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Unionization Structure and the Incentives for Foreign Direct Investment

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Unionization Structure and the Incentives for Foreign Direct Investment

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Abstract: We examine the effects of unionization in the host country on a firm's choices of entry mode when serving a foreign market, i.e., its incentives for exporting, green-field FDI and merger. If, due to government regulations the merged firm must operate a plant in the host country, we find that the firm does green-field investment under decentralized unions, but chooses a merger under a centralized union. The firm's incentive for FDI (either green-field FDI or merger) compared to exporting is higher under decentralized unions than under a centralized union. In contrast, if the merged firm can use its plant from any country, a merger may occur even under decentralized unions, but in this case the merged firm uses the plant in the non-unionized country. Under a centralized union, merger always arises if the merged firm can produce in any country, but it chooses to produce in the host country if the market is small.

Key Words: Labor Unionizations; Entry mode; Export; Merger; FDI

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1. Introduction

The recent wave of globalization has generated interests to analyze the incentives and consequences of different entry modes, viz., exports, green-field foreign direct investment (FDI), or cross-border merger and acquisition (M&A),[1] of a firm when serving a foreign market. Though, a vast literature has developed along this line, the effects of labor unions (or generally the effects of imperfectly competitive input markets) are not well understood. Further, while recent evidences (see, e.g., WIR, 2006) show that cross-border merger is more important than green-field FDI, the theoretical literature has not paid much attention to it.

In this paper, we study how unionization and the structure of unionization in the host country affect a firm's incentives for exporting, green-field FDI and merger. Our analysis pays special attention to cross-border mergers. If the merged firm uses the host country plant, it has to face the labor union there, whereas if it uses the home country plant, it has to incur the cost of exporting. And suppose that the merged firm is compelled to use the former plant due to government regulations, we find that the firm does green-field FDI under decentralized unions, while it decides to merge under a centralized union.[2] The firm's incentive for FDI (through either green-field investment or merger) compared to exporting is higher under decentralized unions than under a centralized union.

However, if the merged firm is allowed to use any plant, merger may occur even under decentralized unions, but the merged firm uses the plant in the non-unionized home country. In contrast, under a centralized union, merger always occurs, but the merged firm produces in the host country if the market is very small.

[1] Of course there are other modes such as licensing, joint ventures, etc., which we abstract in the present analysis.
[2] Under decentralized unionization, firm-specific unions set the wage rates for respective firms. Under centralized unionization, there is a single union who sets the wage rates for all respective firms.

Our results may explain some stylized facts. In the European Union, especially in manufacturing sectors, centralized unionization is more common, while in North America (the U.S. and Canada), decentralized unionization is more relevant.[3] Our model would predict that cross-border mergers are more common in EU manufacturing than in North American manufacturing, and this prediction is in line with the actual numbers. Gugler et al. (2003, table 2A, p633) document that during the period 1981-1998, the ratios of cross-border mergers to all mergers are respectively 33.5% in Continental Europe, 29.9% in the UK and 10.6% in the US. They find that there is no dramatic difference between domestic and cross-border mergers. Furthermore, according to the European Commission (2004), in the largest EU 25 countries, about 31.5% (the biggest share) M&A in 2003 occurred in manufacturing, while in the U.S. the biggest share occurred in services with 31.1 %, and manufacturing had a share of 27% (Table 2, p5). In addition, from 1990 to 2003, Europe had 52% of the world's total M&A (with 40% going to the largest 15 countries), while North America (U.S. and Canada) had only 21% (graph 1, p8).[4]

Leahy and Montagna (2000), which is a nice initial attempt to study the effects of centralized and decentralized labor unions under *inward* FDI is perhaps the most closely related paper to ours. However, the most important difference between their paper and ours is that they do not allow cross-border merger, thus are unable to analyze the effects of unionization structure on different types of FDI. Further, in their analysis, they do not allow the centralized labor union to charge different wages between asymmetric firms. However, it is well known that an upstream agent will prefer price discrimination than uniform pricing if there are differences in the

[3] See, e.g., Iversen (1998) for an index of centralization of wage bargaining in different countries.

[4] There are caveats for our empirical evidences. While, in our analysis, we consider an unionized and a non-unionized country, it is very much possible that the mergers in Europe or in North America involves both firms from unionized countries. Further, the market structure in Europe and in North America (i.e., the number of firms operating in urope and in North America) may also differ, and may have impact on the incentives for mergers. The aggregative data for the number of mergers in Europe and North America do not address these issues, and therefore, the empirical evidences should be considered for indicative purposes.

downstream agents (Yoshida, 2000), and therefore, uniform wage setting by a centralized labor union in presence of the asymmetric firms is suboptimal for the union. We allow the centralized labor union to discriminate wage rates between firms. It is also important to note that Leahy and Montagna (2000) ignore exporting by the foreign firm. In contrast, we consider exporting in addition to different types of FDI and thus can determine the foreign firm's alternative payoff endogenously. We will see that this endogenous alternative payoff and wage discrimination by the centralized labor union will have important implications on the incentives for FDI.

In the literature of FDI in unionized labor markets, Bughin and Vannini (1995) examine a foreign firm's incentives to join the union in the host country and how it is affected by the union bargaining power. Zhao (2001) shows that incentives for vertical merger in a bilateral monopoly are lower under unionization due to the threat of union strike. Skasen and Sorensen (2001) examine whether outward FDI hurts domestic workers. They show that workers are likely to lose due to FDI provided there is a high degree of substitutability between activities in the home and the host countries. Naylor and Santoni (2003) argue that FDI is less likely the higher is union bargaining power and the more substitutable are the firms' products. Lommerud et al. (2003) consider the effects of trade liberalization on firm location in presence of labor unions, and show that trade liberalization can increase FDI. However, unlike the present paper, none of these works consider the effects of unionization structure in determining the type of FDI.[5]

The present paper also makes a contribution to the literature on horizontal mergers. In a seminal paper, Salant et al. (1983) show that, under a linear demand curve, Cournot firms have incentives to merge horizontally if the merged firm's

[5] Here, we do not try to review the vast literature on FDI that focuses on other aspects of FDI. Interested readers can read Saggi (2002) for a recent survey on FDI.

market share is above 80 percent.[6] In the present paper, we find that this standard result may not hold in unionized markets. Specifically, we demonstrate that, under decentralized unions, a merger can always be dominated by other strategies in a Cournot duopoly with linear demand functions. Basically, in our analysis, there are two effects involved under mergers: a competition effect and a unionization effect. A merger reduces competition and increases profits, but unionization would take away a share of the realized profits from the firms, reducing or even eliminating firms' incentives for merger.

In Salant et al. (1983), a bilateral merger in an oligopoly may not occur since it creates a positive externality on the non-merged firms by increasing their residual demand. However, if the merger creates a monopoly, this external effect on the non-merged firm is absent, then such a merger is always profitable in their analysis. In contrast, in our analysis, even if there is no external effect in the product market, under decentralized unions, a merger creates positive externality on the input supplier by reducing the number of unions, and thereby reducing competition between the unions, which, in turn, helps to make merger unprofitable even if merger creates monopoly.

However, if unionization is centralized, then merger does not affect the number of unions in the economy, and therefore, does not create the above-mentioned externality. As a result, the incentives for merger remain under a centralized union if it creates monopoly.

[6] The paper by Salant el al. (1983) has generated a vast literature trying to explain the rationale for profitable mergers. Denecker and Davidson (1985) show that bilateral merger in an oligopoly can always be profitable if the firms compete in prices. Another typical approach is to assume that the merger changes the rules of the game (e.g., Daughety, 1990, anlayzes a Stackelberg model with multiple followers and leaders in which a merger between two followers allows the new firm to become a leader). In addition, some papers assume that a merger allows the new firm to use strategies that were not available before the merger (see, e.g., Creane and Davidson 2004 or Huck, Konrad, and Mueller 2004). Davidson and Mukherjee (2007) and show that "the merger paradox" may not occur in presence of free entry. Also, see Werden and Froeb (1998), Cabral (2003) and Spector (2003) for the effects of entry on horizontal mergers. Qiu and Zhou (2006b) analyze the dynamic process of mergers, focusing on when and with whom to merge. They find that firm heterogeneity and negative demand shocks are necessary for mergers to occur.

The strand of literature that focuses on cross-border merger is also related to the present paper. Neary (2003, 2004) studies international mergers in general equilibrium, and shows that bilateral mergers in which low-cost firms buy out higher-cost foreign rivals are profitable under Cournot competition. Such mergers follow comparative advantage and trigger merger waves, which are supported by empirical studies in Brakman et al. (2005). In Nocke and Yeaple (2004), cross-border acquisitions involve firms trading heterogeneous corporate assets to exploit complementarities, while green-field FDI involves building a new plant in the foreign market. In equilibrium, green-field FDI and cross-border acquisitions co-exist. In an economy with public and private firms, Norbäck and Persson (2004) find that high costs of green-field investment and high trade costs not necessarily induce foreign acquisition in privatizations. Qiu and Zhou (2006a) explain the role of information sharing in international mergers in the presence of asymmetric information about market demand. However, all these papers ignore the role of unionized labor markets on merger profitability and on the mode of foreign market entry.

The remainder of the paper is organized as follows. Section 2 describes the model and derives the results. Section 3 discusses the implications of some of our assumptions and concludes. We show the results for an alternative formulation in the Appendix.

2. The model and the results

Consider two firms named 1 and 2, competing in country F. Firm 1 is from country H, who sells its product in firm 2's home country F. We assume that production requires only labors. Assume that firm 1 requires 1 labor to produce 1 unit of output, while firm 2 requires, λ labors to produce 1 unit of output, where $\lambda > 1$. Hence, the firms differ in terms of labor productivity. In the **Appendix**, we will consider a formulation

for firm asymmetry, and will show that the qualitative results of this paper remain under this alternative formulation.

Workers are immobile between countries. While the labor market in H is perfectly competitive, that in F is unionized. The reservation wages are assumed to be zero in both countries. Therefore, the equilibrium wage rate in H is zero, but that in F will be above zero for any positive bargaining power of the labor union. For simplicity, we will assume that the labor union has full bargaining power[7] and sets the wage rate, while the firms hire workers according to their needs. Hence, we assume that the firms have right-to-manage autonomy over employment as in Bughin and Vannini (1995), Vannini and Bughin (2000) and López and Naylor (2004), to name a few. In the following analysis, we will consider two types of unionization structure: (i) decentralized unions, where firm-specific unions set the wage rates for respective firms, and (ii) a centralized union, where a single union sets the wage rates for all firms producing in country F.

The inverse market demand in the host country is

$$P = a - q\,, \tag{1}$$

where the notations have usual meanings.

We consider the following game. At stage 1, firm 1 decides whether to serve the host country market (country F) through either export or FDI. In the case of FDI, firm 1 has two options: Either it sets up a fully owned subsidiary – green-field FDI, or it merges with firm 2. At stage 2, the wage rate in the host country is determined by the labor union. At stage 3, the firms compete like Cournot duopolists in cases of green-field FDI and exports, and become a monopolist with a merger. Then respective profits are realized. We solve the game by backward induction.

[7] For earlier works on monopoly labor unions, we refer to Dunlop (1944) and Oswald (1982). For more recent ones, see, e.g., Leahy and Montagna (2000) and Haucap et al. (2004).

Exporting by firm 1 requires per-unit trade cost, t. To show the implications of labor unions on the incentive for FDI in the simplest way, we assume away any cost associated with green-field FDI. It should be clear that positive cost of green-field FDI would reduce the firm's incentive for this entry mode.

Before analyzing the above game, as a benchmark, let us consider the situation with perfectly competitive labor markets in both countries. It is trivial that in this benchmark case, the wage rates in both countries are zero, and firm 1 has no incentives for exporting. Further, due to trade costs and the benefits of monopolization, the equilibrium production strategy of firm 1 would be to merge with firm 2 rather than doing either exporting or green-field FDI.

In contrast, in the following analysis, we shall demonstrate that the production strategy of firm 1 would be altered significantly in presence of labor unions. Further, it would also be affected significantly by the type of unionization.

To show our results in the simplest way, we will restrict our attention to those parameter values which ensure that both firms always produce positive outputs if they compete in the product market. As we will see, this happens if the demand intercept (i.e., a) is not very small. Hence, we avoid the possibility of corner solution so that one firm becomes monopoly in some situations, since, that does not add much to our purpose.

2.1. Decentralized unions

Let us first consider the situation of decentralized unions. Firm 1 has three possible choices: exporting, green-field FDI and a merger with firm 2.

2.1.1. Export by Firm 1

If firm 1 does exports, given the wage rates, the equilibrium outputs of firms 1 and 2 are respectively $q_1^{d,x} = \frac{(a - 2t + \lambda w_2^{d,x})}{3}$ and $q_2^{d,x} = \frac{(a - 2\lambda w_2^{d,x} + t)}{3}$, where the subscripts denote firm identity, the superscripts denote union type and the production strategy of firm 1 (i.e., either export or green-field FDI or merger), and thus $w_2^{d,x}$ is the wage rate charged by the decentralized labor union in country F under export.

Next, the labor union in the host country chooses $w_2^{d,x}$ to maximize the following expression:

$$\underset{w_2^{d,x}}{Max} \frac{(a - 2\lambda w_2^{d,x} + t)}{3} \lambda w_2^{d,x}. \tag{2}$$

The equilibrium wage rate is found to be $w_2^{d,x} = \frac{a + t}{4\lambda}$, and the equilibrium profits of firms 1 and 2 are respectively

$$\pi_1^{d,x} = \frac{(5a - 7t)^2}{144} \text{ and } \pi_2^{d,x} = \frac{4(a + t)^2}{144}. \tag{3}$$

Note that firm 1 produces positive outputs provided $a > \frac{7t}{5}$. We assume that it holds.

2.1.2. Green-field FDI by Firm 1

If firm 1 decides to conduct green-field FDI and opens a fully owned subsidiary in country F, the equilibrium outputs of firms 1 and 2 are respectively $q_1^{d,f} = \frac{(a - 2w_1^{d,f} + \lambda w_2^{d,f})}{3}$ and $q_2^{d,f} = \frac{(a - 2\lambda w_2^{d,f} + w_1^{d,f})}{3}$, where $w_1^{d,f}$ and $w_2^{d,f}$ are the wage rates charged by the respective labor unions to firms 1 and 2 respectively. Then, the respective labor unions choose the wage rates to maximize the following expressions simultaneously:

$$\underset{w_1^{d,f}}{Max}\frac{(a-2w_1^{d,f}+\lambda w_2^{d,f})}{3}w_1^{d,f}, \tag{4a}$$

$$\underset{w_2^{d,f}}{Max}\frac{(a-2\lambda w_2^{d,f}+w_1^{d,f})}{3}\lambda w_2^{d,f}. \tag{4b}$$

The equilibrium wage rates are found to be $w_1^{d,f}=\frac{a}{3}$ and $w_2^{d,f}=\frac{a}{3\lambda}$, and the equilibrium profits of firms 1 and 2 are respectively

$$\pi_1^{d,f}=\frac{4a^2}{81} \text{ and } \pi_2^{d,f}=\frac{4a^2}{81}. \tag{5}$$

Note that here both firms always produce positive outputs.

Proposition 1: *Under decentralized unions, firm 1 prefers green-field FDI (export) than export (green-field FDI) if* $a\in(\frac{7t}{5},3t)$ *(*$a>3t$*).*

Proof: Under decentralized unions, if $a>\frac{7t}{5}$, both firms always produce positive outputs irrespective of whether firm 1 exports or does green-field FDI. Further, the comparison of firm 1's profits in (3) and (5) shows that firm 1's profit is higher under green-field FDI (export) provided $a<(>)3t$. Given that, both firms always produce positive outputs, firm 1 prefers green-field FDI (export) than export (green-field FDI) if $a\in(\frac{7t}{5},3t)$ ($a>3t$). Q.E.D.

If there were positive fixed-cost of green-field FDI, it would be immediate that this would make green-field FDI less attractive compared to exporting, and if this fixed-cost were not very high, there would also be exporting for relatively very small a within $(\frac{7t}{5},3t)$. Hence, for small positive costs of green-field, firm 1 would prefer

green-field FDI than exporting for very small and for very large values of a, while green-field FDI is preferable than exporting for intermediate values of a. Sufficiently large fixed-cost of green-field FDI would eliminate the incentive for green-field FDI.

It is immediate from the above result that if there is no trade cost (i.e., $t = 0$) or if the trade cost is sufficiently small and there is a positive cost of FDI, firm 1 never prefers green-field FDI to exporting. Hence, if the alternative payoff to FDI (i.e., the payoff under exporting) is endogenous, the foreign firm may never prefer to undertake green-field FDI under decentralized unions. This shows the importance of determining the endogenous alternative payoffs of firm 1 in contrast to the "exogenous alternative payoff" assumption of Leahy and Montagna (2000), which always creates FDI as the equilibrium entry strategy if the alternative payoff to FDI is sufficiently small.

2.1.3. Merger between Firms 1 and 2

Now consider a merger between the two firms. The merged firm uses the relatively efficient production technology of firm 1. However, it is not immediate whether the firms will prefer to produce in country F or in country H. If they produce in country F, they have to face the labor union there, whereas if they produce in country H, they have to incur the cost of exporting. In the following analysis, we will look at two situations: First, the firms are required to produce in the host country (country F) under merger. This may be an extreme situation, but it serves to illustrate our point. Second, the merged firm is allowed to use any plant under merger. The implication of the intermediate case, where the merged firm is required to produce certain amount in the host country, follows immediately from these polar cases.

2.1.3.1. Production in country F under merger

First, consider the situation where regulation requires that the merged firm must produce in the host country F. Given the wage rate, the equilibrium output of the merged monopoly is $q^{d,m} = \frac{(a - w^{d,m})}{2}$. Then, the labor union in F chooses $w^{d,m}$ to maximize the following expression:

$$\underset{w^{d,m}}{Max} \frac{w^{d,m}(a - w^{d,m})}{2}. \tag{6}$$

The equilibrium wage rate is $w^{d,m} = \frac{a}{2}$, and the corresponding profit is

$$\pi^{d,m} = \frac{a^2}{16}. \tag{7}$$

Proposition 2: *If the merged firm is required to produce in country F, under decentralized labor unions, a merger between firms 1 and 2 is always dominated by both export and green-field FDI by firm 1.*

Proof: If firms 1 and 2 prefer merger, their joint profits must be greater under merger than under other alternatives. Note that their alternative joint profits are their total profits under either green-field FDI or exporting by firm 1.

Let us first consider green-field FDI, which occurs if $a \in (\frac{7t}{5}, 3t)$. The comparison of profits in (5) and (7) shows that the joint profit of firms 1 and 2 is higher under green-field FDI by firm 1 compare to merger, i.e., $\pi^{d,m} > \pi_1^{d,f} + \pi_2^{d,f}$.

Next, consider exporting by firm 1, which occurs either for $a > 3t$. The joint profit of firms 1 and 2 is higher under merger compared to exporting by firm 1 provided

$$\pi^{d,m} > \pi_1^{d,x} + \pi_2^{d,x},$$

or $$0 > 20a^2 + 53t^2 - 62at. \tag{8}$$

We find that the right hand side (RHS) of (8) is convex with respect to a and reaches minimum at $a = \frac{31t}{20}$, and $\frac{31t}{20} < 3t$. Since exporting occurs for $a > 3t$, the relevant values of a to consider for (8) are $a > 3t$. We get that RHS of (8) is positive for $a > 3t$. This proves the result. Q.E.D.

Propositions 1 and 2 together imply that firm 1 does not prefer a merger if there are decentralized labor unions in the host country. This is the exact opposite of the situation when labor unions are absent. The reason for no merger to arise in our analysis is attributed to the role of labor unions and can be explained as follows.

Let us first consider the situation where firm 1 prefers green-field FDI than exporting. Given the marginal cost of production, a merger between firms 1 and 2 increases profits of these firms. However, the merger not only reduces the number of firms, but also reduces the number of unions, and increases the marginal cost of production (which is $w^{d,m} = \frac{a}{2}$ under merger) compared to those under green-field FDI (i.e., $w_1^{d,f} = \frac{a}{3}$ and $\lambda w_2^{d,f} = \frac{a}{3}$).[8] Therefore, a merger between the firms creates a positive externality on the labor unions and allows the labor union to take away the benefit of merger by raising the wage rates. We find that the loss of profits due to higher wage rate outweighs the advantage of product market concentration through merger, and makes merger unprofitable compared to when firm 1 does green-field FDI.

Next, we consider the situation where exporting is preferred to green-field FDI by firm 1. If the firms merge, it will increase the marginal cost production by raising the labor demand in country F, since production in country F under merger implies

[8] Note that the marginal cost of production for firm 2 is λw.

that the output produced in country F increases compared to when firm 1 exports its product from country H. Specifically, under merger the marginal cost of production is $w^{d,m} = \frac{a}{2}$, whereas the marginal cost of production under exporting by firm 1 are t for firm 1 and $\lambda w_2^{d,x} = \frac{a+t}{4}$ for firm 2, and the former is higher than the latter values for $a > 3t$, i.e., where exporting by firm 1 is the alternative to merger. As a result, merger is unprofitable if the alternative to merger is exporting by firm 1 and the merged firm uses the plant in country F.

It is important to note that the mechanism for no merger in our analysis is different from the existing explanation in the literature, the so-called "merger paradox", where the merged firms must reduce their own outputs, which increases the outputs of the firms outside the merger, thus reducing the profits of the merged firms if their new market share is not sufficiently large (Salant et al., 1983).

2.1.3.2. Use of any plant under merger

Now assume that the merged firm can produce either in country H or in country F. [9] We have already seen the incentives for merger if the merged firm produces in country F. Let us now consider the case where the merged firm produces in country H. If the merged firms produces in country H, the profit of the merged firm is $\pi_H^{d,m} = \frac{(a-t)^2}{4}$. It should be immediate that this is greater than the joint profits of firms 1 and 2 under exporting by firm 1, since the cost of exporting is the same but

[9] It is important to note that, under green-field FDI and merger, it may be possible for the firm to produce in both country H and country F following Mukherjee (2005), if it could commit certain amount of production in the plant in H before the wage setting in F. However, if the commitment about production in H is not credible or there are resource constraints or diseconomies of managing and operating two plants (as in Barros and Cabral, 2003, Fumagalli, 2003 and Bjorvatn and Eckel, 2006, to name a few), production in both plants cannot be the equilibrium outcome and the merged firm will produce only in one country, which is what we assume in our analysis. Hence, like the existing papers on FDI and labor unions, mentioned in the introduction, the firm considers expoprt and FDI (green-field or merger) as substitutes, and production in both H and F is not a posibility.

there is product market concentration (collusion). Thus, merger can occur even under decentralized unions if the merged firm can use its plant in country H.

However, we have one more comparison to make, i.e., whether merger is profitable compared to when firm 1 does green-field FDI, and the result is ambiguous. This is because, on the one hand, the merger increases market concentration, and on the other hand, exporting its product from country H to country F requires trade costs. If the merged firm produces in country H, its profit is $\pi_H^{d,m} = \frac{(a-t)^2}{4}$, but if firm 1 does green-field FDI, the joint profit of firms 1 and 2 is $\pi_1^{d,f} + \pi_2^{d,f} = \frac{8a^2}{81}$. The profit under merger and production in country H is higher than the joint profit of firms 1 and 2 if firm 1 does green-field FDI provided $a > \frac{9t}{9-4\sqrt{2}}$, which implies that if $a \in (\frac{7t}{5}, \frac{9t}{9-4\sqrt{2}})$, firm 1 prefers green-field DI than merger even if the merged firm can produce in any country. Therefore, if the merged firm can produce in any country, merger always occurs if the alternative is exporting by firm 1, while merger may or may not occur if the alternative is green-field FDI by firm 1.

Therefore, the following proposition is immediate.

Proposition 3: *If the merged firm can produce in any country, merger occurs for* $a \in (\frac{9t}{9-4\sqrt{2}}, 3t)$*, but the merged firm uses the plant in country H. Firm 1 does green-field FDI for* $a \in (\frac{7t}{5}, \frac{9t}{9-4\sqrt{2}})$.

2.2. Centralized Labor Union

In this subsection we turn to centralized unionization, where a single labor union determines the wage rates for all firms producing in country F. If firm 1 serves country F either through exports or merge with firm 2, then there is a single producer in F, and it should be clear that the equilibrium values under a centralized labor union are similar to subsections 2.1.1. and 2.1.3.

However, if firm 1 does green-field FDI in F, the analysis under a centralized union will be different from that of subsection 2.1.2. Then, the equilibrium outputs can be derived as $q_1^{c,f} = \frac{(a - 2w_1^{c,f} + \lambda w_2^{c,f})}{3}$ and $q_2^{c,f} = \frac{(a - 2\lambda w_2^{c,f} + w_1^{c,f})}{3}$, where $w_1^{c,f}$ and $w_2^{c,f}$ are the wage rates charged by the centralized union to firms 1 and 2 respectively. Therefore, the centralized labor union chooses $w_1^{c,f}$ and $w_2^{c,f}$ to maximize the following expression:

$$\underset{w_1^{c,f}, w_2^{c,f}}{Max} \frac{w_1^{c,f}(a - 2w_1^{c,f} + \lambda w_2^{c,f}) + w_2^{c,f}\lambda(a - 2\lambda w_2^{c,f} + w_1^{c,f})}{3}. \quad (9)$$

The equilibrium wage rates are $w_1^{c,f} = \frac{a}{2}$ and $w_2^{c,f} = \frac{a}{2\lambda}$, and both firms' profits are respectively

$$\pi_1^{c,f} = \frac{a^2}{36} \text{ and } \pi_2^{c,f} = \frac{a^2}{36}. \quad (10)$$

Note that here both firms always produce positive outputs.

At this point, it is worth noting that if firm 1 does green-field FDI, its profit under decentralized unions, which is $\pi_1^{d,f} = \frac{4a^2}{81}$, is greater than its profit under a centralized union, which is $\pi_1^{c,f} = \frac{a^2}{36}$. Therefore, in the absence of exporting, the incentive for FDI is higher under decentralized unions than under a centralized union. This situation contrasts that in Leahy and Montagna (2000), where the exogenous

profit alternative to FDI implies that the incentive for FDI is determined by the profits under FDI only. And they show that FDI incentive may be higher under a centralized union if the firms are asymmetric. The wage discrimination by a centralized union in our analysis is responsible for deriving our result. In our analysis, a centralized union not only eliminates competition between the unions, but also provides the union further flexibility by allowing it to offer different wages between the firms. As a result, a centralized labor union is more harmful to the firms in our analysis compared to Leahy and Montagna (2000). Note that, if firm 1 does green-field FDI, it pays the wage rate $w_1^{d,f} = \frac{a}{3}$ under decentralized unions, which is lower than the wage rate it pays under a centralized labor union, which is $w_1^{c,f} = \frac{a}{2}$.

Proposition 4: *Under a centralized union, firm 1 prefers green-field FDI (export) to export (green-field FDI) if* $a \in (\frac{7t}{5}, \frac{7t}{3})$ $(a > \frac{7t}{3})$.

Proof: Under a centralized union, if $a > \frac{7t}{5}$, both firms produce positive outputs irrespective of whether firm 1 exports or does green-field FDI. Further, (3) and (10) show that firm 1's profit is higher under green-field FDI (export) provided $a < (>) \frac{7t}{3}$. Given that both firms always produce positive outputs, firm 1 prefers green-field FDI (export) to export (green-field FDI) if $a \in (\frac{7t}{5}, \frac{7t}{3})$ $(a > \frac{7t}{3})$. Q.E.D.

Like the case of decentralized unions, Proposition 4 also shows that firm 1 does not prefer FDI to exporting if the trade cost is sufficiently small, which again contrasts with Leahy and Montagna (2000), where the assumption of "exogenous

alternative payoff" can always generate FDI as the equilibrium entry strategy if the alternative payoff to FDI is sufficiently small.

2.2.1. Merger

Let us now consider centralized unionization and the possibility of merger between firms 1 and 2. As in decentralized unions, the choice of plant under merger will have important impacts on the equilibrium production strategy of firm 1.

2.2.1.1. Merged firm uses the plant in country F

Assume that government regulation induces the merged firm to produce in country F. Then, we have the following proposition.

Proposition 5: *If the merged firm must produce in country F, then, under a centralized union, merger occurs if* $a \in (\frac{7t}{5}, \frac{7t}{3})$*, and does not occur if* $(a > \frac{7t}{3})$*.*

Proof: From Proposition 4, and comparing the profits in (7) and (10), one finds that a merger is profitable than green-field FDI by firm 1 (which occurs for $a \in (\frac{7t}{5}, \frac{7t}{3})$), since the profit under merger, which is $\frac{a^2}{16}$, is greater than the joint profit of firms 1 and 2 under green-field FDI by firm 1, which is $\frac{a^2}{18}$.

Next, consider the case of $a > \frac{7t}{3}$. Here, exporting is the alternative to merger. The profit under merger is greater the joint profit of firms 1 and 2 under exporting provided

$$0 > 20a^2 + 53t^2 - 62at. \qquad (11)$$

(RHS) of (11) is convex with respect to a and reaches minimum at $a = \frac{31t}{20}$, and $\frac{31t}{20} < \frac{7t}{3}$. Since exporting occurs for $a > \frac{7t}{3}$, the relevant values of a to consider for (11) are $a > \frac{7t}{3}$. We get that RHS of (11) is positive for $a > \frac{7t}{3}$. This proves the result. Q.E.D.

This above result contrasts with the case of decentralized labor unions, in which merger is always dominated when the merged firm is required to produce in country F. Since there is only one producer in country F under either exporting by firm 1 or merger, the reason for the former to dominate the latter is similar to what we have described in subsection 2.1.3.1.

Finally we compare merger with green-field FDI by firm 1. A merger reduces competition and increases profits, but unionization would take away a share of the realized profits from the firms. If firm 1 chooses to undertake green-field FDI, it creates some competition between the firm-specific unions under decentralized unionization, but no such competition exists under centralized unionization. Hence, unlike decentralized unions, a merger under a centralized union does not reduce the number of unions. That is, under a centralized union, merger does not create the positive externality effect by reducing competition between the unions, while it increases product market concentration. Therefore, even if merger increases the average wage rate compared to green-field FDI by firm 1 (since the wage rate under merger is $w^{d,m} = \frac{a}{2}$, while the wage rates under green-field FDI by firm 1 are $w_1^{c,f} = \frac{a}{2}$ and $w_2^{c,f} = \frac{a}{2\lambda}$), the positive effect of product market competition makes merger profitable under a centralized union.

Combining Propositions 4 and 5, we obtain:

Corollary 1: *Under centralized unionization, green-field FDI is always dominated.*

2.2.1.2. Use of any plant under merger

We have seen in subsection 2.2.1.1 that merger dominates green-field FDI by firm 1 even if the merged firm uses the plant in country F, and it follows from subsection 2.1.3.2 that the firms will prefer to merge and produce in country H if the alternative to merger is exporting by firm 1. Therefore, unlike decentralized unions, merger always occurs under a centralized union if the merged firm is allowed to produce in either country H or country F.

It remains to be examined whether the merged firm can be better off by producing in country H than in country F, if the union is centralized and green-field FDI by firm 1 is the alternative to merger. If the merged firm produces in country F, its profit is $\pi^{d,m} = \frac{a^2}{16}$. But, if the merged firm produces in country H, its profit is $\pi_H^{d,m} = \frac{(a-t)^2}{4}$. Therefore, the merged firm prefers to produce in country F (country H) provided $a < (>) 2t$. Since, it follows from Proposition 4 that green-field FDI by firm 1 is the alternative to merger for $a \in (\frac{7t}{5}, \frac{7t}{3})$, the merged firm prefers to produce in country F (country H) for $a \in (\frac{7t}{5}, 2t)$ ($a \in (2t, \frac{7t}{3})$. More specifically, the merged firm produces in country F if the market is very small, since the cost of exporting (which is t) is higher than the cost of producing in country H (which is the wage rate $w^{d,m} = \frac{a}{2}$) if the market is very small (i.e., $a < 2t$).

Hence, the following proposition is immediate.

Proposition 6: *If the merged firm is allowed to produce in any country, merger always occurs under a centralized union. The merged firm produces in the host country F provided that the market is very small (* $a \in (\frac{7t}{5}, 2t)$ *).Otherwise, it produces in country H.*

2.3. The Effects of Unionization Structure

We are now in position to compare the effects of the unionization structure on the production strategy of firm 1, which depends on whether the merged firm needs to produce in country F and on the type of unionization.

Proposition 7: *Suppose the merged firm is required to produce in country F. If firm 1 decides to do FDI, it prefers green-field FDI under decentralized unions, while it prefers to merge with firm 2 under a centralized union. Firm 1's incentive for FDI is higher under the decentralized unions than under a centralized union.*

Proof: It follows from Propositions 1, 2 and 5 that firm 1 prefers to do green-field FDI under decentralized unions and merger under a centralized union for $a \in (\frac{7t}{5}, 3t)$ and $a \in (\frac{7t}{5}, \frac{7t}{3})$ respectively. Since, $3t > \frac{7t}{3}$, it proves the result. Q.E.D.

Since, competition between the unions is eliminated under a centralized union and the flexibility to charge different wage rates to different firms remains under a centralized union, the decentralized unions are less harmful for the firms compared to

a centralized union. As a result, firm 1's incentive for FDI is higher under a centralized union than under decentralized unions.

Let us now consider firm 1's production strategy if the merged firm can produce in any country. Comparison of Propositions 3 and 6 gives the following result immediately.

Proposition 8: *Assume that the merged firm can produce in any country. Under decentralized unions, firm 1 may do green-field FDI, but merger always occurs under a centralized union. Further, under decentralized unions, the merged firm always produces in the non-unionized country, while, under a centralized union, the merged firm produces in the host country if the market is small.*

3. Discussion and Conclusions

This paper considered the effects of different unionization structures on the incentives for FDI and on what type of FDI a firm may take. We find that whether policies induce the merged firm to produce in the host country has important implications on the incentives for merger. If the merged firm is required to produce in the host country, the foreign firm prefers to undertake green-field FDI under decentralized unions, while it prefers merger under a centralized union. The firm's incentive for FDI (either green-field FDI or merger) compared to exporting is higher under decentralized unions than under a centralized union. However, if the merged firm is allowed to produce in any country, it increases the incentive for merger. We find that, under a centralized union, merger always occurs and the merged firm produces in the host country if the market is very small. However, under decentralized unions, the merged firm chooses to produce in the non-unionized country, and green-field FDI may occur in equilibrium, even if the merged firm can produce in any country.

To demonstrate the wage effects of different types of FDI compared to exporting in the simplest way, we have abstracted our analysis from some important aspects such as the number of firms, synergy from merger and the effect of bargaining between the firms and the unions. However, it will be intuitive to see their impacts on our results.

Let us first consider bargaining between the firms and the unions. We have considered the extreme case where the full bargaining power is with the labor union. For the other extreme situation, where the full bargaining power is with the firms, the wage rates will always be equal to the reservation wage rates of the labors. It is trivial that, in this situation, the firms always prefer merger and the merged firm will always produce in the host country since this allows them to obtain the advantage of product market concentration and to produce at the least cost. Hence, it must be clear that, our results will hold if the bargaining power of the unions is not very small.

Second, in our analysis, we have assumed that merger does not create any synergic benefits, while it is often the case that merger generates synergy by allowing the firms to put together their expertise. If there is synergy from merger, it would be trivial to understand that, merger is more likely to occur and so we may always observe merger even under decentralized unions.

Next, we have assumed that there is a single firm in each country and merger creates monopoly in the industry. It is well known that, in a Cournot oligopoly, merger between a subset of firms creates positive externality to the firms outside the merger (Salant et al., 1983), and therefore, a merger is not profitable unless a significant number of firms merge. However, this externality does not arise if there are no firms outside merger. Our assumption of a duopoly helps us to focus only on the wage effects of different types of FDI compared to exporting by eliminating this product market externality, since in our analysis merger between the firms create

monopoly in the industry. Thus, if there are firms outside merger, the positive merger externality on the non-merged firms will prevail along with the wage effects of merger, and will reduce the profitability of merger. Therefore, in the presence of firms outside the merger, it is not necessary that merger always dominates green-field FDI under a centralized union. However, since the positive externality effect prevails irrespective of the unionization structure, the possibility of merger will be higher under a centralized union than under decentralized unions.

Finally, we have assumed that there is a single firm doing FDI. However, if there are more firms, it will generate the possibility of merger by many firms and multiple mergers. As a result, along with the wage effects shown in this paper, there will be additional strategic effects of FDI and merger choices, which may have important implications on the equilibrium outcomes. We leave this and related issues for future research.

Appendix

An alternative formulation for firm asymmetry:

In the text, we have assumed that firms 1 and 2 differ in terms of the labor coefficient. Let us now consider an alternative formulation for firm asymmetry. Assume that firm 1 requires only labors to produce its output, while firm 2 requires both workers and an intermediate input,[10] and the input-output ratio is 1 to 1 for both firms for all inputs.[11]

As in the text, workers are immobile between countries, and the labor market in H is perfectly competitive, while that in F is unionized. The reservation wages are assumed to be zero in both countries. We assume that firm 2 can buy the intermediate input in the world market at a perfectly competitive price, c. Exporting by firm 1 requires per-unit trade cost, t. Further, the inverse market demand and the moves of the game are similar to the text. We restrict our attention to those parameter values which ensure that both firms always produce positive outputs if they compete in the product market.

A.1. Decentralized unions

If firm 1 does exports, given the wage rates, the equilibrium outputs of firms 1 and 2 are respectively $q_1^{d,x} = \frac{(a - 2t + w_2^{d,x} + c)}{3}$ and $q_2^{d,x} = \frac{(a - 2w_2^{d,x} - 2c + t)}{3}$.

Next, the labor union in the host country chooses $w_2^{d,x}$ to maximize the following expression:

$$\underset{w_2^{d,x}}{Max} \ \frac{(a - 2w_2^{d,x} - 2c + t)}{3} w_2^{d,x}. \qquad \text{(A.1)}$$

[10] Our assumption that firm 1 does not need the intermediate input is for simplicity. The qualitative results of this paper do not change if firm 1 requires an intermediate input, as long as its requirement is lower than firm 2.

[11] It may be worth mentioning that our qualitative results remain if λ workers are required to produce one unit of output.

The equilibrium wage rate is found to be $w_2^{d,x} = \frac{a-2c+t}{4}$, and the equilibrium profits of firms 1 and 2 are respectively

$$\pi_1^{d,x} = \frac{(5a-7t+2c)^2}{144} \quad \text{and} \quad \pi_2^{d,x} = \frac{4(a+t-2c)^2}{144}. \tag{A.2}$$

Note that firms 1 and 2 produce positive outputs respectively provided $a > \frac{7t-2c}{5}$ and $a > 2c-t$. We also have $\frac{7t-2c}{5} \gtrless 2c-t$ provided $t \gtrless c$.

If firm 1 decides to conduct green-field FDI and opens a fully owned subsidiary in country F, the equilibrium outputs of firms 1 and 2 are respectively $q_1^{d,f} = \frac{(a-2w_1^{d,f}+w_2^{d,f}+c)}{3}$ and $q_2^{d,f} = \frac{(a-2w_2^{d,f}-2c+w_1^{d,f})}{3}$. The respective labor unions choose the wage rates to maximize the following expressions simultaneously:

$$\underset{w_1^{d,f}}{Max} \ \frac{(a-2w_1^{d,f}+w_2^{d,f}+c)}{3} w_1^{d,f}, \tag{A.3a}$$

$$\underset{w_{21}^{d,f}}{Max} \ \frac{(a-2w_2^{d,f}-2c+w_1^{d,f})}{3} w_2^{d,f}. \tag{A.3b}$$

The equilibrium wage rates are found to be $w_1^{d,f} = \frac{(5a+2c)}{15}$ and $w_2^{d,f} = \frac{(5a-7c)}{15}$, and the equilibrium profits of firms 1 and 2 are respectively

$$\pi_1^{d,f} = \frac{(10a+4c)^2}{2025} \quad \text{and} \quad \pi_2^{d,f} = \frac{(10a-14c)^2}{2025}. \tag{A.4}$$

Note that while firm 1 always produces positive output, firm 2 produces positive output if and only if $a > \frac{7c}{5}$.

Proposition A.1: *If* $5t > 3c$, *under decentralized unions, firm 1 prefers green-field FDI (export) than export (green-field FDI) if* $a \in (\max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}, \frac{15t-2c}{5})$ *(*$a > \frac{15t-2c}{5}$*). Exporting occurs for* $5t < 3c$.

Proof: Under decentralized unions, if $a > \max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}$, both firms always produce positive outputs irrespective of whether firm 1 exports or does green-field FDI. Further, the comparison of firm 1's profits in (A.2) and (A.4) shows that firm 1's profit is higher under green-field FDI (export) provided $a < (>)\frac{15t-2c}{5}$. If $5t > 3c$, we get $\frac{15t-2c}{5} > \max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}$. Therefore, firm 1 prefers green-field FDI (export) than export (green-field FDI) if $a \in (\max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}, \frac{15t-2c}{5})$ ($a > \frac{15t-2c}{5}$).

However, if $5t < 3c$, we get $\frac{15t-2c}{5} < \max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}$. Since positive outputs of all firms require that $a > \max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\} > \frac{15t-2c}{5}$, exporting occurs for $5t < 3c$. Q.E.D.

Now consider a merger between the two firms. The merged firm uses the relatively efficient production technology of firm 1.

First, consider the situation where regulation requires that the merged firm must produce in the host country F. Given the wage rate, the equilibrium output of the

merged monopoly is $q^{d,m} = \frac{(a - w^{d,m})}{2}$. The labor union in F chooses $w^{d,m}$ to maximize the following expression:

$$\underset{w^{d,m}}{Max} \frac{w^{d,m}(a - w^{d,m})}{2}. \tag{A.5}$$

The equilibrium wage rate is $w^{d,m} = \frac{a}{2}$, and the corresponding profit is

$$\pi^{d,m} = \frac{a^2}{16}. \tag{A.6}$$

Proposition A.2: *If the merged firm is required to produce in country F, under decentralized labor unions, a merger between firms 1 and 2 is always dominated by both export and green-field FDI by firm 1.*

Proof: If firms 1 and 2 prefer merger, their joint profits must be greater under merger than under other alternatives. Note that their alternative joint profits are their total profits under either green-field FDI or exporting by firm 1.

Let us first consider green-field FDI, which occurs if $5t > 3c$ and $a \in (\max\{\frac{7t - 2c}{5}, 2c - t\}, \frac{15t - 2c}{5})$. The joint profit of firms 1 and 2 is higher under merger compared to green-field FDI by firm 1 provided

$$\pi^{d,m} > \pi_1^{d,f} + \pi_2^{d,f},$$

or $$0 > 1175a^2 - 3200ac + 3392c^2. \tag{A.7}$$

RHS of (A.7) is convex with respect to a and reaches a positive minimum at $a = \frac{64c}{47}$. Therefore, condition (A.7) does not hold, which implies that the joint profit of firms 1 and 2 under merger is lower than their counterparts with green-field FDI by firm 1.

Next, consider exporting by firm 1, which occurs either for $5t > 3c$ and $a > \frac{15t - 2c}{5}$ or for $5t < 3c$ and $a > \max\{\frac{7t - 2c}{5}, 2c - t\}$. The joint profit of firms 1 and 2 is higher under merger compared to exporting by firm 1 provided

$$\pi^{d,m} > \pi_1^{d,x} + \pi_2^{d,x},$$

or $$0 > (5a - 7t + 2c)^2 + 4(a - 2c + t)^2 - 9a^2. \quad \text{(A.8)}$$

We find that the RHS of (A.8) is convex with respect to a and reaches minimum at $a = \frac{31t - 2c}{20}$.

If $5t > 3c$, exporting occurs for $a > \frac{15t - 2c}{5}$, and $\frac{15t - 2c}{5} > \frac{31t - 2c}{20}$. Therefore the relevant values of a to consider for (A.8) are $a > \frac{15t - 2c}{5}$. We get that RHS of (A.8) is positive for $a > \frac{15t - 2c}{5}$.

Next, consider the case of $5t < 3c$, where exporting occurs for $a > \max\{\frac{7t - 2c}{5}, 2c - t\}$. If $5t < 3c$, we get that $2c - t > \frac{7t - 2c}{5}$. Further, $2c - t > \frac{31t - 2c}{20}$, which implies that, if $5t < 3c$, the relevant values of a to consider for (A.8) are $a > 2c - t$. We get that RHS of (A.8) is positive for $a > 2c - t$. This proves the result. Q.E.D.

Now assume that the merged firm can produce either in country H or in country F. We have already seen the incentives for merger if the merged firm produces in country F. Let us now consider the case where the merged firm produces in country H. If the merged firms produces in country H, the profit of the merged firm

is $\pi_H^{d,m} = \frac{(a-t)^2}{4}$. It should be immediate that this is greater than the joint profits of firms 1 and 2 under exporting by firm 1, since the cost of exporting is the same but there is product market concentration (collusion). Thus, merger can occur even under decentralized unions if the merged firm can use its plant in country H.

Let us consider whether merger is profitable compared to when firm 1 does green-field FDI, and the result is ambiguous. As an example, assume that $t = c$. Here, the joint profit of the firms under merger (and using the plant in country H) is higher than their joint profit if firm 1 does green-field FDI provided $\frac{(a-t)^2}{4} > \frac{(10a+4t)^2 + (10a-14t)^2}{2025}$. We find that this condition is satisfied if $a > \frac{t(325+36\sqrt{37})}{245}$, where $\frac{7t}{5} < \frac{t(325+36\sqrt{37})}{245} < \frac{13t}{5}$.[12]

Therefore, the following proposition is immediate.

Proposition A.3: *If the merged firm can produce in any country, merger may occur even under decentralized unions, but the merged firm uses the plant in country H. Merger always occurs if the alternative is exporting by firm 1, while merger may or may not occur if the alternative is green-field FDI by firm 1.*

A.2. Centralized Labor Union

If firm 1 serves country F either through exports or merge with firm 2, then there is a single producer in F, and the equilibrium values will similar to the one shown under decentralized unions.

[12] Note that if $t = c$, the firm prefers green-field FDI to exporting if $a \in (\frac{7t}{5}, \frac{13t}{5})$.

However, if firm 1 does green-field FDI in F, the analysis under a centralized union will be different from that of under decentralized unions. Then, the equilibrium outputs can be derived as $q_1^{c,f} = \frac{(a - 2w_1^{c,f} + w_2^{c,f} + c)}{3}$ and $q_2^{c,f} = \frac{(a - 2w_2^{c,f} - 2c + w_1^{c,f})}{3}$. Therefore, the centralized labor union chooses $w_1^{c,f}$ and $w_2^{c,f}$ to maximize the following expression:

$$\underset{w_1^{c,f}, w_2^{c,f}}{Max} \frac{w_1^{c,f}(a - 2w_1^{c,f} + w_2^{c,f} + c) + w_2^{c,f}(a - 2w_2^{c,f} - 2c + w_1^{c,f})}{3}. \qquad \text{(A.9)}$$

The equilibrium wage rates are $w_1^{c,f} = \frac{a}{2}$ and $w_2^{c,f} = \frac{(a-c)}{2}$, and both firms' profits are respectively

$$\pi_1^{c,f} = \frac{(a+c)^2}{36} \text{ and } \pi_2^{c,f} = \frac{(a-2c)^2}{36}. \qquad \text{(A.10)}$$

Note that firm 1 always produces positive outputs, while firm 2 produces positive outputs provided $a > 2c$.

Proposition A.4: *If $7t > 6c$, under a centralized union, firm 1 prefers green-field FDI (export) to export (green-field FDI) if $a \in (\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$ ($a > \frac{7t}{3}$).*

Exporting occurs for $7t < 6c$.

Proof: Under a centralized union, if $a > \max\{\frac{7t-2c}{5}, 2c\}$, both firms produce positive outputs irrespective of whether firm 1 exports or does green-field FDI. Further, (A.2) and (A.10) show that firm 1's profit is higher under green-field FDI (export) provided $a < (>)\frac{7t}{3}$. If $7t > 6c$, we get $\frac{7t}{3} > \max\{\frac{7t-2c}{5}, 2c\}$. Therefore,

firm 1 prefers green-field FDI (export) to export (green-field FDI) if $a \in (\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$ ($a > \frac{7t}{3}$).

If $7t < 6c$, we get $\frac{7t}{3} < \max\{\frac{7t-2c}{5}, 2c\}$. Since positive outputs of all firms require that $a > \max\{\frac{7t-2c}{5}, 2c\}$, exporting occurs for $7t < 6c$. Q.E.D.

Let us now consider centralized unionization and the possibility of merger between firms 1 and 2. Assume that government regulation induces the merged firm to produce in country F. Then, we have the following proposition.

Proposition A.5: *If the merged firm must produce in country F, then, under a centralized union, merger occurs if* $a \in (\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$, *and does not occur if* ($a > \frac{7t}{3}$).

Proof: From Proposition A.4, and comparing the profits in (A.6) and (A.10), one finds that a merger is profitable than green-field FDI by firm 1 (which occurs for $7t > 6c$ and $a \in (\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$) provided

$$(a+10c)(a-2c) > 0, \qquad \text{(A.11)}$$

and it holds always since $a > 2c$. Therefore, a merger occurs always if $a \in (\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$.

Now we compare the profits under and green-field FDI, which occurs if either $7t > 6c$ and $a > \frac{7t}{3}$ or $7t < 6c$ and $a > \max\{\frac{7t-2c}{5}, 2c\}$. Since, there is only one firm producing in country F under merger and under exporting, the profitability of

merger over exporting is given by condition (A.8). We have seen that RHS of (A.8) is convex with respect to a and reaches minimum at $a = \frac{31t - 2c}{20}$.

Since, $\frac{7t}{3} > \frac{31t - 2c}{20}$, the relevant values of a to consider for (A.8) are $a > \frac{7t}{3}$ if $7t > 6c$. We get that RHS of (A.8) is positive for $a > \frac{7t}{3}$.

Next, consider the case of $7t < 6c$, where exporting occurs for $a > \max\{\frac{7t - 2c}{5}, 2c\}$. If $7t < 6c$, we get that $2c > \frac{7t - 2c}{5}$. Further, $2c > \frac{31t - 2c}{20}$, which implies that, if $7t < 6c$, the relevant values of a to consider for (A.8) are $a > 2c$. We get that RHS of (A.8) is positive for $a > 2c - t$. This proves the result.

Q.E.D.

Combining Propositions A.4 and A.5, we obtain that u*nder centralized unionization, green-field FDI is always dominated.*

We have already seen that merger dominates green-field FDI by firm 1 even if the merged firm uses the plant in country F, and it follows from the above discussion that the firms will prefer to merge and produce in country H if the alternative to merger is exporting by firm 1. Therefore, unlike decentralized unions, merger always occurs under a centralized union if the merged firm is allowed to produce in either country H or country F.

Let us now see whether the merged firm can be better off by producing in country H than in country F, if the union is centralized and green-field FDI by firm 1 is the alternative to merger. If the merged firm produces in country F, its profit is $\pi^{d,m} = \frac{a^2}{16}$. But, if the merged firm produces in country H, its profit is

$\pi_H^{d,m} = \frac{(a-t)^2}{4}$. Therefore, the merged firm prefers to produce in country F (country H) provided $a < (>) 2t$. Since, it follows from Proposition A.4 that green-field FDI by firm 1 is the alternative to merger for $a < \frac{7t}{3}$, the merged firm prefers to produce in country F (country H) for $a < 2t$ ($a \in (2t, \frac{7t}{3})$.

Hence, the following proposition is immediate.

Proposition A.6: *If the merged firm is allowed to produce in any country, merger always occurs under a centralized union. The merged firm produces in the host country F provided that the market is very small ($a < 2t$).Otherwise, it produces in country H.*

A.3. The Effects of Unionization Structure

Let us now consider the effects of unionization structure on the production strategy of firm 1.

Proposition A.7: *Suppose the merged firm is required to produce in country F. If firm 1 decides to do FDI, it prefers green-field FDI under decentralized unions, while it prefers to merge with firm 2 under a centralized union. Firm 1's incentive for FDI is higher under the decentralized unions than under a centralized union.*

Proof: It is immediate from Propositions A.1 and A.5 that if $10t > 6c > 7t$, FDI occurs only under decentralized unions. Hence, it is trivial that, in this situation, the incentive for FDI is higher under decentralized unions.

Let us now consider that $10t > 7t > 6c$. In this situation, FDI occurs under both decentralized and centralized unions. However, it follows from Propositions A.1,

A.2 and A.5 that firm 1 prefers to do green-field FDI under decentralized unions and merger under a centralized union for $a \in (\max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}, \frac{15t-2c}{5})$ and $a \in (\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$ respectively. If $10t > 7t > 6c$, we get $\frac{15t-2c}{5} > \frac{7t}{3}$ and $\max\{\frac{7t-2c}{5}, 2c\} \geq \max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}$, which implies that the interval $\max\{\frac{7t-2c}{5}, 2c-t, \frac{7c}{5}\}, \frac{15t-2c}{5})$ is greater than the interval $\max\{\frac{7t-2c}{5}, 2c\}, \frac{7t}{3})$. Hence, the incentive for FDI is higher under decentralized unions than under a centralized union. Q.E.D.

Let us now consider firm 1's production strategy if the merged firm can produce in any country. Comparison of Propositions A.3 and A.6 gives the following result immediately.

Proposition A.8: *Assume that the merged firm can produce in any country. Under decentralized unions, firm 1 may do green-field FDI, but merger always occurs under a centralized union. Further, under decentralized unions, the merged firm always produces in the non-unionized country, while, under a centralized union, the merged firm produces in the host country if the market is small.*

Hence, we find that the qualitative results of this alternative formulation are similar to the results shown in the text, which imply that our results are does not depend on whether the firm asymmetry is the outcome of the difference in labor productivity or not.

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