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ABSTACT

This paper establishes a crucial link between international trade and local organization of production. By using the standard Heckscher-Ohlin-Samuelson model we show that international trade promotes fragmentation, entrepreneurship and outsourcing due to the capital cost effect and the scale effect. We also unveil one source of productivity and formalize a link between trade and productivity. We illustrate that both the scale effect and the flourish of entrepreneurial talent due to capital cost effect contribute to the improvement of productivity. For the import competing sector the productivity effect and the scale effect move against each other. Accordingly, the impacts of international trade on local outsourcing in export sector are different from that in import competing sector. Further, we find that the above findings still hold in a world where the intermediate goods are tradable. In addition, we demonstrate that a higher trading cost involved in trading the intermediate goods encourages fragmentation and local outsourcing.

JEL Classification No: F11, D23, J54, O47

Key words: Trade, Outsourcing, Entrepreneurship, Productivity

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Introduction

The world is increasingly characterized by the expansion of international trade. Previous literatures have shown that international trade has been playing a key role in shaping the international pattern of production, organizational forms and economic development. A new feature is the fast change in the local organization of production. In some developing countries, e.g. China and India, local outsourcing is emerging in the form of the establishment of new local firms serving as the intermediate goods providers for local final good producers.

There is considerable evidence of this new trend. The data from the survey conducted jointly by the World Bank and the Enterprise Survey Organization of China in 2003 shows that the percentage of firms hiring subcontracting firms is 24.8% for a total sample of 2400 firms from in 18 cities in China in 2002. While in the sector of electronic parts making, one of the exporting sectors in China, the percentage of firms hiring subcontracting firms reaches 29.7%. From some recent surveys conducted through fieldwork in India Maiti and Marjit (2007) have found that international trade leads to separation of production and marketing activities. Merchants provide export orders to small fragmented units of production. These merchants are mostly producers of bigger firms which were primarily engaged in production when the markets were mainly local and national. Maiti (2008) finds that firms in formal sectors in India tend to concentrate on marketing while subcontracting production to low-wage informal sectors.

One emerging area of research in this context is the relationship between trade and organization of production. The important question is how international trade alters internal

production organization of a firm. Whether the changes in organization of firms in exporting sectors are different from firms in import competing sectors in these countries? What are the impacts on firms' productivity as a result of change in organizational form? In this paper we address these questions and propose a simple and tractable theoretical model in which firm's local organizational forms are affected by international trade in a systematic way.

International fragmentation of production and service, subsequent outsourcing of such fragmentation, its implications for intra-country income distribution, employment, migration, research and development and regulation have been well documented. Jones & Kierzkowski (2003), Deardoff (2001), Jones and Marjit (2001), Marjit (2007) are the recent studies focusing on the reasons behind fragmentation and its implications for the pattern of trade, specialization, income distribution and development process. Recent papers by Grossman and Helpman (2005) discuss the issue of outsourcing in terms of heterogeneous firms, incomplete contracts and product variety. Helpman (2006) and Antras (2005b) study some of these issues in terms of models with heterogeneous firms, trading costs and incompleteness of contracts based on an earlier analysis of Melitz (2003).

The above literature, however, has not touched on the impacts of international trade on entrepreneurship and local outsourcing which have proliferated in recent years. Our paper tries to fill this void by developing a model to capture this new feature. In this paper we use a standard HOS framework to demonstrate how international trade can affect entrepreneurship and local outsourcing in a typical labor abundant economy. We consider a world in which there is heterogeneity of occupations of entrepreneurs who can either toil as workers in the industry or can set up their own firms. Capital intensive set up costs for new and small business deter entrepreneurship in general even if some workers can be more productive as

entrepreneurs. International trade leads to the declining capital cost, the capital cost effect, and the boost of production of the export goods, the scale effect. As a result, the productivity of firms in the export sector is improved as entrepreneurial talent flourishes, which we call the productivity effect. The local organizational forms will be changed accordingly. For the import competing sector the productivity effect and the scale effect will move against each other. Accordingly, the impacts of international trade on local outsourcing in export sector are different from that in import competing sector.

Such separation and specialization of activities have been modeled in a partial equilibrium framework in Maiti and Marjit (2008). This paper is a general equilibrium construct and adopts a completely different mechanism by focusing directly on cost of capital and scale of production.

In a related paper, Jones and Marjit (2001) illustrate the role of fragmentation in development process by noting the fact that more liberal and open regimes are resisted by "older" generations because they control the source of capital and education. Vertically integrated processes require lumpy capital and "younger" generations can thrive better in world, which allows fragmentation and trade in fragments lowering the requirement of capital. In contrast, we take a direct route by which more trade reduces cost of capital in a labor abundant economy instead of comparing older and younger generations.

This paper is also related to Jones and Marjit (2008), which provide cases where trade may lead to greater number of activities relative to autarky even if one observes specialization. In this paper greater orientation towards export business will lead to diversified fresh activities hitherto contained in the vertically integrated production process of the export industry. Typically such an outcome will reflect productivity growth of some

kind and a regime switch affecting the relationship between commodity prices and factor returns. The relationship between our paper and the one popularly discussed in the literature is that we focus on heterogeneity of occupations of workers who can either toil as workers within in the industry or can set up their own firms. In a way trade creates an environment where entrepreneurial talent flourishes. Even if one abstracts from heterogeneity of firms, moral hazard or adverse selection type problems consistent with contractual complexities, the standard workhouse of trade theory is capable enough to address this issue.

Our analysis is also related to the study on incomplete contracts and trade structure by Antras (2003) based on the previous work by Grossman and Hart (1986). Antras (2003) illustrates how incomplete contracts and firm's organizations can affect the pattern of international trade. He describes a world in which incomplete contracts occur when the production process involves noncontractible inputs while transferability of capital investment is allowed. Investment sharing reduces the holdup problem faced by suppliers. While capital cost sharing is large enough, which naturally is the case in capital-intensive processes, the residual rights of control and ownership should be assigned to the final-good producers. As a result, the attractiveness of vertical integration and the probability of intrafirm trade in increasing in capital-intensity of the industry. However, our analysis differs in that we focus on the how the pattern of international trade alters firms organizations. We address this issue by analyzing the scale effect and productivity effect from the international trade.

The paper's analysis has four primary contributions. First, we focus on local organization instead of international organization. We show that local outsourcing boosts in export sector as entrepreneurial talent flourishes. Thus, we find that outsourcing does not only have an international dimension, but also an important local dimension. Second, we

expose traditional trade models to new issues. While heterogeneity of firms within an industry opens up huge reservoir of possibilities where different firms choose different modes of operations, even within the ambit of the Hecksher-Ohlin-Samuelson type set up the export sector can be a natural domain for outsourcing related activities. Third, it has been widely recognized that firms' productivity play an important role in shaping international trade and fragmentation. In this paper we unveil one source of productivity and formalize a crucial link between trade and productivity. We illustrate that both the scale effect due to boost of production of the export goods and the flourish of entrepreneurial talent due to the declining capital cost contribute to the improvement of productivity.

The rest of our paper is organized as follows. In section 2 we present a basic model and analyze the equilibrium outcomes. In section 3 we demonstrate the effect of trade on fragmentation and outsourcing and analyses the 'productivity' impact. We further examine how the equilibrium results with tradable intermediate goods in section 4. We offer concluding remarks in the final section.

2. The Basic Setup

It is a standard 2×2 HOS framework with X being the output of the export good and Y that of the import-competing good. Each sector uses a different intermediate good, which uses only labor and used in fixed proportions with labor and capital. We first analyze the scenario where the intermediate goods are non-tradable. We will relax this assumption later.

The competitive price-equations are given by

$$wa_{lx} + ra_{kx} + P_{m_1} = P_x \quad (1)$$

$$\mathrm{wa_{ly}} + ra_{ky} + P_{m_2} = P_y(1+\mathrm{t}) \quad (2)$$

$$\mathrm{P_{m_1}} = a_{mx}w \quad (3)$$

$$\mathrm{P_{m_2}} = a_{my}w \quad (4)$$

$$\mathrm{X = M_1} \quad (5)$$

$$\mathrm{Y = M_2} \quad (6)$$

We assume one unit of intermediate good is required to produce one unit of final good. While K and L are substitutes in the usual neo-classical sense, $\mathrm{M_1}$ and $\mathrm{M_2}$ are not substitutes and required in fixed proportions. Intermediates $\mathrm{M_1}$ and $\mathrm{M_2}$ are used in the vertically integrated process with some labor devoted to the production of those within the firm. t is the tariff rate.

The full employment conditions are given by

$$\mathrm{a_{lx}X + a_{ly}Y + a_{mx}X + a_{my}Y = L} \quad (7)$$

$$\mathrm{a_{kx}X + a_{ky}Y = K} \quad (8)$$

(L, K) are given endowments of labor and capital. We have a small open economy, where production technology follows CRS and diminishing marginal productivity. It exports good X and imports good Y, X is labor intensive and Y is capital intensive. Since we shall work with a fixed set of prices, let's set $\mathrm{P_X = P_y = 1}$. Therefore given (t, K, L) we can find out w, r, X and Y. These in turn determine $\mathrm{P_{m1}, P_{m2}, M_1}$ and $\mathrm{M_2}$.

Some of the workers who produce $\mathrm{M_1}$ and $\mathrm{M_2}$ also have entrepreneurial qualities. If they produce it on their own, they can produce with a better technology, such that $\mathrm{b_{mx} < a_{mx}}$ and $\mathrm{b_{my} < a_{my}}$. We assume that n such workers can get together, incur a fixed

cost of k and thus the total cost of obtaining such inputs from outside are $wb_{mx}X + rk$ and $wb_{my}Y + rk$, respectively. Therefore firms producing X and Y will like a vertically integrated process iff the following holds:

$$wa_{mx} \leq wb_{mx} + \frac{rk}{X} \qquad (9)$$

$$wa_{my} \leq wb_{my} + \frac{rk}{Y} \qquad (10)$$

Market structure in the intermediate industry follows "contestability". Positive profits are competed away by free entry and exit assumption. Thus P_{m_1}, P_{m_2} to be charged by the outside entrepreneurs are given by the RHS in (9) and (10). Thus n worker-entrepreneurs get together and build up such a firm. Another assumption is that $n > \mathbf{max}(b_{mx}X, b_{my}Y)$. This implies that a part of the labor effort goes towards pure entrepreneurial supervision.

Rewriting (9) and (10) we get,

$$\frac{w}{r}(a_{mx} - b_{mx}) \leq \frac{k}{X} \qquad (11)$$

$$\frac{w}{r}(a_{my} - b_{my}) \leq \frac{k}{Y} \qquad (12)$$

Note that $\frac{w}{r}$, X and Y all are impacted by t.

For notational simplicity let us denote $(a_{mx} - b_{mx})$ as d_x and $(a_{my} - b_{my})$ as d_y.

$$\frac{w}{r}(t) \leq \frac{k}{d_x.X(t)} \qquad (13)$$

$$\frac{w}{r}(t) \leq \frac{k}{d_y.Y(t)} \qquad (14)$$

If we look at the incentive constraints (13) and (14) more closely, one can easily check that liberal trade policies are likely to generate local outsourcing in "both" sectors.

While they unambiguously do it for the export sector, it is likely that they would do it for the import-competing sector as well.

Rewriting (13) and (14) as $(13)'$, $(14)'$

$$w(t) \geq \frac{r}{X}(t).dx \qquad (13)'$$

$$w(t) \geq \frac{r}{X}(t).dy \qquad (14)'$$

$(13)'$ and $(14)'$ have to hold for outsourcing to be a viable propositions. We now use the standard Stolper-Samuelson and price-output response in HOS framework to draw the figures 1-5.

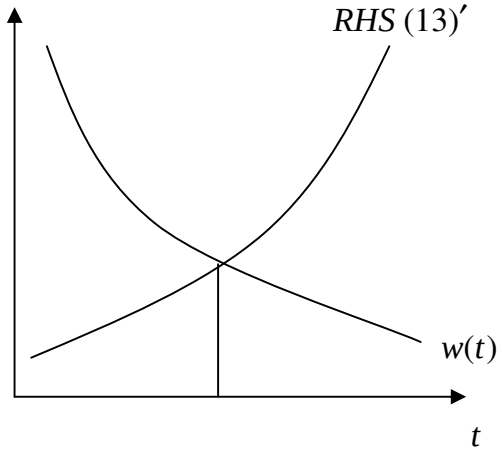

Figure – 1

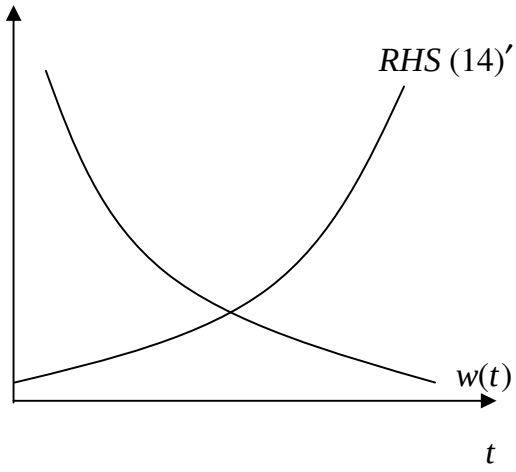

Figure - 2

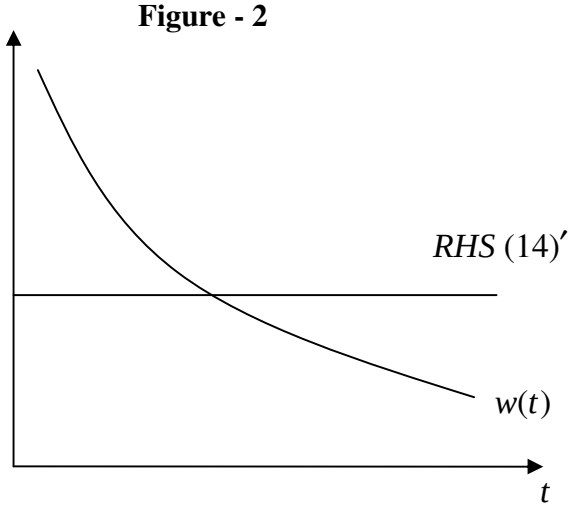

Figure – 3

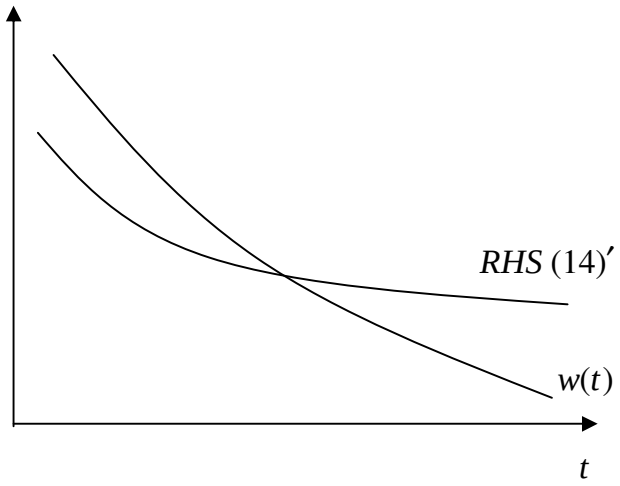

Figure – 4

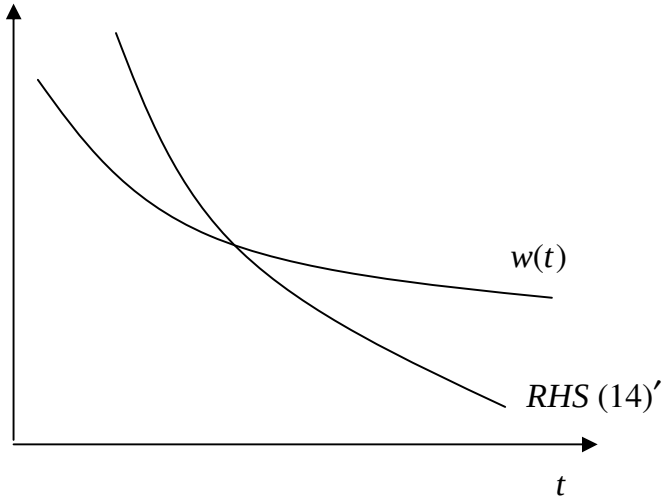

Figure – 5

Figure 3 shows that for low enough tariffs export sector will always go for outsourcing. This is the same as figure 1. Note that as t increases r and Y both increase. Out of four possible cases if $\frac{r}{Y}$ does not decline too fast, outsourcing will be opted by the import-competing producers where tariffs are relatively low. Thus for lower tariff both sectors will go for local outsourcing. We are now ready to propose the following:

<u>Proposition I</u>: **A low enough tariff will lead to fragmentation and local outsourcing in the export sector. If a decline in tariff does not sharply reduce Y relative to r, lower tariff will also encourage fragmentation and outsourcing in the import-competing sector**.

Proof: See the discussion above.

As tariff goes down cost of capital falls in a labor-abundant country and the export-volume increases. Both are conducive for entrepreneurship to flourish. Workers in spite of being more productive as entrepreneurs ($dx > 0$) cannot open their own business because capital is costly. Thus greater trade leads to outsourcing in the export sector.

For the import-competing sector same thing may not happen when t goes up as cost of capital and volume of Y both rise at the same time reflecting nothing on the net incentive for outsourcing in the sector. However as we have shown as long as $\frac{r}{Y}(t)$ does not fall too rapidly, the possibility of outsourcing in this sector seems to be greater with a liberal trade policies. Thus local outsourcing is encouraged by lower tariff in this sector as well.

3. Equilibrium with Fragmentation and Outsourcing in the Export Sector

Once tariff clears a critical level fragmentation and local outsourcing become possible and there is a regime shift in the way production is locally organized. Therefore, one needs to solve for the new equilibrium values. We assume that such a switch occurs only in the export sector and specify the equilibrium conditions accordingly. We discuss existence of such equilibrium in detail in the appendix.

The new general equilibrium configuration is as follows:

$$wa_{lx} + ra_{kx} + wb_{mx} + \frac{rk}{X(t)} = 1 \qquad (15)$$

$$wa_{ly} + ra_{ky} + wa_{my} = 1 + t \qquad (16)$$

$$a_{lx}X + a_{ly}Y + n = \overline{L} \qquad (17)$$

$$a_{kx}X + a_{ky}Y + k = \overline{K} \qquad (18)$$

$$X = M_1 \qquad (19)$$

$$Y = M_2 \qquad (20)$$

n workers gather together and use k as the business set-up cost and supply the intermediate input from outside. As part of labor goes towards pure entrepreneurial activities beyond production related work, we have $n > b_{mx}X$. Given (t, w, k, $\overline{L}$, $\overline{K}$) we determine w, r, X, Y, M_1 and M_2 from (15) - (20).

For each X (t) we can derive another through this process by a function defined as $\phi(X(t))$. The solution process implies whether there is a fixed point of the form

$$X(t) = \phi(X(t)) \qquad (21)$$

As X(t) increases $\frac{w}{r}$ must increase as X is labor-intensive. This is through productivity effect in (15). This should imply an increase in X(t) from (17) and (18). These are all standard HOS outcomes. Thus $\phi'(X(t)) > 0$. Existence and uniqueness of X (t) are assumed. We are more interested in the consequence of such an outcome on X (t) and factor returns. The formal proofs will be worked out later (See the Appendix).

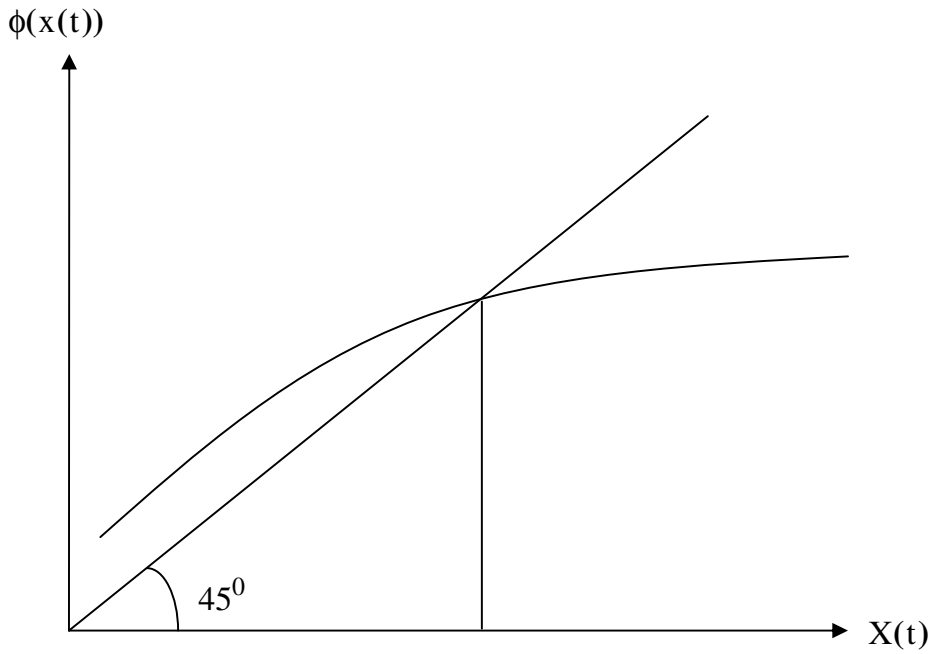

Figure – 6

Note that as long as the tariff is not reduced substantially such fragmentation and outsourcing will not take place. However, once tariff reaches the critical threshold the process will be activated. Two points we need to highlight here.

First, there will be a 'finite' change in the process reflecting a jump as workers shift themselves from inside to outside factory. Second, this will have a positive productivity impact for the X sector. Thus trade will have a distinct productivity impact. Such a growth in productivity will affect factor returns immediately. As figure-3 suggests as soon as t is

lowered beyond a critical level, $\frac{w}{r}$ jumps up and then again follows a monotonically

$\frac{w}{r}(t)$

increasing trajectory.

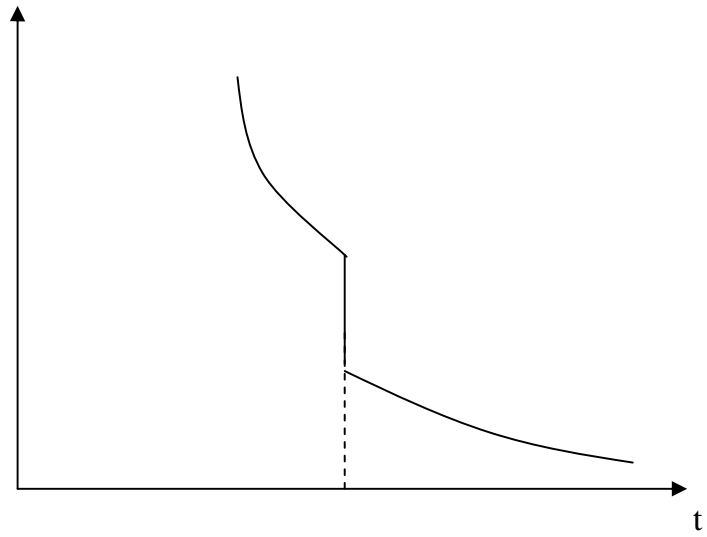

Figure – 7

It is also expected that $\frac{w}{r}$ will increase at a sharper rate beyond the critical point as labor-intensities decline and capital-intensities increase for sector X. Thus the Stolper-Samuelson type outcome gets a further boost.

Once the average cost of obtaining the intermediate input is directly related to the tariff rate, a decline in tariff also means a decline in effective cost of production for the export good. This is just like a productivity effect which will increase the wage rate.

<u>Proposition II</u>: Liberal trade regime will reduce the cost of locally outsourced input and enhance productivity of labor-abundant country.

Proof: See the discussion above.

One issue that needs to be addressed is the transition from the state of no-outsourcing to outsourcing. As we have demonstrated the post-outsourcing equilibrium will throw up some w and r, call them w_2 and r_2. We also know that for outsourcing to be profitable we must have

$$w_1 a_{mx} \geq w_2 b_{mx} + \frac{r_2 k}{X(t)} \qquad (22)$$

Suppose $(w_2, r_2, X(t))$ are such that strict equality holds for (22). Then there should not be any productivity effect of outsourcing. In the new equilibrium w and r will remain the same. With strict inequality w will increase and r will fall and the workers have incentive to set up their own business. An element of bargaining may be latent here if entrepreneurs form a syndicate and bargain for the reservation price of the intermediate in case there is no outsourcing. In our structure $n > b_{mx} X$ implying part of the labor effort goes towards specific entrepreneurial activities. The extent of such labor is given by $(n - b_{mx} X)$, net of labor used for production. A decline in n will reflect improvement in entrepreneurial talent. This has usual general equilibrium implications. A fall in n will, via Rybczynski effect, increase output of X and reduce that of Y. Again this will have productivity effect acting through $\frac{rk}{X(t)}$ and raising w and reducing r via Stolper-Samuelson outcome.

Two issues need to be highlighted here:

First, in case the intermediate input is a traded input, fragmentation and outsourcing do not provide any extra benefit to the sector producing X except that some productive entrepreneur-workers locate themselves out of the industry. Further decline in t will increase wage via Stolper-Sameulson effect, but will not confer any additional productivity benefit. The fact that the price of the intermediate can fall, provides the extra productivity boost. *Second,* we have assumed that in the post-outsourcing the input is available at the average cost. But that may not be the case. The equilibrium price may be a contracted price. But such a price must be a positive function of the average cost and to that extent a rise in X will reduce the price of the intermediate input.

4. Equilibrium with Tradable Intermediate Goods

In previous sections we have demonstrated that liberal trade regime promotes fragmentation and local outsourcing and enhances productivity in the export sector of labor-abundant country under the assumption that intermediate goods are non-tradable and the return to the entrepreneurs is the same as wage rate employed as a worker. However, in the real world it is possible that the intermediate goods are tradable and the return to the special class of entrepreneurs is different from wage rate. To capture these features, we now next turn to an analysis how firms' local organization form and the return to entrepreneurs can be changed when the intermediate goods are tradable.

When the intermediate goods are tradable, the local intermediate goods producer has an outside option of exporting the intermediate goods to the rest of the world while the final

goods producer has an outside option of purchasing the intermediate goods from the rest of the world. Let p_W denote the world price of the intermediate goods and T the trading cost occurred when firms import or export intermediate goods.[1] To simplify the analysis we assume that trading cost involved in import is the same as the trading cost involved in export, which implies that the intermediate goods producer receives $p_W - T$ if he exports its products to the rest of the world, while the final goods producer pays $p_W + T$ if he buys the intermediate goods from the rest of the world. As the equilibrium results for $T = 0$ and $T > 0$ are different, we discuss these two cases separately.

4.1 $T = 0$

We begin by analyzing the case when $T = 0$. If $T = 0$, the entrepreneurs will establish a new firm producing the intermediate good producer if $wb_{mx} + \frac{rk}{X} < p_W$. The final good producer pays p_M for the intermediate good no matter purchasing it from the local producer or from the rest of the world. In this case international trade leads to the declining of capital cost, the capital cost effect, and the boost of production of the export goods, the scale effect. However, the production cost of the final good producer does not change and the benefit from the improvement in productivity in producing the intermediate good all accrues to the intermediate good producer. As a result, there is no productivity effect for the final good producer.

4.2 $T > 0$

Now consider the case when $T > 0$. We first analyze the scenario where the local firm's marginal cost is lower than his net payoff from selling the intermediate goods to the rest of

[1] We assume $p_M < wa_{mx}$.

the world ($wb_{mx} + \frac{rk}{X} < p_M - T$).[2] In this event the final good producer pays $p_W + T$ if he buys the intermediate goods from the rest of the world while the intermediate good producer receives $p_W - T$ if he exports its products to the rest of the world. The difference between the payment of the final good producer and the payoff intermediate good producer receives leads to the benefit of domestic transactions ($2T$), which the final goods producer and the intermediate goods producer bargain over. Let β and $1-\beta$ denote the bargaining power of the intermediate good producer and final good producer respectively. Let P_D denote the price the final good producer pays to the local intermediate good producer. Hence, we have $P_D = P_W + (2\beta - 1)T$.

One consideration for the entrepreneurs is that the return to them as entrepreneurs by establishing a new firm should be no less than the wage rate which is the return to them as an employee. This implies

$$\frac{P_D X - (wb_{mx} + \frac{rk}{X})X}{n - b_{mx}X} \geq w \qquad (23)$$

Solving yields

$$\frac{[P_W + (2\beta - 1)T]X - rk}{n} \geq w \qquad (24)$$

As noted above, w, r and X are function of import tariff rate t. Therefore, equation (24) can be rewritten as

[2] From $p_M < wa_{mx}$ and $wb_{mx} + \frac{rk}{X} < p_M - T$, we can infer that $wb_{mx} + \frac{rk}{X} < wa_{mx}$.

$$\frac{[P_W + (2\beta - 1)T]X(t) - r(t)k}{n} \geq w(t) \qquad (24)'$$

From previous discussion we can infer that both the left-hand-side and right-hand-side of (24)' increase with the tariff rate t. Therefore there are two cases showed in Figure - 8 and Figure-9. Hence establishing a new firm will be opted by the entrepreneurs if tariffs are relatively low. It also follows that a higher trading cost involved in international trade in the intermediate goods also promotes local outsourcing.

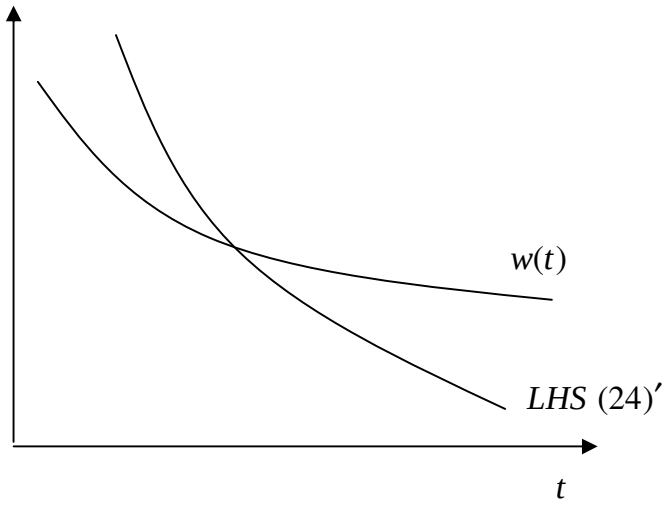

Figure – 8

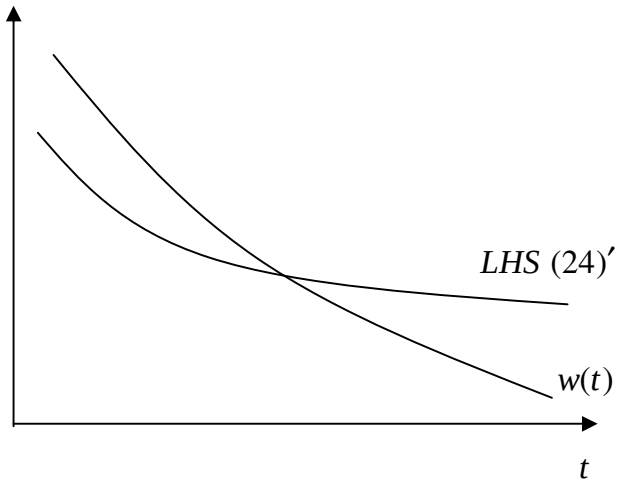

Figure – 9

We next discuss the scenario where the local firm's marginal cost is higher than his net payoff from selling the intermediate goods to the rest of the world but lower than the price the final good producer pays to the rest of the world ($p_M - T < wb_{mx} + \frac{rk}{X} < p_M + T$). In this event we have $P_D = \beta(P_W + T) + (1-\beta)(wb_{mx} + \frac{rk}{X})$. It follows that the return to entrepreneurs is greater than wage rate if the following condition holds.

$$\frac{[\beta(P_W + T) + (1-\beta)wb_{mx}]X(t) - \beta r(t)k}{n} \geq w(t) \quad (25)$$

The analysis is similar to the case where $wb_{mx} + \frac{rk}{X} < p_M - T$. The above results can be summarized as follows.

Lemma 1. In a world where intermediate goods are tradable, Proposition 1 still holds. A low enough tariff will promote fragmentation and local outsourcing in the export sector.

Lemma 2. A higher trading cost involved in international trade in the intermediate goods also encourages fragmentation and local outsourcing.

5. Concluding Remarks

Contemporary research in theory of international trade puts a lot of emphasis on the interaction between international trade and organization of production such as fragmentation and outsourcing. While heterogeneity of firms within an industry opens up huge reservoir of possibilities where different firms choose different modes of operations, even within the ambit of the Hecksher-Ohlin-Samuelson type set up the export sector can be a natural domain for outsourcing related activities. We focus on indigenous outsourcing and entrepreneurship and formalize the crucial link between trade and productivity.

One promising avenue for future research is to extend the analysis to examine simultaneous outsourcing in export and import competing sector. Contractual complexities are also important. To outsource activities one needs to think of monitoring and provision of optimal contracts depending on the informational problem. Such work is becoming popular in trade theory, but not in terms of the standard text book model of trade. Such issues are discussed at length in Helpman (2006) in models of product differentiation and heterogeneity of firms. But similar scopes are available in the more conventional models of trade theory. This is the key point of the paper.

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Appendix

Existence of an Outsourcing Equilibrium in the export sector

Let the initial no-outsourcing situation generates ($w_o, r_o, X_{o,} Y_o$) as equilibrium outcomes. The new equilibrium with outsourcing is represented by (w, r, X, Y).

Equation (15) - (21) determine the equilibrium and (22) must hold (with w_1 replaced by w_0 and w_2 replaced by w and r_2 by r). Let us define

$$wb_{mx} + \frac{rk}{x} = P_{mx}$$

Outsourcing, as argued in the paper, is caused by a decline in t, with n and k jumping from an initial value of zero to some positive number. The new equilibrium must be such that (22) holds with strict inequality.

The proof of existence proceeds as follows.

Step I. Find the effect of n > 0, k > 0 and a declining t on X and the condition that

$$\hat{x} > 0. [\hat{x} \equiv \frac{dx}{x}]$$

Step II. Find out the effect on P_{mx} and the condition that $\hat{P}_{mx} < 0.$

Working with (15) – (21) and using Jones (1965) it is easy to check that

$$\hat{X} = \frac{(\hat{w} - \hat{r})\delta_x}{|\lambda|} - \frac{\lambda_{L3}\lambda_{Ky}}{|\lambda|}.\hat{n} + \frac{\lambda_{K3}\lambda_{Ly}}{|\lambda|} \qquad (1A)$$

where $\delta_x = (\lambda_{Lx}\alpha\sigma_x\theta_{Kx} + \lambda_{Ly}\sigma_y\theta_{Ky})$

where $\lambda_s, \sigma_s, \theta_s$ have usual interpretation. σ_x is adjusted by α to reflect the fact that M is used in fixed proportions with labor and capital in X. λ_{L3} is share of n in total L and λ_{K3} is share of k in total K.

Solving for $(\hat{w} - \hat{r})$ from (15) and (16) we get

$$\hat{X} = \frac{\delta_x\theta_K\hat{X}}{|\theta||\lambda|} - \frac{\hat{T}}{|\theta||\lambda|} - \hat{n}.\frac{\lambda_{L3}\lambda_{Ky}}{|\lambda|} + \hat{k}\frac{\lambda_{K3}\lambda_{Ly}}{|\lambda|} \qquad (2A)$$

where $\hat{T} = (1 + t)^{\wedge}$

Note that $|\theta > 0|$, $|\lambda| > 0$ as X is labor intensive. (2A) captures the following.

(a) The first term is nothing but formal representatives of (21). For stability $1 - \frac{\delta_x\theta_K}{|\theta|\lambda||} < 1$. The fixed point is derived on the transformed space $\hat{X}$ rather than on X. θ_K is share of capital in the unit cost of the intermediate.

(b) $\hat{T} < 0$ implies $(\hat{w} - \hat{r}) > 0$, as well as $\hat{X} > 0$.

(c) $\hat{n} > 0$ and $\hat{k} > 0$ have opposite effects on $\hat{X}$.

(d) If λ_{L3} and λ_{K3} are negligible i.e. n and k are small relative to total K and L, we have

$$\hat{X} = -\frac{\hat{T}}{|\theta||\lambda|}\left[\frac{1}{1-\frac{\delta_x \theta_K}{|\theta||\lambda|}}\right] \qquad (3A)$$

As t goes down, even if workers leave the export sector to become entrepreneurs and capital is released from production for setting up the business, X will rise in equilibrium. From (3A) we can stipulate that following is a set of sufficient conditions under which $\hat{X} > 0$.

(i) $\lambda_{L3} \cong 0, \qquad \lambda_{K3} \cong 0$

(ii) $1 > \delta_x . \frac{\theta_k}{|\theta|\lambda||}$

Along with (i) and (ii) we must have (iii)

(iii) $\lim_{t\to 0}\left[w(t)b_{mx} + \frac{r}{X}(t)k_x \right] < \lim_{t\to 0} w(t)a_{mx}$

(iii) guarantees that $\exists$ t s.t $w(t) > \frac{r}{X}(t).\frac{k}{dx}$