https://doi.org/10.1016/j.iref.2018.10.014

Productivity Enhancing Trade through Local Fragmentation

Sugata Marjit [a,b], Xinpeng Xu [c], Lei Yang [c,*]

[a] *Centre for Studies in Social Sciences, India*
[b] *GEP, Nottingham*
[c] *The Hong Kong Polytechnic University, Hong Kong*

October 2018

ABSTACT

Mechanisms linking trade and productivity are rarely discussed in well accepted trade-theoretic literature although such a link is critical especially for understanding how trade helps developing countries. We restructure the standard neo-classical model of trade to provide a clear mechanism that leads to productivity enhancement in the export sector. As trade in labor-abundant countries reduces the real return to capital due to Stolper-Samuelson hypothesis, entrepreneurs find it easier to establish new businesses as capital costs decline. A section of workers becomes entrepreneurs producing and supplying cheaper intermediate goods to the export sector. Expanding export sector helps such a process, whereas contracting import-competing sector does not. New entrepreneurs boost the productivity of the export sector by supplying low-cost input. Here a boost in entrepreneurship induced by a decline in capital cost increases productivity of the export sector. Thus, this paper establishes a different and novel link between trade and productivity.

JEL Classification: F11, D23, J54, O47

Key words: Trade Liberalization, Vertical Separation, Entrepreneurship, Productivity.

1. Introduction

The world is increasingly characterized by the expansion of international trade, which the literature shows to play a key role in shaping international patterns of production, organizational forms, and economic development (see, e.g., Melitz 2003; Helpman, Melitz, and Yeaple 2004; Antras and Helpman 2004). Helpman (2006) and Antras (2005) investigate some of the related issues using models with heterogeneous firms, trading costs, and contract incompleteness based on earlier analysis by Melitz (2003). Jones and Kierzkowski (2003), Deardoff (2001), Jones and Marjit (2001), and Marjit (2007), among others, focus on the reasons for production fragmentation and its implications for trade patterns, specialization, income distribution, and the development process.

Although the way in which firms respond to trade liberalization has produced a fascinating body of research in the past few years, little attention has been paid to the effects of such liberalization on costs of setting up of new business, entrepreneurship and the vertical relations of local firms and whether it can enhance firm productivity, particularly in labor-abundant developing countries. Evidence has emerged to show that firms in developing countries indeed respond to trade liberalization by reorganizing their internal organization of production. A survey conducted jointly by the World Bank and the Enterprise Survey Organization of China in 18 Chinese cities in 2003 found that 24.8% of the 2400 firms surveyed hired subcontracting firms in 2002. In the

electronics sector, one of the country's most important export sectors, the percentage rose to 29.7%. Maiti and Mukherjee (2013) report that a reduction in trade costs boosts a domestic firm's formal production and employment, but reduces its informal production. Maiti (2008) finds that firms in the formal sectors of India tend to concentrate on marketing and subcontract production to low-wage informal sectors. Marjit and Kar (2011) elaborates how liberal trade policies affect division of production between formal and informal sectors when capital is imperfectly mobile. It is clear that in some developing countries, China and India in particular, vertical separation is emerging, with newly established local firms serving as intermediate goods providers for local final goods producers. Recently Beladi, Dutta and Kar (2016) provides empirical evidence how FDI allows fragmentation of production processes between formal and informal entrepreneurs.

In this paper, we address two main questions: (1) How does international trade shape entrepreneurship and the vertical relations of firms in developing countries? (2) What are the effects on firm productivity of changes in organizational forms? We use the standard Heckscher-Ohlin-Samuelson (HOS) framework to demonstrate how international trade affects entrepreneurship, vertical relations, and firm productivity in a typical labor-abundant economy. We consider a setting in which there is heterogeneity in the occupations of entrepreneurs who can either toil as workers in a given industry

or set up their own firms. Capital-intensive setup costs for new and small businesses generally deter entrepreneurship even if some workers would be more productive as entrepreneurs. International trade leads to a decline in capital costs (the capital cost effect) and a rise in the production of export goods (the scale effect). In response to declining such costs and a larger scale of production, some workers become entrepreneurs, and vertical separation emerges. As a result, the productivity of firms in the export sector improves and entrepreneurial talent flourishes (the productivity effect). In the import-competing sector, the productivity effect and scale effect move against each other. Accordingly, international trade's effects on vertical separation in the export sector differ from those in the import-competing sector.

These findings are based on the assumption that potential entrepreneurs do not have credit constraints to set up a new firm and intermediate goods are non-tradable. As credit constraints are even more acute for potential entrepreneurs in developing countries with less developed financial markets, we also extend our analysis to the case of worker-entrepreneurs facing credit constraints, and find the addition of credit constraints to leave our basic insights unchanged. [1] Interestingly, our model suggests that trade liberalization can act as a substitute for financial market development. The

[1] See Liu et al. (2017), Zhang et al. (2018) and Wojnilower (2018).

aforementioned finding also relies on the assumption that intermediate goods are non-tradable. We further extend our analysis to the case of tradable intermediate goods, and find that the above-cited findings still hold. We also demonstrate that the higher trading costs involved in the trade of intermediate goods encourage both entrepreneurship and vertical separation.

This paper is related to those of Jones and Marjit (2001, 2009). In Jones and Marjit (2001), the authors illustrate the role of fragmentation in the development process by noting the resistance to more liberal and open regimes by the older generation that controls sources of capital and education. Vertically integrated processes require lumpy capital and the ability of the younger generation to thrive in the world market, which allows fragmentation, and trade in fragments lowers capital requirements. In this paper, in contrast, we take a more direct route, whereby more trade reduces the cost of capital in a labor-abundant economy, instead of comparing the older and younger generations. Jones and Marjit (2009) demonstrate that, relative to autarky, trade may lead to a greater number of activities even in the presence of specialization. A greater orientation toward export business leads to diversified fresh activities hitherto contained in the export industry's vertically integrated production process. Such an outcome reflects productivity growth of some kind, as well as a regime switch that affects the relationship between commodity prices and factor returns. In this paper, we

focus on heterogeneity in the occupations of workers who can either toil as workers within an industry or establish their own firms. In this way, trade creates an environment in which entrepreneurial talent flourishes. Even if one abstracts from firm heterogeneity, moral hazard, or adverse selection-type problems consistent with contractual complexities, the standard workhouse of trade theory is capable of addressing the issues involved.

Our analysis is associated with Antras's (2003) study of incomplete contracts and trade structures, which is based on earlier work by Grossman and Hart (1986). Antras (2003) shows how incomplete contracts and a firm's organization can affect the international trade pattern. He describes a world in which such contracts occur when the production process involves non-contractible inputs and the transferability of capital investment is allowed. Investment sharing reduces the holdup problem faced by suppliers. When the degree of capital cost sharing is sufficiently high, which is naturally the case in capital-intensive processes, the residual rights of control and ownership are assigned to final goods producers. As a result, the attractiveness of vertical integration and the probability of intra-firm trade both increase with the capital intensity of the industry. Our analysis here differs in that we focus on how the international trade pattern shapes the organization of local firms by affecting entrepreneurship. We address this issue by analyzing the scale effect and productivity effect of international trade.

This paper also builds on the body of literature concerned with the effects of trade liberalization and offshoring. For example, Mitra and Ranjan (2010) demonstrate that offshoring has a productivity-enhancing (cost-reducing) effect that can lead to wage increases and sectoral unemployment decreases when labor is perfectly mobile intersectorally. Liu and Mukherjee (2013) show the wage effects of trade liberalization on final and intermediate goods in the presence of labor unions.

This paper makes the following contributions to the literature. First, it establishes a link between trade liberalization, entrepreneurship and vertical relations. We show that vertical separation increases in the export sector, as entrepreneurial talent flourishes because of trade liberalization. We thus find that vertical separation has not only an international dimension, but also an important local dimension. Second, we expose traditional trade models to new issues. As firm heterogeneity within an industry opens up a huge range of possibilities, with different firms choosing different modes of operation, even within the ambit of the HOS-type setup the export sector can be a natural domain for vertical separation. Third, firm productivity is widely recognized to play an important role in shaping international trade and fragmentation. In this paper, we unveil one source of productivity gain and formalize the crucial link between trade and firm productivity. We illustrate that both the scale effect arising from a boost in the

production of export goods and the flourishing of entrepreneurial talent arising from the declining cost of capital contribute to improved productivity.

The remainder of the paper is organized as follows. In Section 2, we present our basic model and analyze the equilibrium outcomes. We demonstrate the effect of trade on entrepreneurship and vertical relations and analyze the influence of productivity. Section 3 then extends our analysis to the case of entrepreneur-workers facing credit constraints. In Section 4, we examine whether the equilibrium results change with tradable intermediate goods. Concluding remarks are offered in the final section.

2. The Model

Consider an open economy producing two final goods, X and Y, with two factors of production, labor L and capital K. X is a labor-intensive good, and Y is a capital-intensive good. Let w and r be the factor prices for labor and capital, respectively. Assume that establishing a new firm to produce these goods incurs a fixed cost. That setup cost is paid in period 0 before production begins, and is recovered between period 1 and an infinite period. Let S_X and S_Y denote the setup costs of firms in sectors X and Y, respectively. We denote s_x and s_y as the per period amortization cost of the setup costs of firms in sectors X and Y, respectively. Given r is the factor price for capital, the amortization rate is equal to r. Thus we have

$\sum_{t=1}^{\infty} \frac{s_x}{(1+r)^t} = S_X$ and $\sum_{t=1}^{\infty} \frac{s_y}{(1+r)^t} = S_Y$. Accordingly, we have $s_x = \delta S_X$ and $s_y = \delta S_Y$.

Production technology follows constant returns to scale in both factors. The production of a unit of either of the two final goods also requires a unit of a different intermediate good. More specifically, a firm producing one unit of final good j ($j = x, y$) requires a_{lj} units of labor, a_{kj} units of capital, and one unit of intermediate good M_j.[2] For simplicity, we assume that the production of intermediate goods requires labor alone. The unit labor requirement for the production of intermediate goods is a_{mj}. The economy's total endowment of labor is $\overline{L}$ and capital $\overline{K}$.

As in the traditional HOS framework, a labor-abundant home country exports good X and produces good Y in competition with imports. This open economy takes the world prices of the two final goods as given, and a tariff rate of t is imposed on imports of good Y. Assume that the price of good Y is 1 and that the price of good X relative to good Y is p_x. For the intermediate goods, we first analyze a scenario in which they are not tradable. The assumption of tradability is then relaxed in Section 4. The prices of intermediate goods are denoted as p_{mj} ($j = x, y$).

[2] The production of good X takes the form $X = f(K, L, M_x)$, where the technical rate of substitution between M_x and either K or L is zero (the form for Y is similar).

The market structures in both final goods sector and intermediate goods sector follow "contestability." Positive profits are competed away by the free entry and exit assumption. If a producer charges more than the average cost, there is another potential group that will enter and bring the price down to the average cost. Accordingly, the pricing strategy follows the rule of average cost pricing.

2.1 Equilibrium of Vertical Integration

We now describe the integration equilibrium before new entrepreneurship emerges. In an integrated world, both the intermediate and final goods are produced by the same producer.

In a competitive economy, firms choose optimal factor intensities, taking factor prices and output prices as given. The price of any good (whether final or intermediate) must be equal to the unit cost of production. Thus, for the final goods producer, we have the following. [3]

$$w(a_{lx} + a_{mx}) + ra_{kx} = p_x - r\frac{s_x}{X}. \qquad (1)$$

$$w(a_{ly} + a_{my}) + ra_{ky} = 1 - r\frac{s_y}{Y}. \qquad (2)$$

[3] Equation (1) and (2) only hold when output of good j ($j = x, y$) is positive. If good j ($j = x, y$) is not produced, the setup cost to establish a new firm in that sector will not occur.

The left-hand side of the above equations denotes the unit production cost of good j ($j = x, y$) and the right-hand side of the above equations is the revenue of selling one unit of final good minus set-up cost per unit of output given the output of good j is positive.

The pricing of intermediate goods satisfies

$$p_{mj} = wa_{mj} \qquad \text{for } j = x, y. \tag{3}$$

We now consider domestic factor markets. The market for labor is cleared when employment in the production of intermediate and final goods exhausts the total labor endowment:

$$(a_{lx} + a_{mx})X + a_{ly}Y = \overline{L}, \tag{4}$$

where the output of intermediate goods (M_x and M_y) is the same as that of final goods ($M_x = X$ and $M_y = Y$) because the production of one unit of a final good requires one unit of an intermediate good. Similarly, the full employment condition for capital gives us

$$a_{kx}X + a_{ky}Y = \overline{K}. \tag{5}$$

Let a "hat" indicate the relative change in a variable or parameter. Thus, p_x denotes $\frac{dp_x}{p_x}$. Let θs refer to the factor shares in each industry. Accordingly, θ_{lj} and θ_{mj} represent the labor shares from the final and intermediate goods in sector j

($j = x, y$), respectively, and θ_{kj} and θ_{tj} represent the capital share of the final good and the per period recovery of setup costs in sector j, respectively.

Equations (1) and (2) in the rates of change are as follows.

$$w(\theta_{lx} + \theta_{mx}) + \hat{r}\theta_{kx} = p_x + \theta_{tx} X \ . \tag{6}$$

$$w(\theta_{ly} + \theta_{my}) + \hat{r}\theta_{ky} = \theta_{ty} Y \ . \tag{7}$$

We also have $X = \alpha p_x$ and $Y = -\beta p_x$, where $\alpha = \dfrac{\sigma_x \lambda_{ky} - \sigma_y \lambda_{ly}}{\lambda_{lx}\lambda_{ky} + \lambda_{ly}\lambda_{kx}}$ and $\beta = -\dfrac{\sigma_x \lambda_{kx} + \sigma_y \lambda_{ly}}{\lambda_{lx}\lambda_{ky} + \lambda_{ly}\lambda_{kx}}$. Here, λ_{lj} and λ_{kj} denote the fraction of labor used in sector j ($j = x, y$) and the fraction of capital used in sector j, respectively, and σ_j denotes the elasticity of between-factor substitution in sector j ($j = x, y$). All of the foregoing notations have the usual interpretations in the traditional HOS model. Thus, it can be shown that $\alpha > 0$ and $\beta > 0$, and Equations (6) and (7) can be changed to the following.

$$(\theta_{lx} + \theta_{mx}) w + \theta_{kx} \hat{r} = (1 + \alpha\theta_{tx}) p_x \ . \tag{8}$$

$$(\theta_{ly} + \theta_{my}) w + \theta_{ky} \hat{r} = -\beta\theta_{ty} p_x \ . \tag{9}$$

Define $|\theta| = (\theta_{lx} + \theta_{mx})\theta_{ky} - (\theta_{ly} + \theta_{my})\theta_{kx}$. We also have $|\theta| > 0$. Accordingly, we have

$$w = \frac{(1 + \alpha\theta_{tx})\theta_{ky} + \beta\theta_{ty}\theta_{kx}}{|\theta|} p_x \quad \text{and} \tag{10}$$

$$\hat{r} = -\frac{[(1+\alpha\theta_{tx})(\theta_{ly}+\theta_{my})+(\theta_{lx}+\theta_{mx})\beta\theta_{ty}]}{|\theta|} p_x \,. \qquad (11)$$

Let t denote the tariff rate imposed on good Y. Then, p_X is a function of t, with $p_X'(t) < 0$. With trade liberalization (a decrease in t), we have $p_x > 0$. Hence, $w > 0$ and $\hat{r} < 0$ under trade liberalization.

2.2 Conditions for Vertical Separation

Workers are heterogeneous in our model. Some of the workers who produce intermediate goods M_x and M_y under vertical integration have entrepreneurial qualities. If they leave the integrated firm and produce an intermediate good on their own (i.e., under vertical separation), they can produce it using better technology (a lower unit labor requirement), such that $b_{mj} < a_{mj}$ ($j = x, y$), where b_{mj} denotes the unit labor required to produce the intermediate good in sector j under vertical separation. We assume that n_j ($j = x, y$) such workers can get together and produce intermediate goods after paying a fixed cost of S_{mj} units of capital ($j = x, y$).[4] Denote s_{mj} as the per period recovery of the setup cost of a firm producing M_j in sector j ($j = x, y$), such that $\sum_{t=1}^{\infty} \frac{s_{mj}}{(1+r)^t} = S_{mj}$. We thus have $s_{mj} = rS_{mj}$.

[4] Here we assume that $n_x > b_{mx}X$ and $n_y > b_{my}Y$, which implies that a part of the labor effort goes toward pure entrepreneurial supervision.

As the market structure in the intermediate goods sector also follows "contestability", [5] the p_{mj} ($j = x, y$) to be charged by outside entrepreneurs is given by

$$p_{mj} = \frac{wn_j + rs_{mj}}{X} \quad \text{for } j = x, y. \tag{12}$$

Therefore, firms producing X and Y operate as a vertically separated process if and only if the following holds.

$$\frac{wn_x + rs_{mx}}{X} \leq wa_{mx}. \tag{13}$$

$$\frac{wn_y + rs_{my}}{Y} \leq wa_{my}. \tag{14}$$

The foregoing conditions can be changed to

$$w(t)[a_{mx}X(t) - n_x] \geq r(t)s_{mx} \quad \text{and} \tag{15}$$

$$w(t)[a_{my}Y(t) - n_y] \geq r(t)s_{my}. \tag{16}$$

Here, w, r, X, and Y are all affected by changes in tariff t. Equations (15) and (16) suggest that when the costs that can be saved by establishing a new firm, i.e., $w(t)[a_{mj}X(t) - n_j]$ ($j = x, y$), are higher than the per period recovery of the setup cost, entrepreneur-workers get together and build a new firm, and thus vertical separation occurs. Examining incentive constraints (15) and (16) more closely, we can easily see

[5] This is the case when the intermediate goods are non-tradable. When they are tradable, their producers will sell them to anyone who pays the world price. The latter case in discussed in Section 4.

that liberal trade policies are likely to generate vertical separation in both sectors. These policies do so unambiguously for the export sector, but it is likely that they also do so for the import-competing sector. These results are best illustrated by the standard Stolper-Samuelson theorem and the price-output responses within the HOS framework (see Figure 1).

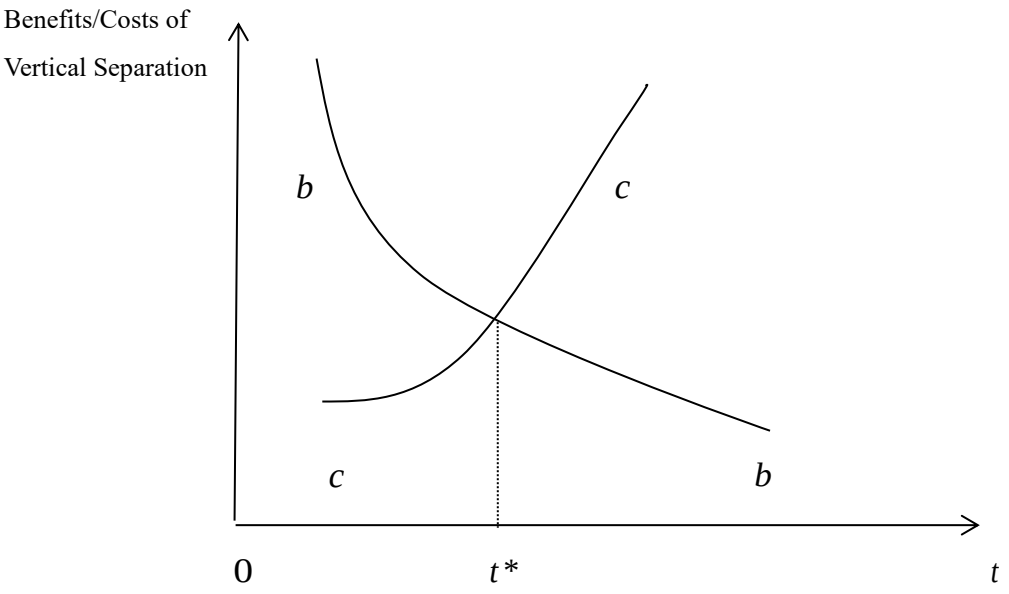

Figure 1: Trade liberalization and Vertical Separation

Figure 1 illustrates the way in which trade liberalization leads to vertical fragmentation in the export sector. The *x* axis denotes the tariff rate while the *y* axis denotes the benefits/cost of local fragmentation. From equation (15), the benefits of local fragmentation in the export sector is given by $w(t)[a_{mx}X(t)-n_x]$, which is

represented by the bb curve in Figure 1. As $w > 0$ and $X > 0$ under trade liberalization, both $w(t)$ and $X(t)$ are decreasing functions of t. Similarly, the costs of local fragmentation in the export sector is given by $r(t)s_{mx}$, which is represented by the cc curve in Figure 1. As $\hat{r} < 0$ under trade liberalization, $r(t)$ is a decreasing function of t. Accordingly, the cc curve is upward sloping in Figure 1.

In the absence of such liberalization, despite being more productive as entrepreneurs ($w(t)[a_{mx}X(t) - n_x] > 0$), entrepreneur-workers may not open their own businesses because capital is too costly. As trade liberalization progresses, and tariff t falls, however, both the cost of labor $w(t)$ and the output of labor-intensive good $X(t)$ increase, thereby leading to a decline in the cost of capital and an increase in export volume in a labor-abundant country. This pattern is the same as that in the standard Stolper-Samuelson theorem and the price-output responses in the HOS framework. When trade liberalization leads to a lowering of the tariff rate below threshold value t^*, the cost that can be saved by establishing a new firm in the export sector, $w(t)[a_{mx}X(t) - n_x]$, is greater than the fixed setup cost, ($r(t)s_{mx}$). In this scenario, entrepreneur-workers find it profitable to separate from the integrated firm and set up their own firms to produce intermediate goods, leading to vertical separation in the export sector.

Whether vertical separation also occurs in the import-competing sector depends on the degree of the tariff reduction. When t goes down, the cost of capital $r(t)$ and output of capital-intensive good $Y(t)$ decrease at the same time in a labor-abundant country. Hence, the net incentive for separation is undetermined in the import-competing sector. However, as long as $\frac{r(t)}{Y(t)}$ does not rise too rapidly, the possibility of vertical separation in that sector seems to be greater with greater trade liberalization. Thus, vertical separation is also encouraged by a lower tariff in the import-competing sector. We are now ready for the following proposition.

Proposition 1 *Trade liberalization leads to vertical separation in the export sector. If a decline in the tariff rate does not sharply increase r relative to Y, then a lower tariff will also encourage vertical separation in the import-competing sector.*

Proof: See the foregoing discussion.

2.3 Equilibrium with Vertical Separation in the Export Sector

Once the tariff clears a critical level at which separation and local outsourcing become possible, a regime shift in the way that production is locally organized takes place. We thus need 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 the existence of such an equilibrium in detail in the appendix.

The new general equilibrium configuration consists of (1) competitive pricing equations,

$$wa_{lx} + r\frac{s_x}{X} + \frac{wn_x + rs_{mx}}{X} + ra_{kx} = p_x \qquad (17)$$

$$w(a_{ly} + a_{my}) + ra_{ky} = 1, \qquad (18)$$

where the price of the intermediate good in integration in the export sector has been replaced by $p_{mx} = \frac{wn_x + rs_{mx}}{X}$, at which point the newly established firm supplies intermediate goods to the final goods producer, and the intermediate goods in the import-competing sector are still produced by the vertically integrated firm, with $p_{my} = wa_{my}$, and (2) factor market clearing conditions:

$$a_{lx}X + n_x + (a_{ly} + a_{my})Y = \overline{L} \qquad (19)$$

$$a_{kx}X + S_{mx} + a_{ky}Y = \overline{K}, \qquad (20)$$

where n_x workers gather together, incurring s_{mx} units of capital as the business setup cost and supply the intermediate goods from outside. As part of the labor force moves toward pure entrepreneurial activities beyond production-related work, we have $n_x > b_{mx}X$. The market clearing conditions for intermediate goods require $M_x = X$ and $M_y = Y$.

Given $(t, n_x, n_y, \overline{L}, \overline{K}, s_x, s_y, s_{mx})$, we determine w, r, X, Y, M_x, M_y from (17)-(20). For each $X(t)$, we can derive another through the same process by a function defined as $\phi(X(t))$. The solution process determines whether there is a fixed point in the form $X(t) = \phi(X(t))$. As t falls, the general equilibrium effect is that both $X(t)$ and $\frac{w}{r}$ increase because X is labor-intensive, which is the familiar HOS outcome. However, there is now a productivity effect through (17). As $X(t)$ increases, the average cost of the intermediate good falls, implying a further increase in $X(t)$ from Equations (19) and (20). Thus, $\phi'(X(t)) > 0$, and there is a fixed point for $X(t) = \phi(X(t))$.[6] We leave the formal proof for the existence and uniqueness of $X(t)$ to the appendix. We are more interested here in the consequences of such an outcome on $X(t)$ and the factor returns.

As long as the tariff is not reduced substantially, such vertical separation will not take place. However, once the tariff reaches a critical threshold, the separation process is activated. First, there is a finite change in the process, reflecting a jump as workers

[6] Here we assume that $\phi(X(t))$ satisfies the concavity assumption, i.e., $\phi''(X(t)) < 0$, which ensures that the curve of $\phi(X(t))$ cuts 45 degrees from above, thereby solving a unique and stable nontrivial equilibrium.

shift from inside to outside the factory. Second, such local outsourcing exerts a positive productivity effect on the X sector through a fall in the cost of the intermediate good.

Note that growth in productivity affects the factor returns immediately. As soon as t falls below a critical level, t^*, $\frac{w}{r}$ jumps and again follows a monotonically increasing trajectory. It is also expected that $\frac{w}{r}$ will increase at a sharper rate beyond the critical point as labor-intensity declines and capital-intensity increases for sector X. Thus, the Stolper-Samuelson-type outcome is further reinforced. Once the average cost of obtaining the intermediate input is directly related to the tariff rate, a decline in the tariff means a decline in the effective cost of production for the export good. This process is akin to a productivity effect that increases the wage rate.

Proposition 2 *A liberal trade regime reduces the cost of the input under vertical separation and enhances the productivity of a labor-abundant country.*

Proof: See the foregoing discussion.

In our model, trade exerts a distinct effect on firm productivity through new entrepreneurship and vertical separation. The channel we suggest here differs from that highlighted by Melitz (2003). In that study, trade's effect on productivity operates

through inter-firm resource reallocation, and trade improves average industry productivity but not firm productivity.

We now consider the transition from no separation to separation. As we have already demonstrated that the post-outsourcing equilibrium has a different w and r, we call the two states w' and r'. We also know that for vertical separation to be profitable we must have $wa_{mx} \geq \frac{w'n_x + r's_{mx}}{X(t)}$. Suppose that strict equality holds for $(w', r', X(t))$. Accordingly, outsourcing should exert no productivity effect. In the new equilibrium, w and r remain the same. With strict inequality, w increases and r falls, and entrepreneur-workers have an incentive to set up their own businesses. An element of bargaining may be latent here if these entrepreneur-workers form a syndicate and bargain for the reservation price of the intermediate good in the absence of outsourcing. In our structure, $n_x > b_{mx}X$, implying that part of the labor effort goes toward specific entrepreneurial activities. The extent of such a labor effort allocation is given by $(n_x - b_{mx}X)$, net of the labor used for production. A decline in n reflects an improvement in entrepreneurial talent, which has the usual general equilibrium implications. Via the Rybczynski effect, a fall in *n* increases the output of X and reduces that of Y, which again exerts a productivity effect acting through $\frac{rs_{mx}}{X(t)}$ and raising w and reducing r via the Stolper-Samuelson outcome.

Finally, two additional issues need to be highlighted here. First, if the intermediate input is tradable, local outsourcing provides no extra benefit to the sector producing X except that a number of productive entrepreneur-workers move outside the industry. A further decline in t increases wages via the Stolper-Samuelson effect, but confers no additional productivity benefit. However, the possibility that the price of the intermediate good may fall provides an extra productivity boost. Second, in our discussion thus far we have assumed that, under vertical separation, the input is available at the average cost, but that may not be the case in reality. The equilibrium price may be a contracted price. However, such a price must be a positive function of the average cost, and to that extent a rise in X reduces the price of the intermediate input.

3. Frictional Financial Market

In Section 2, we assume that there is no friction in the financial market, meaning that workers turned entrepreneurs are able to finance startup capital $r(t)s_{mx}$. However, numerous surveys suggest that obtaining adequate access to capital constitutes one of the biggest hurdles to starting a new business (Kerr and Nanda 2009). In this section, we extend our analysis to the case of entrepreneurs facing credit constraints.

Suppose that an entrepreneur-worker faces an exogenous credit constraint such that he or she cannot borrow more than a fixed amount of debt, $\overline{B}$. Credit constraints may arise either because there exists an underdeveloped financial market or because the amount of personal wealth available for collateral is insufficient. In the face of credit constraints, the entrepreneur-worker is unable to start a new business unless the cost of capital is sufficiently low. In this situation, (15) and (16) remain the incentive constraints for local outsourcing for final goods producers. However, the entrepreneur-workers in each sector face new constraints:

$$r(t)s_{mx} \leq \overline{B}. \qquad (21)$$

We illustrate the case for the export sector in Figure 2. Credit constraint $\overline{B}$ is represented by horizontal curve *dd*.[7] At t^*, $w(t)[a_{mx}X(t) - n_x] \geq r(t)s_{mx}$, and yet $r(t)s_{mx} \geq \overline{B}$, which violates the constraint facing the entrepreneur-worker (21). Therefore, in the presence of credit constraints, lowering the tariff to t^* is insufficient to induce workers to become entrepreneurs even when the cost of startup capital is reduced and the incentive condition for vertical separation (15) is met. However, lowering the tariff further to t^{**} successfully releases these constraints owing to

[7] These conditions are isomorphic to the well-known Inada conditions in the growth literature.

friction in the financial market. When the tariff falls below this new critical level (t^{**}), new entrepreneurship flourishes. In sum, adding credit constraints does not change the basic insights derived in the previous sections.

Interestingly, our model suggests that trade liberalization can act as a substitute for financial market development. For example, suppose that the initial tariff is set at t^{*}, and vertical separation occurs because workers face credit constraints (Figure 2). To unleash the forces of entrepreneurship, the government may embark on financial market reforms that render it easier to obtain credit if further trade liberalization is politically unpopular. Doing so will shift credit constraint curve dd upward until it intersects the bb and cc curves at point A, beyond which new entrepreneurship and vertical separation occur. Alternatively, for a given stage of financial market development, the government may choose to liberalize trade further (without financial market reform) until t^{**} is reached, beyond which new entrepreneurship will flourish. Thus, two otherwise identical countries following the same trade liberalization policy, but with different levels of financial market development, may experience different degrees of new entrepreneurship and improvements in firm productivity.

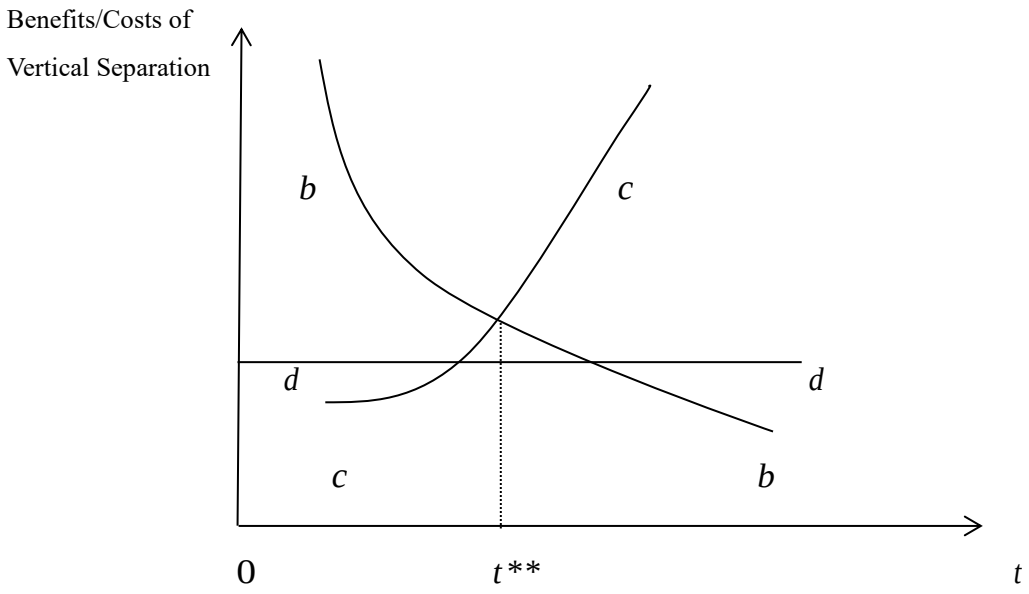

Figure 2: Trade liberalization, Financial Friction, and Vertical Separation

4. Tradable Intermediate Goods

In previous sections, we demonstrate that a liberal trade regime promotes vertical separation, which enhances productivity in the export sector of a labor-abundant country, based on the assumption that intermediate goods are non-tradable. This assumption is relaxed in this section.

When intermediate goods are tradable, the local producer of those goods has an outside option of exporting them to the rest of the world, whereas the final goods producer has an outside option of purchasing them from the rest of the world. The final goods producer has to pay a per unit trading cost if he or she purchases intermediate goods from the rest of the world. The trading cost in our context refers to the iceberg

transport cost paid by firms engaged in international trade. Let p_w denote the world price of the intermediate goods, and T represent the trading cost incurred when firms import those goods. Hence, the intermediate goods producer receives p_w by exporting those goods to the rest of the world, whereas the final goods producer pays $p_w + T$ by purchasing them from the rest of the world.

Our analysis depends on how the unit production cost of the intermediate goods producer ($\frac{wn_x + rs_{mx}}{X}$) differs from the world price (p_w) and the import price that the final goods producer pays in purchasing from the rest of the world ($p_w + T$). Hence, we divide the possible values of $\frac{wn_x + rs_{mx}}{X}$ into three regions and discuss them separately.

We first analyze the scenario in which the unit production cost of the intermediate goods producer is lower than the world price ($\frac{wn_x + rs_{mx}}{X} \leq p_w$). In this scenario, the final goods producer pays $p_w + T$ to purchase intermediate goods in the international market, and the intermediate goods producer receives p_w to export to the rest of the world. The difference between the payment of the final goods producer and the payoff of the intermediate goods producer leads to the benefit of domestic transactions (T), which the two producers bargain over.

Let β and $(1-\beta)$ denote the bargaining power of the intermediate and final goods producers, respectively, and p_d represent the price that the final goods

producer pays to the local intermediate goods producer. Thus, we have $p_d = p_w + T$. It can be inferred that the latter's unit production cost is lower than his or her payoff from the local final goods producer ($\frac{wn_x + rs_{mx}}{X} \leq p_d$). In these circumstances, vertical separation occurs if the unit production cost of the intermediate goods is lower under vertical separation than vertical integration ($\frac{wn_x + rs_{mx}}{X} \leq wa_{mx}$). This condition is the same as equation (15), and implies that trade liberalization promotes vertical separation because of the declining cost of capital (the capital cost effect) and boost in the production of export goods (the scale effect).

We now consider the case in which the unit production cost of the intermediate goods producer is higher than his or her payoff from exporting but lower than the import price that the local final goods producer pays ($p_w \leq \frac{wn_x + rs_{mx}}{X} \leq p_w + T$). In this event, the net payoff that the intermediate goods producer receives from the rest of the world is negative given that his or her unit production cost is higher than the world price. Hence, the intermediate goods producer has no bargaining power in negotiating with the final goods producer because selling to the rest of the world is no longer an outside option. As a result, vertical separation still occurs if $\frac{wn_x + rs_{mx}}{X} \leq wa_{mx}$, but the price that the intermediate goods producer receives from the final goods producer is equal to unit production cost $\frac{wn_x + rs_{mx}}{X}$. It follows that vertical separation becomes more viable with a reduction in the tariff rate. Note that the $\frac{wn_x + rs_{mx}}{X} < p_w + T$ condition is more likely to be satisfied with an increase in trading cost (T). Hence, a higher

trading cost in the international trade of intermediate goods also encourages entrepreneurship and vertical separation.

Finally, we consider the case in which the unit production cost of the intermediate goods producer is higher than the import price paid by the local final goods producer ($\frac{wn_x + rs_{mx}}{X} > p_w + T$). In this case, establishing a new firm confers no cost advantage upon the intermediate goods producer. Therefore, the final goods producer will always opt to purchase intermediate goods from the rest of the world, and vertical separation will not occur. The foregoing results are summarized in the following lemmas.

Lemma 1 In a world in which intermediate goods are tradable, Proposition 1 holds. A sufficiently low tariff promotes vertical separation in the export sector.

Lemma 2 The higher trading costs involved in international trade in intermediate goods also encourage vertical separation.

5. Concluding Remarks

Contemporary research in international trade theory places considerable emphasis on the interaction between international trade and the organization of production through fragmentation and outsourcing. Although the heterogeneity of firms within an industry opens up a huge range of possibilities, with different firms choosing different modes of

operation, even within the ambit of the Heckscher-Ohlin-Samuelson-type setup the export sector can be a natural domain for vertical separation. In this paper, we focus on entrepreneurship and indigenous outsourcing, and formalize the crucial link between trade liberalization and vertical separation and firm productivity. We show that trade liberalization lowers the cost of capital, which provides fertile ground for the flourishing of entrepreneurship and vertical separation and, consequently, improvements in firm productivity. The channel through which trade influences productivity in this paper is novel, and complements the trade and firm heterogeneity literature, with trade improving average industrial productivity rather than firm productivity.

One promising avenue for future research would be to extend our analysis to simultaneous separation in the export and import-competing sectors. Contractual complexities are also an important consideration. To examine vertical separation, researchers need to consider the monitoring and provision of optimal contracts, which depend on the information asymmetry problem. Such work is becoming popular in trade theory, but has not yet been addressed in terms of the standard text book model of trade. These issues are discussed at length in Helpman (2006) in models of product differentiation and firm heterogeneity. However, more conventional models of trade theory are similar in scope, which is the key point of this paper.

References

Antràs, P. 2003. Firms, Contracts, and Trade Structure, Quarterly Journal of Economics, 118 (4): 1375-1418.

Antràs, P. 2005. Incomplete Contracts and the Product Cycle. American Economic Review, 95(4): 1054—73

Antràs, P. and Helpman E., 2004. Global Sourcing, Journal of Political Economy, 112(3): 552-580.

Beladi, H., M. Dutta and S. Kar (2016). FDI and Business Internalization of the Unorganized Sector: Evidence from Indian Manufacturing. World Development, 83, 340-349.

Deardorff, A. V., 2001. Fragmentation in simple trade models, The North American Journal of Economics and Finance, 12(2):121-137.

Grossman, G. M. and Helpman, E. 2005. Outsourcing in a Global Economy, Review of Economic Studies, 72:135-159.

Helpman, E. 2006. Trade, FDI, and the Organization of Firms, Journal of Economic Literature. 44(3): 589-630.

Helpman, E., Melitz M. J., and Yeaple S. 2004. Export versus FDI with Heterogeneous Firms. American Economic Review, 94(1): 300—316.

Jones, R.W. and Kierzkowski, H., 2005. International Fragmentation and the New Economic Geography, North American Journal of Economics and Finance 16 (1): 1-10.

Jones, R.W. and Marjit S. 2001. The role of International fragmentation in the Development Process. American Economic Review, 91(2): 363-366.

Jones, R. W. and S. Marjit, 2009. Competitive Trade Models and Real World Features, Economic Theory 41: 163-174

Kerr, W. and R. Nanda, 2009. Financing Constraints and Entrepreneurship, NBER Working Paper No. 15489.

Liu, B., X. Xia and J. Yang, 2017. Financing constraints and the use of performance-sensitive debt. North American Journal of Economics and Finance 40 (2017): 73–84.

Liu, Y. and A. Mukherjee, 2013. The Effects of Trade Liberalization in a Vertical Structure. Review of International Economics, 21(5): 966–973.

Maiti, D., 2008. Organizational Morphology of Rural Manufacturing and its Dynamics in Liberalized India. Cambridge Journal of Economics, 32 (4): 571-592.

Maiti, D and A. Mukherjee, 2013. Trade Liberalization, Outsourcing and Union Wage. Labor Economics 21: 103-110.

Marjit, S. 2007. Trade Theory and the Role of Time Zones. International Review of Economics and Finance, 16(2): 153-160.

Marjit, S. and S. Kar (2011). The Outsiders: Economic Reform and Informal Labor in a Developing Economy. Oxford University Press, Delhi, London.

Melitz, M. J. 2008. International Trade and Heterogeneous Firms, New Palgrave Dictionary of Economics, 2nd Edition.

Melitz, M. J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, Econometrica, 71(6): 1695-1725.

Mitra, D. and P. Ranjan, 2010. Offshoring and Unemployment: The Role of Search Frictions and Labor Mobility. Journal of International Economics 81(2): 219-229.

Wojnilower, J. 2018. On credit and output: Is the supply of credit relevant? North American Journal of Economics and Finance 45 (2018): 38–56.

Zhang, X, Z. He, H. Zhu and J. Li. 2018. Quantity of finance and financial crisis: A non-monotonic investigation. North American Journal of Economics and Finance 44 (2018):129–139.

Appendix

Existence of an Equilibrium of Vertical Separation 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). Equations (17) - (20) determine the equilibrium and $w_0 a_{mx} \geq \frac{wn_x + rs_{mx}}{X(t)}$ must hold. Let us define $\frac{wn_x + rs_{mx}}{X(t)} = p_{mx}$.

Outsourcing, as argued in the paper, is caused by a decline in t, with n_x and s_{mx} jumping from an initial value of zero to some positive number. The new equilibrium must be such that $w_0 a_{mx} \geq \frac{wn_x + rs_{mx}}{X(t)}$ 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 $\hat{x} > 0$ where $[\hat{x} \equiv \frac{dx}{x}]$.

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

Working with (17) – (20) and using Jones (1965) it is easy to check that

$$\hat{X} = \frac{(\hat{w} - \hat{r})\delta_x}{|\lambda|} - \frac{\lambda_{\ln}\lambda_{ky}}{|\lambda|} \cdot \hat{n} + \frac{\lambda_{ks}\lambda_{ly}}{|\lambda|} \cdot s_{mx} \qquad (1A)$$

where $\delta_x = (\lambda_{lx}\alpha\sigma_x\theta_{kx} + \lambda_{ly}\sigma_y\theta_{ky})$ and $\lambda_S, \sigma_S, \theta_S$ 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_{ln} is share of n_x in total L and λ_{ks} is share of k in total K.

Solving for $(\hat{w} - \hat{r})$ from (17) and (18) we get

$$\hat{X} = \frac{\delta_x \theta_k \hat{X}}{|\theta||\lambda|} - \frac{\hat{T}}{|\theta||\lambda|} - \hat{n} \cdot \frac{\lambda_{ln}\lambda_{ky}}{|\lambda|} + s_{mx} \cdot \frac{\lambda_{ks}\lambda_{ly}}{|\lambda|} \qquad (2A)$$

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

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 $X(t) = \phi(X(t))$. 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 $s_{mx} > 0$ have opposite effects on $\hat{X}$.

(d) If λ_{lm} and λ_{km} 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 ($\hat{X} \succ 0$). Thus, the condition for the existence and uniqueness of a fixed point $\hat{X}$ requires $\frac{\delta_x \cdot \theta_k}{\left|\theta|\lambda\right|\!\|} \prec 1$.

Moreover, from (3A) we can stipulate that following is a set of sufficient conditions under which $\hat{X} \succ 0$: (i) $\lambda_{lm} \cong 0$, $\lambda_{\mathrm{km}} \cong 0$ and (ii) $\frac{\delta_x \cdot \theta_k}{\left|\theta|\lambda\right|\!\|} \prec 1$. Condition (i) says that the endowment effect of changes in n and k is negligible. Along with (i) and (ii) we must have (iii) $\underset{t\to 0}{Lim}\left[w(t)b_{mx} + \frac{r}{X}(t)k_x \right] < \underset{t\to 0}{Lim}\, w(t)a_{mx}$ for local outsourcing to be an equilibrium as it guarantees that $w(t)(a_{mx}X(t) - n_x) \geq r(t)s_{mx}$ for given t as in (15) in the text.