{1 - \alpha_Y} w + \frac{\theta_{LX}}{|\theta|} \frac{\alpha_Y}{1 - \alpha_Y} \mu r \right] \quad (13)$$

$$\hat{L}_Z > 0 \text{ iff } \left\{ \left| V \alpha_Y (w + \mu r) \right| + \left| \frac{\theta_{KX}}{|\theta|} \frac{\alpha_Y}{1 - \alpha_Y} w \right| \right\} > \left| \frac{\theta_{LX}}{|\theta|} \frac{\alpha_Y}{1 - \alpha_Y} \mu r \right| \quad (14)$$

Above condition is likely to hold true when sufficient amount of Y is traded for consumption and as X is capital-intensive compared to Y.

Therefore change in Y could be represented by the following expression for given L, K, P

and α_x ,
$$\hat{Y} = \frac{1}{|\lambda|} [(\lambda_{LZ} \lambda_{KX} - \lambda_{KZ} \lambda_{LX})] \hat{L}_Z \quad (15)$$

\hat{Y} would be negative if condition (14) is satisfied and Z happens to be more labor intensive than X since $|\lambda| < 0$. The precise condition would read as $\frac{\lambda_{LZ}}{\lambda_{KZ}} > \frac{\lambda_{LX}}{\lambda_{KX}}$.

Assumption of labor intensive Z entails that, at least, it has to be more labor intensive than the most capital intensive one. For some reason if Z becomes even more labor intensive than Y, \hat{Y} must be negative. Thus negative effect on Y is unambiguous.

Hence we can write down the following proposition:

PROPOSITION II: *Larger trading costs for capital intensive good may raise the volume of production of capital intensive good whereas the same for the labor intensive good unequivocally reduces the production of the labor intensive good. QED*

Proof: See appendix A for detailed mathematical proof.

4. Welfare implications

So far we have not explicitly stated the welfare consequences of introducing trading costs in the standard general equilibrium model. Having a leakage in the form of trading costs related transaction activity entails inefficiency of some sort. Trading or distribution costs, in fact, act as a tax on the productive sector. More tax is envisaged on the labor intensive good because of the assumed production function for trading activity. In the first best situation the economy should have produced more of the labor-intensive good. If the labor-abundant country wishes to engage in trade, prevalence of trading costs will restrict volume of trade and therefore the extent of the gains from trade will be affected. Thus the welfare loss is reinforced. Higher (lower) trading costs in a labor-abundant country will be harmful to the capital-abundant country since higher output of capital intensive good will depress (increase) world price of that good, causing a terms of trade loss (gain) for the capital-abundant country. Thus a reduction in trading costs will unequivocally raise the welfare of capital-rich nations. Interestingly once engaged in trade, the labor-abundant economy may gain (lose) from higher (lower) trading costs, through an improvement (deterioration) in the terms of trade. Then, we may have a case where the labor-abundant country in the post-trade situation can even gain (lose) from higher (lower) trading costs with a strong enough terms of trade effect. This is evident from the following expression for change in welfare.

$$\frac{d\Omega}{d\alpha} = (-) \frac{dP}{d\alpha} M(1-\alpha) + \left(\frac{dY}{d\alpha} + P \frac{dX}{d\alpha} \right) + \alpha P \frac{dM}{d\alpha} + PM$$

Since $M = X_D - X$ and $M = M(\Omega, P)$

$$\frac{d\Omega}{d\alpha} = \frac{1}{1-\alpha\beta_x} \left[\frac{dP}{d\alpha} \left\{ -M(1-\alpha) + \alpha P \frac{\partial M}{\partial P} \right\} + \left(\frac{dY}{d\alpha} + P \frac{dX}{d\alpha} \right) + PM \right] \quad (16)$$

where, $\beta_x = P \frac{\partial M}{\partial \Omega}$ or marginal propensity to import. Note that $\frac{\partial M}{\partial P}$ is nothing but the substitution effect.

PROPOSITION III: *A capital-abundant country's welfare must increase with a reduction in the trading costs in the post-trade situation whereas the labor-abundant nation may experience a reduction in its welfare.* *QED*

Proof: Appendix B provides with the detailed calculation.

5. Conclusion

The purpose of this paper is to model general trading cost within a simple general equilibrium framework and then explain the relationship between international trade and trading costs or distribution costs. We argue that the standard HOS framework provides some insights regarding such a relationship. Trading is a labor-intensive activity. Hence, as more labor is attracted to this sector, labor-intensive traded good suffers, so does the volume of trade for the labor-abundant economy.

Appendix A

Differentiating and manipulating equation (1) and (2) we get,

$$\hat{w} = \frac{\frac{\theta_{KY}}{1-\alpha_x} (\hat{P} - \hat{P}\alpha_x - \hat{\alpha}_x \alpha_x) + \frac{\theta_{KX}}{1-\alpha_y} \alpha_y \hat{\alpha}_y}{|\theta|} \quad (1.A)$$

$$\hat{r} = (-) \frac{\frac{\theta_{LY}}{1-\alpha_x} (\hat{P} - \hat{P}\alpha_x - \hat{\alpha}_x \alpha_x) + \frac{\theta_{LX}}{1-\alpha_y} \alpha_y \hat{\alpha}_y}{|\theta|} \quad (2.A)$$

Where, $|\theta| = (\theta_{KY} - \theta_{KX}) = (\theta_{LY} - \theta_{LX}) < 0$. And, $\theta_{ji} \Rightarrow$ value share of j^{th} factor in i^{th} commodity, $j = L$ and K , and $i = X$ and Y .

$$\text{Therefore, } (\hat{w} - \hat{r}) = \frac{1}{|\theta|} \left[\hat{P} - \hat{\alpha}_x \frac{\alpha_x}{1 - \alpha_x} + \hat{\alpha}_y \frac{\alpha_y}{1 - \alpha_y} \right] \quad (3.A)$$

Differentiating equation (3) and (4) and manipulating them one gets,

$$\hat{X} = \frac{\hat{L}\lambda_{KY} - \hat{K}\lambda_{LY} + \hat{K}_Z\lambda_{KZ}\lambda_{LY} - \hat{L}_Z\lambda_{LZ}\lambda_{KY}}{|\lambda|} \quad (4.A)$$

$$\hat{Y} = \frac{\hat{K}\lambda_{LX} - \hat{L}\lambda_{KX} + \hat{L}_Z\lambda_{LZ}\lambda_{KX} - \hat{K}_Z\lambda_{KZ}\lambda_{LX}}{|\lambda|} \quad (5.A)$$

Note that here $\lambda_{LX} + \lambda_{LY} + \lambda_{LZ} = 1 = \lambda_{KX} + \lambda_{KY} + \lambda_{KZ}$

Where, $|\lambda| = (\lambda_{KY} - \lambda_{LY}) + (\lambda_{LY}\lambda_{KZ} - \lambda_{KY}\lambda_{LZ}) = (\lambda_{LX} - \lambda_{KX}) + (\lambda_{KX}\lambda_{LZ} - \lambda_{LX}\lambda_{KZ}) < 0$.

Because $\lambda_{LY} > \lambda_{KY}$ and $\lambda_{KX} > \lambda_{LX}$ and the second bracketed terms of both the inequalities are net of multiplications of two fractions which are not likely to outweigh the first bracketed negative terms of the said inequalities. And, $\lambda_{ji} \Rightarrow$ share of j^{th} factor in i^{th} commodity, $j = L$ and K , and $i = X, Y$ and Z .

Therefore,

$$(\hat{X} - \hat{Y}) = \frac{(\hat{L} - \hat{L}_Z\lambda_{LZ})(\lambda_{KX} + \lambda_{KY}) - (\hat{K} - \hat{K}_Z\lambda_{KZ})(\lambda_{LX} + \lambda_{LY})}{|\lambda|} \quad (6.A)$$

If we differentiate equation (5) taking μ as constant one gets,

$$\hat{K}_Z = \hat{L}_Z. \quad (7.A)$$

From equation (6a of main text),

$$\hat{L}_Z = \left(\hat{\alpha}_x + \hat{P} \right) V\alpha_x + \hat{\alpha}_y V\alpha_y - \frac{\hat{w}.w + \hat{r}\mu r}{w + \mu r} \quad (8.A)$$

Here, $V\alpha_x$ and $V\alpha_y$ represent share of trading costs in X and Y respectively.

Using homothetic demand and balanced trade condition we have,

$$\hat{P} = (-) \frac{1}{|\lambda|\sigma_b} \left\{ (\hat{L} - \hat{L}_Z \lambda_{LZ}) (\lambda_{KX} + \lambda_{KY}) - (\hat{K} - \hat{K}_Z \lambda_{KZ}) (\lambda_{LX} + \lambda_{LY}) \right\} \quad (9.A)$$

where, σ_b implies demand elasticity.

When trading costs change symmetrically across sectors $\alpha_X = \alpha_Y = \alpha$ equation (8.A) turns out to be

$$\hat{L}_Z (= \hat{K}_Z) = \left(\hat{\alpha} \frac{\alpha}{1-\alpha} + \hat{P} V \alpha_x \right) \quad (\because V \alpha_x + V \alpha_y = 1) \quad (10.A)$$

When labor and capital endowments are held fixed and there is no autonomous change in P equation (9.A) boils down to

$$\begin{aligned} \hat{P} &= (-) \frac{1}{|\lambda|\sigma_b} \left\{ (-\hat{L}_Z \lambda_{LZ}) (\lambda_{KX} + \lambda_{KY}) - (-\hat{L}_Z \lambda_{KZ}) (\lambda_{LX} + \lambda_{LY}) \right\} \\ \text{or, } \hat{P} &= (-) \frac{1}{|\lambda|\sigma_b} \left[\hat{L}_Z \{ \lambda_{KZ} (\lambda_{LX} + \lambda_{LY}) - \lambda_{LZ} (\lambda_{KX} + \lambda_{KY}) \} \right] \\ \text{or, } \hat{P} &= (-) \frac{1}{|\lambda|\sigma_b} \left[\hat{L}_Z \{ \lambda_{KZ} (1 - \lambda_{LZ}) - \lambda_{LZ} (1 - \lambda_{KZ}) \} \right] \\ \text{or, } \hat{P} &= (-) \frac{1}{|\lambda|\sigma_b} \hat{L}_Z (\lambda_{KZ} - \lambda_{LZ}) \quad \text{or, } \hat{P} = (-) \frac{1}{|\lambda|\sigma_b} (\lambda_{KZ} - \lambda_{LZ}) \hat{\alpha} \frac{\alpha}{1-\alpha} \end{aligned}$$

$$\text{Thus } \hat{P} = (-) \frac{1}{|\lambda|\sigma_b} (\lambda_{KZ} - \lambda_{LZ}) d\alpha \quad (11.A)$$

Here it is important to mention that we have assumed zero trading or distribution cost to start with. This is precisely why we get $d\alpha$ in stead of $\hat{\alpha} \frac{\alpha}{1-\alpha}$.

- This proves proposition I.

When trading costs change asymmetrically - there may be two cases: (a) $\hat{\alpha}_X > 0 = \hat{\alpha}_Y$ and (b) $\hat{\alpha}_Y > 0 = \hat{\alpha}_X$. Substituting these conditions in the above equations one can easily arrive at the proposition what we have written in the text.

- Hence proposition II is proved.

Appendix B

The utility function is $U = U(X_D, Y_D)$ (1.B)

Differentiating above equation we get, $d\Omega = dY_D + PdX_D$ (2.B)

$d\Omega$ denotes the change in real income or welfare in Y units.

We also know that the budget constraint is,

$$Y_D + PX_D = w\bar{L} + r\bar{K} = w(\bar{L} - Lz) + r(\bar{K} - Kz) + wLz + rKz$$

$$Y_D + PX_D = (1 - \alpha)(PX + Y) + \alpha[P(X + M) + Y]$$

$$Y_D + PX_D = (PX + Y + \alpha PM) \quad (3.B)$$

$$\text{Therefore, } \frac{d\Omega}{d\alpha} = (-) \frac{dP}{d\alpha} M(1 - \alpha) + \frac{(dY + PdX)}{d\alpha} + \alpha P \frac{dM}{d\alpha} + PM \quad (4.B)$$

Since $M = X_D - X$ and $M = M(\Omega, P)$.

$$\frac{d\Omega}{d\alpha} = (-) \frac{dP}{d\alpha} M(1 - \alpha) + \frac{(dY + PdX)}{d\alpha} + \alpha P \frac{\partial M}{\partial \Omega} \frac{d\Omega}{d\alpha} + \alpha P \frac{\partial M}{\partial P} \frac{dP}{d\alpha} + PM$$

$$\frac{d\Omega}{d\alpha} (1 - \alpha \beta_x) = \left[\frac{dP}{d\alpha} \left\{ -M(1 - \alpha) + \alpha P \frac{\partial M}{\partial P} \right\} + \left(\frac{dY}{d\alpha} + P \frac{dX}{d\alpha} \right) + PM \right]$$

$$\frac{d\Omega}{d\alpha} = \frac{1}{1 - \alpha \beta_x} \left[\frac{dP}{d\alpha} \left\{ -M(1 - \alpha) + \alpha P \frac{\partial M}{\partial P} \right\} + \left(\frac{dY}{d\alpha} + P \frac{dX}{d\alpha} \right) + PM \right] \quad (5.B)$$

$$\text{where, } \beta_x = P \frac{\partial M}{\partial \Omega}.$$

Note that $\frac{\partial M}{\partial P}$ signifies normal substitution effect and β_x is the marginal propensity to import.

We know that $\frac{dP}{d\alpha} < 0$, $\frac{\partial M}{\partial P} < 0$ because of negativity of substitution effect

and $\left(\frac{dY}{d\alpha} + P \frac{dX}{d\alpha} \right)$ is also negative as a rise in trading cost leads to lowering the value of

total production for a given P. However, $(1 - \alpha\beta_x) > 0$ since $0 < \alpha, \beta_x < 1$. Therefore, if α falls, change in welfare would go in favor of a capital-rich nation as substitution effect is very unlikely to offset all other positive effects. Whereas for a labor-rich country welfare implication is ambiguous. It may fall if terms of trade effect is relatively weaker.

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Footnote

1. Trading does not necessarily mean international transportation or trading. In order to make the produced goods available for consumption the same needs to be reached from producers to consumers. At least this domestic, if not international, trading needs some cost which is what we shall focus on in the current paper. Therefore we shall interchangeably use the terms trading cost, domestic trading cost, retailing coast or distribution cost to indicate the cost of transferring goods from producers to consumers.
2. Interested readers may look at Anderson (2000), Anderson and Wincoop (2004), Davis (1998), Trefler (1995), Laussel and Riezman (2008), Bandopadhyay and Roy (2007), Bernard, Jensen and Schoot (2006), Limao and Venables (2001). However, a considerable part of trading cost may be bureaucratic corruption and rent seeking. There are a large number of papers that deal with these issues.
3. This crucially depends on the intensity assumption of the trading activity.
4. Per unit trading of X and Y require both labor and capital. This is because of the nature of trading cost, iceberg type that we assumed here.
5. Here by productive resources we mean labor and capital employed in producing X and Y but not used for the trading services. Z sector’s labor and capital are not unproductive in a finer sense as without this service production of X and Y becomes useless. However, in terms of goods production their marginal productivities are zero though they get some pecuniary benefits. Hence, in tune with Bhagwati (1982) this segment of resources can be considered as Directly Unproductive Profit seeking activities (DUP).
6. Note that this is not the Rybczynski effect. Since available productive resources shrink, PPF moves down.
7. Interested readers may look into Jones, R. W (1965) for more detailed analysis and mathematical calculations.
8. When both L_z and K_z fall the reverse outcome would be there and we need to compare between first round positive effect with second round negative effect. Again when L_z and/or

Kz remain same (X/Y) should increase eventually due to first round positive Rybczynski effect.

9. Initial trading cost may not be necessarily 0. Without losing the essence of the model we can think of any positive value of α_X and α_Y to start with. In that case the value of \hat{P} would be (assume that $\alpha_X = \alpha_Y = \alpha$) $\hat{P} = (-) \frac{1}{|\lambda| \sigma_b} (\lambda_{KZ} - \lambda_{LZ}) \hat{\alpha} \frac{\alpha}{1 - \alpha}$. If we start from zero

trading cost, $\alpha = 0$ and $\hat{\alpha} \frac{\alpha}{1 - \alpha}$ would be $d\alpha$. One can check that this will provide us with the same result.

10. For a constant and given μ from equation (5) we get, $\hat{K}_Z = \hat{L}_Z$.

$$[\alpha_x P(X) + \alpha_y (Y)], L_z(w + \mu r)$$

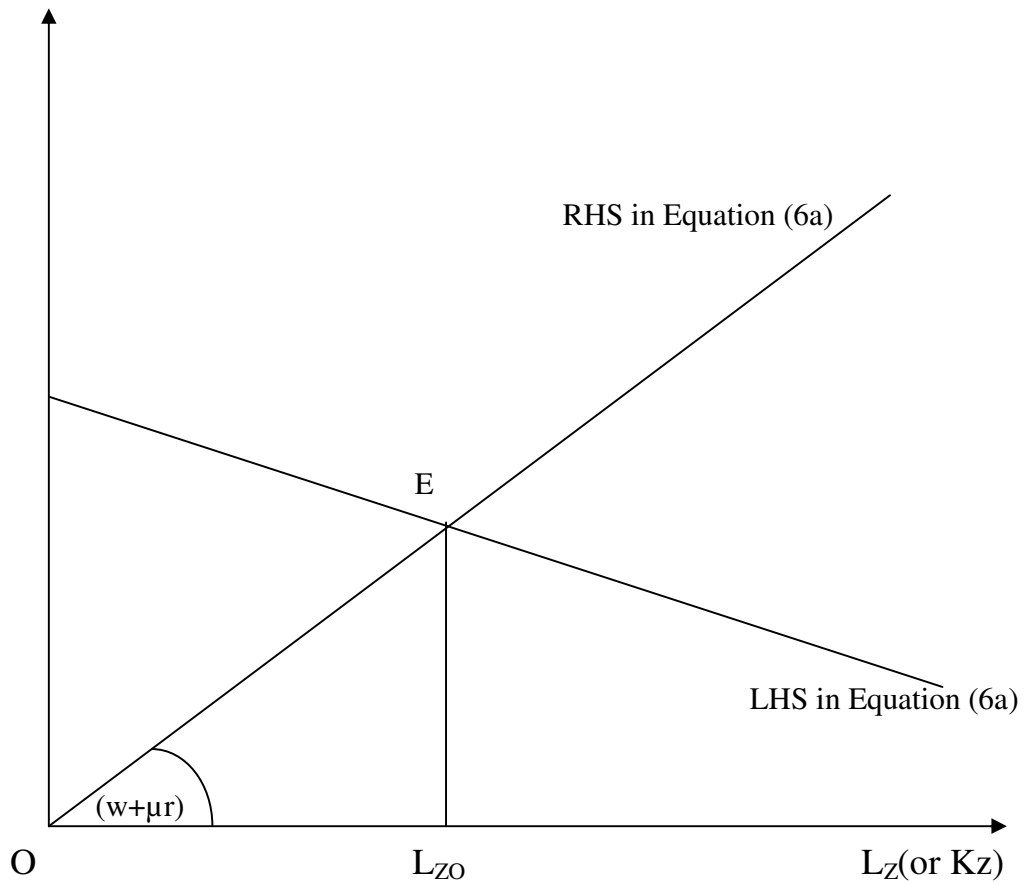


Figure -1

Determination of equilibrium L_z or K_z for given P and Trading costs

$$[\alpha_x P(X) + \alpha_y (Y)], L_Z(w + \mu r)$$

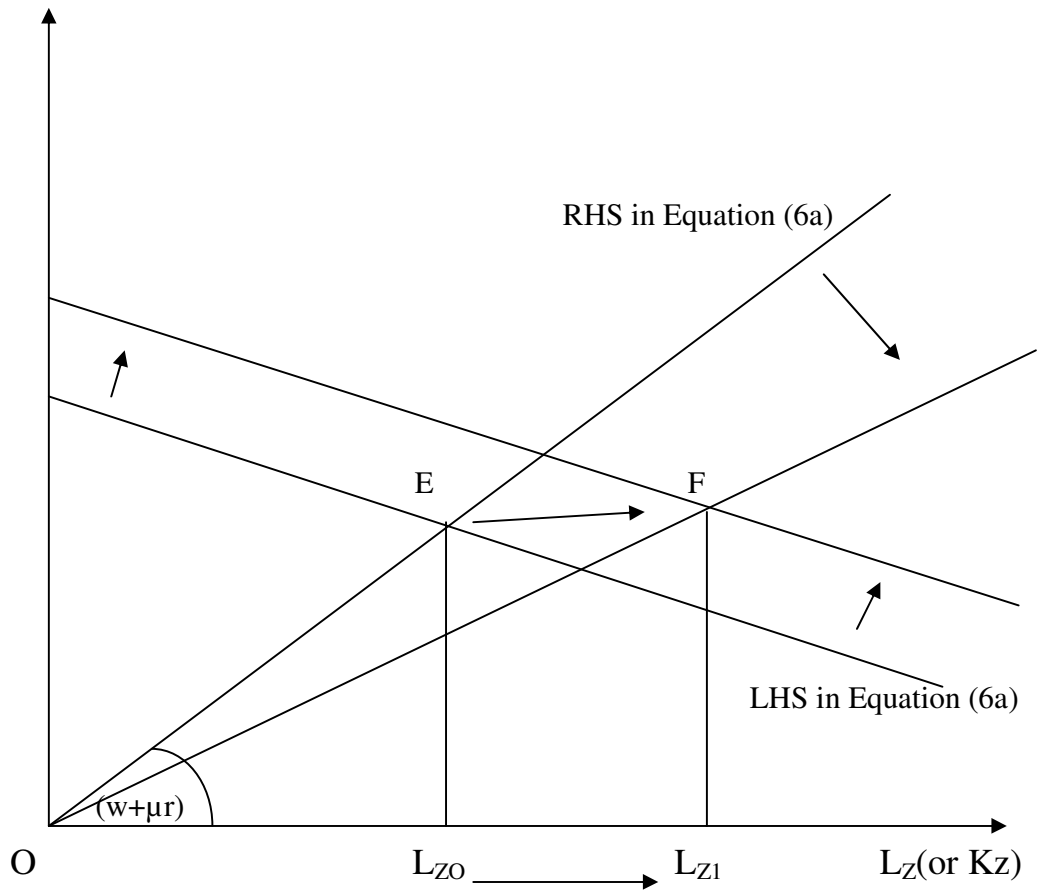


Figure -2

Effect of a change in P on L_z or K_z when Z sector uses relatively more labor

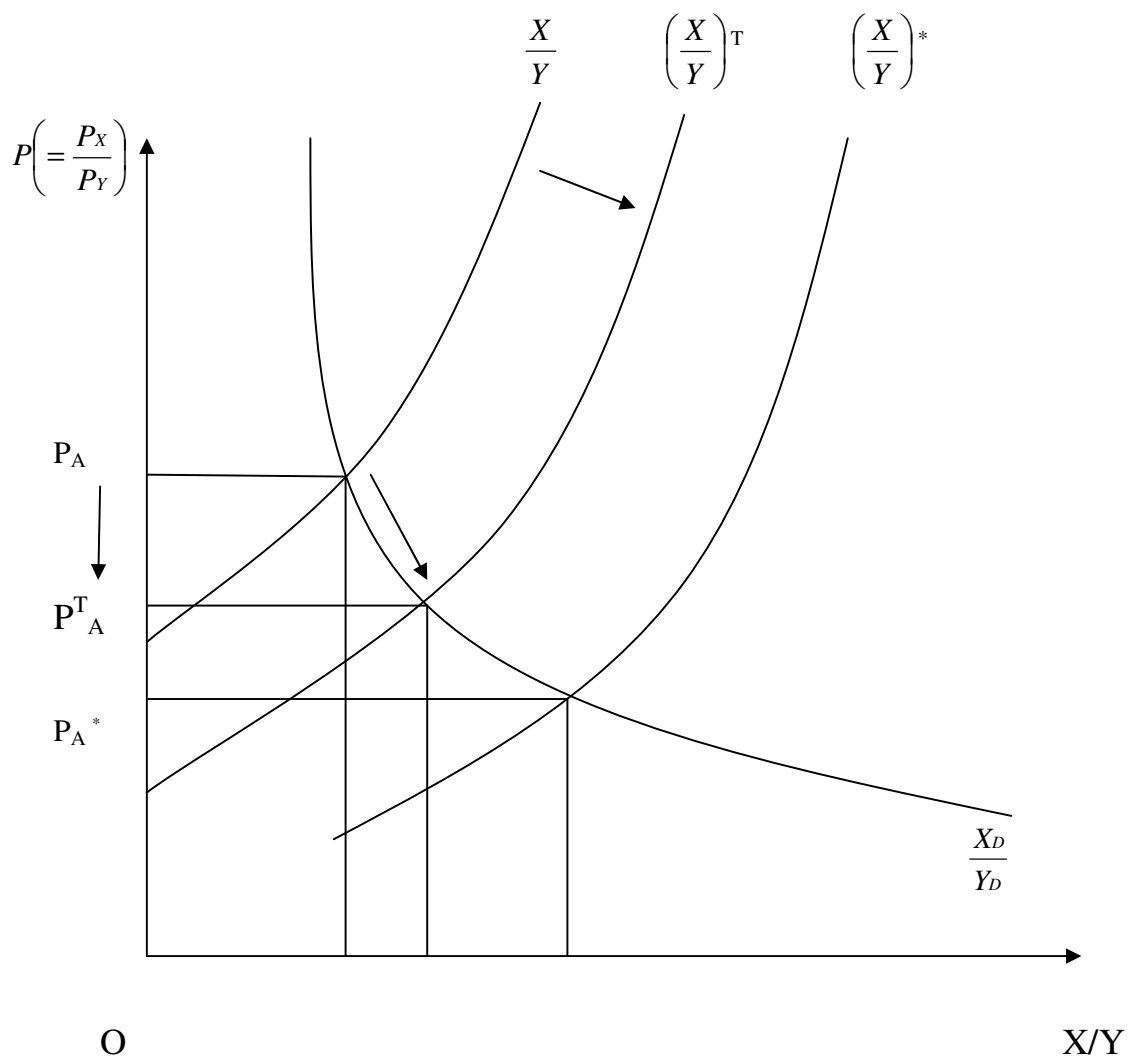


Figure-3

Determination of autarkic equilibrium prices in home and foreign countries and effect of an increase in trading costs at home, labor-rich economy