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DOMESTIC COMPETITION AND FOREIGN DIRECT INVESTMENT IN UNIONIZED OLIGOPOLY

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Domestic Competition and Foreign Direct Investment in Unionized Oligopoly*

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Abstract

It is often argued, though mostly informally, that outward foreign direct investment (FDI) is a synonym for the export of employment and thus detrimental to the home economy. To see whether and under what conditions this intuition indeed holds true, we construct a model of unionized duopoly and examine welfare implications of outward FDI by paying special attention to the role of domestic competition. We find that the welfare effect of FDI is largely non-monotonic, and there are indeed such things as "excessive FDI." We also show that, when FDI reduces welfare, this negative effect arises more at the expense of consumers rather than the unions: in fact, quite contrary to the popular belief, FDI may actually benefit the unions because it serves to soften price competition between them. The paper points out that welfare effects of outward FDI hinges crucially on the nature of domestic competition, and policymakers must carefully take this aspect into consideration.

JEL classification numbers: F21, J31, L13.

Key words: R&D investment, vertical relation, transport cost, welfare, wage bargaining

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1 Introduction

Should a government encourage, or even subsidize, globalization of domestic firms? If so, then to what extent? With the increasing degree of globalization,[1] those questions become more and more critical for policymakers these days. Specifically at issue, regarding those questions, is the welfare effect of outward FDI on the home country: a policy intervention that encourages domestic firms to expand abroad can be justified only if outward FDI indeed proves to be welfare-improving. While the answer to this question is not necessarily straightforward, many government authorities in reality appear to be in favor of outward FDI and are often eager to encourage globalization of domestic firms in various ways. To name a few, the Canadian Trade Commissioner Service and the Japan External Trade Organization (JETRO) provide information and various types of support, as one of their missions, to help Canadian and Japanese firms, respectively, to expand overseas. The Swiss Organization for Investment Facilitation (SOFI) was set up in 1997 by the Swiss Secretariat for Economic Affairs to offer a wide scope of services to promote outward FDI. The Spanish Institute for Foreign Trade organizes fairs named *Expotecnia* in various countries in an attempt to boost outward FDI as well as exports. Countries such as Singapore, South Korea and Mexico have gone even further by creating what is called "comfort zones" in host countries to facilitate outward FDI.[2] In many cases, attempts are made not only to reduce or remove potential barriers but also to actively promote outward FDI through several policy instruments, ranging from disseminating information on investment opportunities to providing investment insurance against political risk.

This tendency seems to suggest that there is an emerging global consensus, at least among policymakers, that outward FDI is generally beneficial for the home country and should therefore be encouraged. To justify this policy stance, there is certainly a bright side of outward FDI because firms that undertake FDI can improve their productive efficiency through several channels. First, firms may invest abroad to save transport costs, including tariffs and other non-tariff trade barriers, which allows them to serve the foreign market more efficiently.

[1] The amount of outward FDI has steadily increased over time and now reached 778.7 billion dollars worldwide in 2005, compared to the annual average of 553.1 billion over 1994-1999 (UNCTAD, World Investment Report 2006).

[2] One notable example of comfort zones is the China-Singapore Suzhou Industrial Park. The basic idea behind this project is "to offer a one-stop point of access to various government ministries as well as Singapore-style education, health and recreation facilities, and an international school (UNCTAD, World Investment Report 2006, p.211)."

Second, especially when firms invest in developing economies, FDI allows them to gain access to cheap raw material and labor force. Finally, outward FDI is also a means to acquire knowledge and to diversify country risk. Proponents of outward FDI would thus argue that FDI plays quite a similar role to R&D investment, which is normally welfare-improving if its investment cost is negligible, directed at the foreign market.

Despite those virtues, however, there may also be a cost associated with outward FDI when the production process involves some immobile factors such as labor. In such a case, the effect of outward FDI is no longer identical to that of R&D investment. It is often argued, though mostly informally, that FDI can be regarded as the export of employment and hence is detrimental to workers in the home country. Based on this argument, the overall welfare effect of FDI on the home country is ultimately determined by the tradeoff between firms' gains and workers' losses. FDI is not necessarily welfare-improving if firms gain only at the expense of domestic workers.[3]

While the welfare analysis of outward FDI offers critical policy implications, studies on the effect of outward FDI are relatively scarce, both theoretically and empirically.[4] The paper intends to fill this gap. In particular, the main purpose of this paper is to examine whether and under what circumstances the intuition mentioned above (that outward FDI may reduce social welfare) actually holds true. Special attention is paid to the role of domestic competition, i.e., how welfare implications of FDI are related to and influenced by the nature of market competition in the domestic market. To this end, we construct a model of unionized duopoly where there are two downstream firms, firms A and B, and two unions (or, more generally, upstream suppliers). Each firm procures labor input from its own union which possesses some bargaining power. We then look at a situation where firm A first determines whether to set up a plant in the foreign market and then firm B determines whether to follow its rival: for expositional clarity, we say that the first FDI (the second FDI) is undertaken when firm A (firm B) sets up a foreign plant.

Within this framework, we examine welfare and policy implications of outward FDI. We first show that when there is only one domestic firm in the market to begin with, outward FDI is *always* welfare-improving when the home and foreign markets are comparable in size.

[3]For instance, Skaksen and Sørensen (2001) show that unions are likely to lose on FDI if domestic and foreign activities are substitutable.

[4]The literature on the welfare effect of FDI has mainly focused on the effect of inward FDI, i.e., the effect of FDI on the host country. See Lipsey (2004) for an extensive survey on this issue.

Given this result, one might be tempted to conjecture that outward FDI is in general welfare-improving even in the presence of strong labor unions. As it turns out, however, this conclusion does not necessarily hold true with the addition of another rival firm. When there are more than one domestic firm-union pair, one firm's FDI decision affects not only its own union but also the other union as well. The main findings of the paper are summarized as follows:

1. FDI may reduce welfare in the presence of domestic competition. In particular, when the home and foreign markets are comparable in size, the second FDI *always* reduces welfare. Moreover, this holds true even when we disregard any fixed cost necessary to set up foreign plants, i.e., the effect of outward FDI can be purely negative. In general, an asymmetric pattern of FDI is socially desirable and hence the amount of FDI can easily be excessive in that sense.

2. The main reason why FDI reduces welfare is a reduction in consumer surplus. That is, FDI reduces welfare at the expense of consumers, rather than the unions. In fact, under certain conditions, the second FDI actually benefits the unions because it serves to soften price competition between them.

At the core of these results is the presence of domestic competition, which gives rise to effects that are hardly straightforward and have critical bearings on social welfare. The reason why the second FDI reduces social welfare and is especially detrimental to consumers is as follows. When a firm sets up a foreign plant, its union is consequently forced to concentrate on the home market that it can serve more effectively, and thus responds to this by raising its wage. The magnitude of this effect, however, depends heavily on the structure of FDI. When only one of the two firms undertakes FDI, there arises a differential between them in the cost of supplying to the foreign market. Because of this, the union of the less productive firm, the one that does not undertake FDI, must lower its wage to stay competitive in the foreign market, and intense price rivalry between the unions arises as a result: the presence of the rival firm thus functions as an anchor to keep the wages low in the domestic market. This is welfare-improving since lower wages lead to more output, which particularly benefits consumers. The effect of this price rivalry is totally wiped out, however, when the second (and the last, in this case) FDI is undertaken. The wages suddenly go up and the increase in the wages results in less output, which entails welfare losses. The result indicates that the welfare effect of outward FDI hinges critically on the nature of domestic competition, especially in its relation to upstream suppliers: when the price rivalry among upstream suppliers is intense, the amount of outward FDI can easily be excessive, even if the effect of fixed costs is fairly negligible. In light of this finding, we argue that any government intervention to encourage outward FDI could be beneficial only up to some point.

While the first result roughly confirms a popular view that outward FDI may reduce social welfare under certain conditions, it is important to note that this is not necessarily at the expense of the unions, as one might anticipate. The more dominant factor in this is rather a reduction in consumer surplus, resulting from higher wages. The effect of FDI, especially the second one, on the unions is less clear. The first FDI puts downward pressure on the wages in order to compete in the foreign market, and the price competition between the unions can be excessively intense from the unions' viewpoint. The second FDI may be beneficial for them, quite contrary to the popular belief, because it releases them from this downward pressure. In other words, as the option of exporting is no longer available, the second FDI serves as a strong commitment device to substantially soften price competition between the unions and consequently benefits them.

The present analysis is related to a line of research which deals with FDI in the presence of labor unions (Bughin and Vannini, 1995; Zhao, 1995, 2001; Leahy and Montagna, 2000; Skaksen and Sørensen, 2001; Naylor and Santoni, 2003; Lommerud et al., 2003; Ishida and Matsushima, 2005).[5] Among them, the paper is most closely related to Lommerud et al. (2003), on which our model framework is based. The difference lies in its goals and objectives: their model has only one domestic firm and hence does not consider domestic competition, which proves to be crucial for our main results. This difference amounts to different welfare and policy implications. We show that an asymmetric pattern of FDI is normally desirable from the social point of view whereas, in their mode with only one domestic firm, this situation by design cannot arise. Moreover, while they also point out that the amount of FDI can be excessive, it is due to the presence of the fixed cost: that is, they show that there arises a case in their model where the welfare gain from FDI is exceeded by the fixed cost of investment. In contrast, we argue that the pure welfare effect of FDI is often negative, meaning that FDI reduces welfare even when its fixed cost approaches zero, in the presence of domestic

[5]There is also a growing body of literature on international unionized oligopoly. Examples along this line include Brander and Spencer (1988), Naylor (1998, 1999), Straume (2002, 2003), Skaksen (2004), Lommerud et al. (2006), and Lommerud et al. (2009).

competition.

The paper proceeds as follows. The next section outlines the basic model. Section 3 analyzes as a benchmark a case with only one domestic firm and shows that outward FDI is normally welfare-improving. Section 4 extends the analysis to a case with two domestic firms and illustrate how market outcomes driven by upstream competition are affected by the amount of FDI. Section 5 extends the baseline model to include the option of full FDI. Finally, section 6 offers some concluding remarks.

2 The model

2.1 Basic environment

There are two markets, home and foreign, and two firms, denoted by A and B. Both of the firms are initially located in the home market.[6] Labor is unionized in the home market, whereas it is not in the foreign market. Each firm procures its labor input from its firm-specific union: we refer to the union of firm i as union i in the subsequent analysis. Needless to say, the unions can interchangeably be regarded as the upstream input suppliers.

2.2 Production and market competition

Each firm uses labor as the sole input and produces output in a constant-returns-to-scale technology. Let x^i denote i's sale in the home market and y^i denote i's sale in the foreign market ($i \in \{A, B\}$). We assume that the two countries are symmetric and the demand function for each country is given by

$$\begin{aligned} p &= 1 - (x^A + x^B), \\ q &= 1 - (y^A + y^B). \end{aligned}$$

p is the price level that prevails in the home market, while q is the price level in the foreign market. The firms engage in Cournot competition in each market. Following the convention, we adopt the segmented market hypothesis where the firms choose separate quantities for the two markets. If a firm in one market exports to the other, it must incur a transport cost per

[6]In Lommerud et al. (2003), there is only one firm that initially is located in the home market. The other firm is located in the foreign market and is non-unionized. The presence of domestic competition proves to give rise to strategic interactions and welfare implications absent in the case with only one domestic firm, as stated in the introduction. It should also be noted that our main results are qualitatively unchanged even when there exists a firm in the foreign market. See Appendix B for the case with a foreign firm.

unit, denoted by $t > 0$. The transport cost is meant to capture various trade barriers, most notably tariffs. Throughout the analysis, we restrict our attention to a case where $t \leq 0.5 \equiv \bar{t}$. Under this restriction, the firms choose nonnegative quantities to export.

Within this framework we consider a situation where firms A and B in the home market may potentially undertake FDI by shifting part (or all) of their productive capacities abroad. More precisely, each firm chooses one of the three alternatives, denoted by $j \in \{N, P, F\}$:

1. No FDI ($j = N$): A firm remains entirely in the domestic market and exports, if necessary, to the foreign market.

2. Partial FDI ($j = P$): A firm sets up a plant in the foreign market, which is used strictly to supply to that market.

3. Full FDI ($j = F$): A firm sets up a plant in the foreign market, which is used to supply to both of the market.

In the case of partial FDI, the firm operates two plants, one in each market, and the option of importing from its foreign plant is ruled out.[7] For most part, we examine the effect of partial FDI by restricting attention to the case where full FDI is not an available option. The model is later extended to incorporate the possibility of full FDI in section 5, mainly to show that this addition would not affect the substance of our model.

2.3 Unions

The difference in unionization across the two markets implies different costs of production. In this paper we focus on a situation where the two unions are disintegrated and each union independently supplies labor to its firm.[8] The competitive wage in the two countries is set equal to $\bar{w} = 0$.[9] Taking this as their reservation wage, the unions in the home market independently set wages to maximize the following utility function:

$$u^i = w^i z^i, \quad i = A, B.$$

z^i is firm i's production in the home country where $z^i = x^i$ ($z^i = x^i + y^i$) if its downstream firm undertakes FDI (no FDI).

[7] This assumption can be considered as a type of capacity constraint.

[8] The assumption that the unions are disintegrated turns out to be insignificant and innocuous as we can obtain qualitatively similar results even when they are integrated as an industry-wide union. See Appendix B for this extension.

[9] This is strictly to simplify the analysis since the competitive wage plays no role in a qualitative sense.

2.4 Timing

The timing of the model is summarized as follows:

1. the domestic firms sequentially choose whether to undertake FDI;
2. the unions simultaneously set wages to maximize their utilities;
3. the firms simultaneously choose quantities for each country to maximize their profits.

3 Benchmark: one domestic firm

3.1 Equilibrium wages and quantities

Before we proceed further, we first consider as a benchmark a case with only one domestic firm (for the analysis, we abbreviate the superscript i). The analysis of this benchmark case is instrumental in illustrating the role of domestic competition in unionized international oligopoly.

(N-FDI): In the absence of FDI, the monopolist maximizes

$$\max_{x,y}\ (1-x-w)x+(1-y-t-w)y,$$

subject to the constraint that all the quantities are nonnegative (this evidently applies for all subsequent problems). The first-order condition then leads to

$$x,y=\frac{1-w}{2},\frac{1-t-w}{2}.$$

Taking this into account, the union sets its wage to maximize the union utility. Depending on the transport cost, there arise two distinct cases. The firm chooses a positive quantity to export if the wage set by the union is sufficiently low relative to the transport cost, i.e., $1-t\geq w$. In this case, the union maximizes

$$\max_{z}\ w(x+y)=\frac{w(2-t-2w)}{2},\quad s.t.\ \ 1-t\geq w.$$

If the wage is sufficiently high, i.e., $1-t<w$, the union maximizes

$$\max_{w}\ wx=\frac{w(1-w)}{2},\quad s.t.\ \ 1-t<w.$$

It is then straightforward to obtain

$$w = \frac{(2-t)}{4}, \quad x, y = \frac{2+t}{8}, \frac{2-3t}{8}.$$

Given the firm's FDI choice j, the profit, the union utility, and the domestic consumer surplus are:

$$\pi_N = \frac{4-4t+5t^2}{32}, \ u_N = \left(\frac{2-t}{4}\right)^2, \ CS_N = \frac{(2+t)^2}{128}. \tag{1}$$

(P-FDI): If the monopolist undertakes partial FDI, it maximizes

$$\max_{x,y} \ (1-x-w)x + (1-y)y.$$

The first-order condition leads to

$$x, y = \frac{1-w}{2}, \frac{1}{2}.$$

The union loses the foreign market when its firm establishes a plant in the foreign market. The union's problem is thus defined as

$$wx = \frac{w(1-w)}{2}.$$

The union never sets the wage above the transport cost because it loses all the employment by doing so. Given this, we can show that

$$w = \frac{1}{2}, \quad x, y = \frac{1}{4}, \frac{1}{2}.$$

The profit, the union utility, and the domestic consumer surplus are:

$$\pi_P = \frac{5}{16}, \ u_P = \frac{1}{8}, \ CS_P = \frac{1}{32}. \tag{2}$$

3.2 Welfare effects of FDI with one domestic firm

We measure the social efficiency of FDI by what we refer to as the domestic welfare W_j, defined as $W_j \equiv \pi_j + u_j + CS_j$. The primary purpose here is to show that FDI is in general welfare-improving in the absence of domestic competition when the fixed cost of FDI is sufficiently small. This is despite the fact that the size of the market that the union can serve is cut in half when its firm undertakes FDI. This positive effect arises because FDI is a type of cost-reducing investment which allows the firm to save transport costs, and always dominates the loss of employment.[10]

In order to investigate the relationship between the firm's optimal choice and the overall social efficiency, we need to explicitly incorporate the fixed cost into the model. Let C_P denote the fixed cost necessary for partial FDI. Given this, the monopolist undertakes FDI if and only if

$$\pi_P - C_P \geq \pi_N \Leftrightarrow \frac{6 + 4t - 5t^2}{32} \geq C_P. \tag{3}$$

It is, on the other hand, socially efficient to undertake FDI if and only if

$$W_P - C_P \geq W_N \Leftrightarrow \frac{8 + 44t - 29t^2}{128} \geq C_P. \tag{4}$$

Examining these two conditions one can see that (3) is implied by (4) for $t \leq \bar{t}$, indicating that the incentive for FDI is in general excessive. This implies that simple transfer payments to subsidize outward FDI would never improve welfare.

Although simple transfers would not work even in this monopolistic case, the government can in general do more than just distributing subsidies. As stated in the introduction, the government may provide public goods and services (hereafter, we simply call them public goods), through disseminating information or providing various types of support, to reduce the fixed cost of FDI, thereby encouraging domestic firms to expand abroad. To see whether this type of government intervention can be ever warranted, we suppose that the government is able to provide public goods which reduce the fixed cost of FDI to $\lambda_0 C_j$ whereas the cost of providing those public goods is denoted by $\lambda_1 C_j$. Let $\lambda \equiv \lambda_0 + \lambda_1$ denote the social cost of FDI (the total cost incurred by the home country) where λ captures the social efficiency of the government intervention. We assume $\lambda \in (0, 1)$ so that the government intervention itself is efficient in that it decreases the social cost of FDI. Our question is then whether and when the government intervention of this type is justified. Under this formulation, the condition for the social efficiency is now given by

$$\frac{8 + 44t - 29t^2}{128} \geq \lambda C_P. \tag{5}$$

[10] This conclusion holds when the home and foreign markets are comparable in size. If the foreign market is sufficiently larger than the home market, the loss of employment becomes more significant and a situation arises where FDI is welfare-reducing.

Note that the left-hand side is always positive for $t \leq \bar{t}$, meaning that this condition holds for any given C_P if λ is sufficiently small. This suggests that the government intervention is indeed justifiable as long as it is sufficiently efficient.

4 Main Results

4.1 Equilibrium wages and quantities

We now extend the analysis by introducing another domestic firm (firm B) and examine the effect of domestic competition on the home market. Suppose that a new firm (firm B) along with its union (union B) enters into the market for some exogenous reasons. Firm B is assumed to be identical to firm A in every aspect. The addition of a competing domestic rival results in strategic interactions absent in the benchmark case.

With this addition, the model becomes increasingly complicated because there are generically three possible pairs of FDI decisions: (i) none of the firms undertakes FDI (N-FDI, N-FDI); (ii) only one of the firms undertakes partial FDI (P-FDI, N-FDI); (iii) both of the firms undertake partial FDI (P-FDI, P-FDI). We now examine each case in turn.

(N-FDI, N-FDI): With both of the firms remaining in the home country, each firm maximizes

$$\max_{x^i, y^i} \; (1 - (x^i + x^{-i}) - w^i)x^i + (1 - (y^i + y^{-i}) - w^i - t)y^i,$$

where $i \neq -i$ throughout the analysis. Solving the first-order conditions, the optimal quantities are obtained as

$$x^i, y^i = \frac{1 - 2w^i + w^{-i}}{3}, \frac{1 - t - 2w^i + w^{-i}}{3}.$$

Each union thus maximizes

$$\max_{w^i} \; w^i(x^i + y^i) = \frac{w^i(2 - t - 4w^i + 2w^{-i})}{3}, \quad s.t. \;\; 1 - t - 2w^i + w^{-i} \geq 0.$$

It is conceptually straightforward, though computationally tedious, to solve this problem (see Appendix A for more detail). The equilibrium wages and quantities are given by

$$w^i = \frac{(2 - t)}{6}, \quad x^i, y^i = \frac{4 + t}{18}, \frac{4 - 5t}{18}.$$

Let π^i_{jk}, u^i_{jk}, CS_{jk} denote the (equilibrium) profit, the union utility and the consumer surplus when the pair of FDI choices is given by (j,k), $j,k \in \{N,P\}$. With some algebra, we obtain

$$\pi^i_{NN} = \frac{16-16t+13t^2}{162},\ u^i_{NN} = \frac{(2-t)^2}{27},\ CS_{NN} = \frac{(4+t)^2}{162}.$$

(P-FDI, N-FDI): This is an intriguing case which apparently never occurs with one domestic firm. In this situation each union faces different demand schedules for labor: as a consequence, two different wages prevail in equilibrium. Without loss of generality, suppose that firm A undertakes partial FDI.

Suppose that firm B chooses a nonnegative quantity to export (because the wage set by its union is sufficiently low relative to the transport cost). Each firm's problem is then defined as

$$\max_{x^A,y^A} (1-(x^A+x^B)-w^A)x^A + (1-(y^A+y^B))y^A$$
$$\max_{x^B,y^B} (1-(x^A+x^B)-w^B)x^B + (1-(y^A+y^B)-w^B-t)y^B.$$

Solving the first-order conditions, the optimal quantities are obtained as

$$\begin{aligned} x^A, y^A &= \frac{1+w^B-2w^A}{3}, \frac{1+t+w^B}{3} \\ x^B, y^B &= \frac{1-2w^B+w^A}{3}, \frac{1-2t-2w^B}{3}. \end{aligned} \tag{6}$$

Since firm A has two plants, the unions are now asymmetric. Each union maximizes

$$\max_{w^A} w^A x^A = \frac{w^A(1+w^B-2w^A)}{3},$$
$$\max_{w^B} w^B(x^B+y^B) = \frac{w^B(2-2t+w^A-4w^B)}{3}.$$

It also follows from (6) that if $(1-2t-2w^B)/3 \le 0$, firm B chooses not to export. The optimal quantities in this case are given by

$$x^A, y^A = \frac{1+w^B-2w^A}{3}, \frac{1}{2};\ \ x^B, y^B = \frac{1-2w^B+w^A}{3}, 0$$

and each union now maximizes

$$\max_{w^i} w^i x^i = \frac{w^i(1+w^{-i}-2w^i)}{3}.$$

Define

$$t^* \equiv \frac{54-31\sqrt{2}}{48} \sim 0.212.$$

With some algebra (see Appendix A), the equilibrium wages are given by

$$w^A = \begin{cases} \dfrac{2(5-t)}{31} & \text{if } t \in [0, t^*) \\ \dfrac{1}{3} & \text{if } t \in [t^*, \bar{t}], \end{cases} \quad w^B = \begin{cases} \dfrac{9-8t}{31} & \text{if } t \in [0, t^*) \\ \dfrac{1}{3} & \text{if } t \in [t^*, \bar{t}]. \end{cases}$$

It follows from these that the equilibrium quantities are

$$x^A, y^A = \begin{cases} \dfrac{4(5-t)}{93}, \dfrac{40+23t}{93} & \text{if } t \in [0, t^*) \\ \dfrac{2}{9}, \dfrac{1}{2} & \text{if } t \in [t^*, \bar{t}], \end{cases}$$

$$x^B, y^B = \begin{cases} \dfrac{23+14t}{93}, \dfrac{13-46t}{93} & \text{if } t \in [0, t^*) \\ \dfrac{2}{9}, 0 & \text{if } t \in [t^*, \bar{t}]. \end{cases}$$

The profit, the union utility, and the consumer surplus are

$$\begin{aligned} \pi^A_{PN} &= \frac{16(5-t)^2}{8649} + \frac{(40+23t)^2}{8649}, \ \pi^B_{PN} = \frac{(23+14t)^2}{8649} + \frac{(13-46t)^2}{8649}, \\ u^A_{PN} &= \frac{8(5-t)^2}{2883}, \ u^B_{PN} = \frac{4(9-8t)^2}{2883}, \ CS_{NP} = \frac{(43+10t)^2}{17298}, \end{aligned}$$

for $t \in [0, t^*)$ and

$$\pi^A_{PN} = \frac{97}{324}, \ \pi^B_{PN} = \frac{4}{81}, \ u^A_{PN} = u^B_{PN} = \frac{2}{27}, \ CS_{PN} = \frac{16}{162},$$

for $t \in [t^*, \bar{t})$.

(P-FDI, P-FDI): Suppose that firm B follows firm A and sets up a plant in the foreign market. When each of the firms has two plants, each firm maximizes

$$\max_{x^i, y^i} \ (1 - (x^i + x^{-i}) - w^i)x^i + (1 - (y^i + y^{-i}))y^i.$$

Solving the first-order conditions, we obtain

$$x^i, y^i = \frac{1 - 2w^i + w^{-i}}{3}, \frac{1}{3}.$$

In this case, the wage set by a union has no effect on the foreign market. With no strategic consideration, each union simply maximizes

$$\max_{w^i} \ w^i x^i = \frac{w^i(1 - 2w^i + w^{-i})}{3}.$$

It is straightforward to obtain

$$w^i = \frac{1}{3};\ x^i, y^i = \frac{2}{9}, \frac{1}{3}.$$

The profit, the union utility, and the consumer surplus are

$$\pi^i_{PP} = \frac{13}{81},\ u^i_{PP} = \frac{2}{27},\ CS_{PP} = \frac{8}{81}.$$

4.2 Equilibrium FDI patterns

(N-FDI, N-FDI): The pair appears as an equilibrium outcome if and only if

$$\pi^i_{NN} \geq \pi^A_{PN} - C_P \quad \Leftrightarrow \quad C_P \geq \pi^A_{PN} - \pi^i_{NN} \equiv H_1.$$

It is intuitively clear that no firm undertakes FDI when its fixed cost is large, relative to the transport cost t.

(P-FDI, N-FDI): The pair appears as an equilibrium outcome if and only if

$$\pi^A_{PN} - C_P \geq \pi^i_{NN},\ \pi^B_{PN} \geq \pi^i_{PP} - C_P \quad \Leftrightarrow \quad H_1 \geq C_P,\ C_P \geq \pi^i_{PP} - \pi^B_{PN} \equiv H_2.$$

The pair is supported as an equilibrium if C_P is neither too large nor too small, as expected. The lowerbound of C_P is determined by firm B which has not undertaken FDI. As can be seen from Figure 1, the lowerbound of C_P is not monotonic with respect to t: that is, an increase in the transport cost may actually reduce the incentive to undertake FDI. This somewhat counterintuitive result stems from the fact that w^B, the wage paid by firm B, actually decreases with t because firm B now faces intense competition with firm A in the foreign market and its union is hence forced to lower the wage demands.[11] Since this effect is wiped out and w^B suddenly goes up once firm B undertakes FDI, the incentive to undertake FDI could decrease with an increase in t.

(P-FDI, P-FDI): The pair appears as an equilibrium outcome if and only if

$$\pi^i_{PP} - C_P \geq \pi^B_{PN} \quad \Leftrightarrow \quad H_2 \geq C_P.$$

Both of the firms apparently undertake FDI when C_P is sufficiently small.

[11] See Ishida and Matsushima (2005) for more detail on this.

The equilibrium pattern depends on the fixed cost C_P as well as the transport cost, which is depicted in Figure 1.

[Figure 1 about here]

4.3 Welfare effects of FDI with two domestic firms

When there is only one domestic firm, FDI is welfare-improving when its fixed cost is sufficiently small. This leads us to the following question: is more FDI in general beneficial for the home economy? As it turns out, the answer to this question is mostly negative; this is so even when we disregard the fixed cost of FDI. We in particular show that the second FDI is normally welfare-reducing in this two-firm setting.

Outward FDI gives rise to two distinct effects of particular interest. First, FDI improves the firm's efficiency as it allows the firm to gain access to cheaper labor as well as to save the transport cost. Both of them apparently contribute to a reduction in the cost of production and thus play a similar role to cost-reducing R&D investment directed at the foreign market. We refer to this as the productivity effect of FDI, which is generally welfare-improving.

When the production process involves immobile factors such as labor, FDI also has an impact on the factor prices because the union's wage-setting behavior hinges critically on the productivity of its downstream firm. When FDI is undertaken, the union is consequently forced to concentrate on the home market. Since the firm can serve the home market more effectively by the margin of the transport cost, there arises an incentive for the union to raise its wage to take advantage of this situation. The consequences of this incentive are not simply a matter of distributional concern since the wage levels subsequently determine the output levels. We refer to this as the factor-price effect of FDI. The factor-price effect may or may not be welfare-improving, depending crucially on the structure of FDI. When only firm A undertakes FDI, there arises a productivity gap between the two firms in terms of supplying to the foreign market. In order to fill this gap and to compete in the foreign market, union B has a strong incentive to lower its wage, which also places downward pressure on the wage set by union A. The presence of the rival firm, which remains entirely in the home market, thus acts as an anchor to keep the wages low and improves welfare under certain conditions. Note that this incentive is totally wiped out when firm B follows its rival and undertakes FDI. The wages tend to go up rather sharply as a consequence. To see this, Figure 2 illustrates the relationship between the equilibrium wages and the pattern of FDI. The figure shows that the wages are likely to be lower when only one firm undertakes FDI.

[Figure 2 about here]

We are now ready to examine the social efficiency of FDI in this duopolistic setting. To this end, as above, define the domestic welfare given the pair of FDI choices (j, k) as

$$W_{jk} \equiv \pi_{jk}^A + \pi_{jk}^B + u_{jk}^A + u_{jk}^B + CS_{jk}.$$

The domestic economy consists of three components: the firms, the unions and domestic consumers. In order to identify who gains and who loses, we examine each component in turn.

Total profit: It can be shown that the firm that undertakes FDI can always increase its profit. This does not necessarily mean, however, that FDI always increases the firms' total profit because a firm may gain at the expense of its rival firm.

To see this, Figure 3 depicts the total profit as a function of t. First, it can be seen from the figure that the first FDI unambiguously increases the total profit. The productivity effect is evidently a crucial contributing factor in this. Moreover, when the transport cost is sufficiently small, the wage effect also works positively for the firms as it invites intense competition between the unions. While the factor-price effect leads to higher wages as the transport cost increases, the productivity effect generally prevails and the overall effect of the first FDI on the total profit is in general positive.

[Figure 3 about here]

While the first FDI in general increases the total profit, the effect of the second FDI is more ambiguous. In particular, when $t \in [t^*, \bar{t}]$, the second FDI actually decreases the total profit. This is because, in this range, the transport cost is so large that firm B (or more precisely union B) chooses not to export to the foreign market: as a result, firm A can monopolize the foreign market. The total profit naturally declines as the foreign market becomes duopolistic. In any event, though, the figure indicates that the effect of the second FDI on the total profit seems to be fairly negligible, compared to that of the first FDI. This implies that the firms' gains associated with FDI are almost fully exploited by the first FDI.

Total union utility: With the relocation of productive capacities, the unions inevitably lose employment to foreign workers. Intuition thus suggests that the unambiguous loser of FDI is the unions. This intuition is in general true for the first FDI, but there are situations where the unions are actually made better off by the second FDI. The driving force behind this result is the presence of domestic competition. When only firm A undertakes FDI and $t \in [0, t^*]$, union B is placed in a difficult situation since it needs to lower its wage to compete in the foreign market. Note that this downward pressure works adversely for union A as well since it must also lower its wage in response to union B's wage-setting behavior. The second FDI may be beneficial for the unions as a whole because they no longer have this competitive pressure on their wages. This implies that the fact that the firm can export and potentially capture the foreign market may sometimes work adversely for the unions because it leads to excessive price competition between them.[12] As a result, there may arise a situation where FDI benefits the unions because it serves to soften price competition between them by depriving them of the option of exporting altogether. See Figure 4. The next proposition summarizes this result.

Proposition 1 *When (i) there are two domestic firms and (ii) the two markets are symmetric in size, there exists some $\tilde{t} \in (0, t^*)$ such that the unions benefit from the second FDI for $t \in [\tilde{t}, t^*]$.*

[Figure 4 about here]

While the incentive to lower the wage to compete in the foreign market becomes stronger as t increases, it eventually reaches a point where it no longer pays off for union B to continue to do so. The union then gives up the foreign market and instead raises its wage to compensate for the loss of the market: that is, the union behaves as if its firm undertakes FDI. This also releases union A from the downward pressure on its wage. When $t \in [t^*, \bar{t}]$, therefore, the second FDI has no effect on how union B behaves because its firm does not export in the first place. As a result, nothing changes as far as the unions are concerned when the second FDI is undertaken.

[12] Apparently, the unions can avoid this problem if the union, whose firm does not undertake FDI, can somehow credibly commit itself to setting higher wages and thus staying out of the foreign market.

Domestic consumers: The consumer surplus is ultimately determined by the wages set by the unions. Higher wages are detrimental to consumers since they result in higher prices and less output. By comparing Figures 4 and 5, one can see that the unions' gains are roughly consumers' losses and vice versa. In this sense, the consumer surplus can be seen as a flip side of the union utility.

[Figure 5 about here]

In general, the consumer surplus is minimized when both of the firms undertake FDI because the factor-price effect pushes the wages upward. The first FDI is beneficial for consumers when $t \in [0, t^*]$ because upstream competition between the unions over the foreign market drives down the wages. The second FDI is, on the other hand, always detrimental to consumers because it releases the unions from this downward pressure on the wages. This indicates that while FDI as a device to soften price competition benefits the unions, it works adversely for consumers because of less output resulting from higher wages. This result is summarized in the next proposition.

Proposition 2 *When (i) there are two domestic firms and (ii) the two markets are symmetric in size, the consumer surplus is minimized when both of the firms undertake FDI.*

The loss incurred by consumers dues to the second FDI constitutes a substantial part of the overall welfare loss, as we will see next.

Domestic welfare: There are several forces at work as illustrated, depending on t. Figure 6 compares equilibrium and social efficiency. The figure again indicates that the incentive to undertake FDI is generally excessive, as in the case with one domestic firm. This shows that simple transfer payments to encourage FDI would never be welfare-improving.

As far as policy issues are concerned, we are more interested in the case where the government can to some extent reduce the fixed cost of FDI by removing barriers or providing public goods to facilitate outward FDI. To see this, Figure 7 illustrates the welfare effect of FDI when the fixed cost of FDI vanishes to zero. The figure consistently reveals that there exists a non-monotonic relationship between the domestic welfare and the amount of FDI: the first FDI is always welfare-improving while the second FDI is always welfare-reducing. The driving force behind this is again the presence of upstream competition. In particular, the first FDI leads to intense rivalry between the unions and consequently results in welfare gains, although the competition may be excessively intense from the unions' viewpoint. Note also that, when t is sufficiently small, the domestic welfare is minimized when both of the firms undertake FDI, i.e., (P-FDI, P-FDI) is worse, in terms of the domestic welfare, than not only (P-FDI, N-FDI) but also (N-FDI, N-FDI). This draws clear contrast to the case with one domestic firm where outward FDI is always welfare-improving, provided that the markets are comparable in size. The following statement summarizes the main result of the paper.

Proposition 3 *When (i) there are two domestic firms, (ii) the two markets are symmetric in size and (iii) the fixed cost of FDI is negligibly small, the domestic welfare is maximized for any $t \in [0, \bar{t}]$ when only one of the firms undertakes FDI. Alternatively, the second FDI is always welfare-reducing.*

[Figure 6 about here]

Note that this result overturns the insight obtained in the case with only one domestic firm, where any government intervention to encourage outward FDI is warranted as long as the government can reduce the fixed cost down to some negligible level. This finding amounts to a critical policy implication: there are indeed such things as "excessive FDI" and any form of government intervention, no matter how efficient it is, can be beneficial only up to some point.

[Figure 7 about here]

5 The case with full FDI

In the baseline case, we do not allow firms to relocate entirely to the foreign market. Under certain conditions, however, it may be the best interest of a firm to shift all of its productive capacity to the foreign market. We now introduce this additional option of full FDI and investigate how this modification alters our analysis.

5.1 Benchmark with one domestic firm

We follow the same steps as in the main text and start with the benchmark case where there is only one domestic firm. Here, the monopolist faces three alternatives, $j \in \{N, P, F\}$, to choose from. Since the first two alternatives, $j = N, P$, are already discussed, however, we only need to look at the case where the monopolist undertakes full FDI.

(F-FDI): If the monopolist undertakes full FDI, it maximizes

$$\max_{x,y} \ (1 - x - t)x + (1 - y)y.$$

The first-order condition leads to

$$x, y = \frac{1-t}{2}, \frac{1}{2}.$$

In this case, the union ends up with zero rent. The profit and the domestic consumer surplus are:

$$\pi_F = \frac{2 - 2t + t^2}{4}, \ CS_F = \frac{(1-t)^2}{8}.$$

Let C_F denote the fixed cost of full FDI. It is perhaps more natural to assume that $C_F > C_P$, but we do not impose any restriction on the relationship between C_P and C_F. Figure 8 illustrates the social efficiency and the equilibrium pattern for different values of t.

[Figure 8 about here]

There are two observations we can make here. First, the figure indicates that the incentive to undertake FDI, either partial or full, is in general excessive. Second, FDI is socially desirable when its fixed cost is negligible. These observations are basically in line with those when only partial FDI is an option, and hence all the welfare and policy implications are preserved.

5.2 Domestic competition and full FDI

We now introduce another domestic firm to see the impact of domestic competition. With the addition of full FDI, there are generically six possible pairs of FDI decisions: (i) none of the firms undertakes FDI (N-FDI, N-FDI); (ii) only one of the firms undertakes partial FDI (P-FDI, N-FDI); (iii) both of the firms undertake partial FDI (P-FDI, P-FDI); (iv) only one of the firms undertakes full FDI (F-FDI, N-FDI); (v) one of the firms undertakes full FDI and the other does partial FDI (F-FDI, P-FDI); (vi) both of the firms undertake full FDI (F-FDI, F-FDI). Since computation is tedious and mostly a repetition of what has been presented thus far, the derivation of equilibrium is placed in Appendix A.

The results are summarized in Figure 9, which illustrates the socially efficient pattern of FDI for different values of t. The socially efficient pattern is slightly more complicated than in the case where only partial FDI is available, but the main message remains intact: for a wide range of parameter values, the asymmetric pattern of FDI, where only one firm undertakes either partial or full FDI, is socially desirable. This is so even when the fixed costs of FDI, both C_P and C_F, are negligibly small. For instance, when $t = 1/10$, both firms undertaking any form of FDI is never socially efficient even when the fixed costs tend to zero.[13] This result again roughly confirms our main contention that any form of government intervention can be beneficial only up to some point, no matter how efficient the intervention is, even with the option of full FDI.

[Figure 9 about here]

6 Conclusion

The paper constructs a model of unionized duopoly and explores welfare and policy implications of outward FDI. It is found that the presence of domestic competition gives rise to welfare effects that lead to a non-monotonic relationship between social welfare and the amount of FDI. With the strategic interaction between the unions, the amount of FDI can be excessive even when FDI is totally costless. The present analysis identifies a possible mechanism through which outward FDI actually reduces welfare in the home economy, as often argued informally, and thus raises a critical policy implication: whether outward FDI should be encouraged depends on the nature of domestic competition, especially in its relation to upstream input suppliers. When the unions possess strong bargaining power, asymmetric patterns of FDI, where only a subset of firms undertakes FDI, are desirable from the social point of view for a wide range of parameter values. This implies that there are indeed such things as "excessive FDI" and encouraging (or even subsidizing) more FDI could be beneficial only up to some point. Although ultimate long-run consequences of outward FDI are not necessarily transparent in our partial-equilibrium framework, the paper illuminates an important aspect that should be carefully taken into account by policymakers. Since our analysis is confined in a relatively simple framework to make our points succinctly, it is of some interest to extend

[13] When the transport cost t becomes even smaller and tends to zero, there arises a small range of C_F for which (F-FDI, F-FDI) is socially efficient.

the present analysis to various settings to gain further insight on the home-country welfare effect of outward FDI.

Appendix A

A1. Without full FDI

When each firm can choose either no FDI or partial FDI, there are generically three pairs of FDI decisions. Since (P-FDI, P-FDI) is computationally straightforward, we cover the other two cases in more detail.

(N-FDI, N-FDI): In this situation, each firm may choose not to export, depending on the wage set by its union. If both of the firms choose to export, we obtain

$$w^i = \frac{2 + 2w^{-i} - t}{8},$$

which leads to

$$w^i = \frac{2 - t}{6}; \quad x^i, y^i = \frac{4 + t}{18}, \frac{4 - 5t}{18}.$$

It follows from this that each union's utility is

$$u^i = \frac{(2 - t)^2}{27}. \tag{A.1}$$

We now show that this pair of wages indeed constitutes an equilibrium. To see this, it suffices to show that each union has no incentive to deviate from this wage level taking the other union's wage as given. If a union unilaterally deviates and prevents its firm from exporting, the objective function becomes

$$\max_{w^i} \ w^i x^i = \frac{w^i(1 - 2w^i + w^{-i})}{3}, \quad s.t. \ \ 1 - t - 2w^i + w^{-i} < 0.$$

If $t < 8/13$, the constraint is binding and we have

$$w^i = \frac{1 - t + w^{-i}}{2} = \frac{8 - 7t}{12}, \quad x^i, y^i = \frac{t}{3}, 0.$$

The union's utility when it deviates is then

$$u^i = \frac{(8 - 7t)t}{36}. \tag{A.2}$$

There is no incentive to unilaterally deviate from the equilibrium if (A.1) is larger than (A.2), i.e.,

$$\frac{(2-t)^2}{27} \geq \frac{(8-7t)t}{36}.$$

It is straightforward to verify that this holds for any t.

(P-FDI, N-FDI): In this situation, firm B may choose not to export, depending on the wage set by union B. Suppose first that the wage set by union B is low enough for firm B to export. The first-order conditions then imply that

$$\begin{aligned}
x^A, y^A &= \frac{1-2w^A+w^B}{3}, \frac{1+w^B}{3}, \\
x^B, y^B &= \frac{1+w^A-2w^B}{3}, \frac{1-2w^B-2t}{3}.
\end{aligned}$$

The maximization problem for each union becomes

$$\begin{aligned}
&\max_{w^A} \ w^A x^A = \frac{w^A(1-2w^A+w^B)}{3}, \\
&\max_{w^B} \ w^B(x^B+y^B) = \frac{w^B(2+w^A-4w^B-2t)}{3}, \quad s.t. \ \frac{1-2w^B-2t}{3} \geq 0.
\end{aligned}$$

If $t < 13/46$, the constraint is not binding, the optimal wages must satisfy

$$w^A = \frac{1+w^B}{4}, \quad w^B = \frac{2+w^A-2t}{8}.$$

We can then show that

$$w^A = \frac{10-2t}{31}, \ w^B = \frac{9-8t}{31}, \ x^A, y^A = \frac{20-4t}{31}, \frac{40-23t}{31}, \ x^B, y^B = \frac{23+14t}{93}, \frac{13-46t}{93}.$$

It follows from these that union B's utility is

$$u^B = \frac{4(9-8t)^2}{2883}. \tag{A.3}$$

Now suppose that union B raises the wage to the level that makes firm B unable to export. Solving the first-order conditions, we have

$$x^A, y^A = \frac{1-2w^A+w^B}{3}, \frac{1}{2}; \quad x^B, y^B = \frac{1+w^A-2w^B}{3}, 0.$$

The maximization problem for each union now becomes

$$\max_{w^A}\ w^A x^A = \frac{w^A(1-2w^A+w^B)}{3},$$
$$\max_{w^B}\ w^B x^B = \frac{w^B(1+w^A-2w^B)}{3}, \quad s.t. \quad \frac{1-2w^B-2t}{3} < 0.$$

If $t > 1/6$, the constraint is not binding and the optimal wages and quantities are given by

$$w^A = w^B = \frac{1}{3},\ x^A, y^A = \frac{2}{9}, \frac{1}{2},\ x^B, y^B = \frac{2}{9}, 0.$$

It follows from these that union B's utility is

$$u^B = \frac{2}{27}. \tag{A.4}$$

Union B then chooses the latter strategy, which prevents firm B from exporting, if (A.4) exceeds (A.3), i.e.,

$$\frac{2}{27} - \frac{4(9-8t)^2}{2883} > 0, \quad \Rightarrow \quad t > \frac{54-31\sqrt{2}}{48} \sim 0.212.$$

A2. With full FDI

With the option of full FDI, there arise three additional pairs of FDI decision. We examine each case in turn.

(F-FDI, N-FDI): In this situation each union faces different demand schedules for labor: as a consequence, two different wages prevail in equilibrium. Without loss of generality, suppose that firm A is the one to undertake full FDI

Suppose that firm B chooses a nonnegative quantity to export (because the wage set by its union is sufficiently low relative to the transport cost). Each firm's problem is then defined as

$$\max_{x_A, y_A}\ (1-(x_A+x_B)-t)x_A + (1-(y_A+y_B))y_A$$
$$\max_{x_B, y_B}\ (1-(x_A+x_B)-w_B)x_B + (1-(y_A+y_B)-w_B-t)y_B.$$

Solving the first-order conditions, the optimal quantities are obtained as

$$\begin{aligned} x_A, y_A &= \frac{1+w_B-2t}{3}, \frac{1+t+w_B}{3} \\ x_B, y_B &= \frac{1-2w_B+t}{3}, \frac{1-2t-2w_B}{3}. \end{aligned} \tag{A.5}$$

Since firm A does not have plants at the domestic market, only the union of firm B exists. The union maximizes

$$\max_{w_B}\ w_B(x_B+y_B)=\frac{w_B(2-t-4w_B)}{3}.$$

It also follows from (A.5) that if $(1-2t-2w_B)/3\le 0$, firm B chooses not to export. The optimal quantities in this case are given by

$$x_A,y_A=\frac{1+w_B-2t}{3},\frac{1}{2};\quad x_B,y_B=\frac{1-2w_B+t}{3},0.$$

and the union now maximizes

$$\max_{w_B}\ w_Bx_B=\frac{w_B(1+t-2w_B)}{3}.$$

Define

$$t^{**}\equiv 3\sqrt{2}-4.$$

With some algebra, the equilibrium wage is given by

$$w_B=\begin{cases}(2-t)/8 & \text{if } t\in[0,t^{**})\\ (1+t)/4 & \text{if } t\in[t^{**},\bar{t}],\end{cases}$$

It follows from these that the equilibrium quantities are

$$x_A,y_A=\begin{cases}\dfrac{10-17t}{24},\ \dfrac{10+7t}{24} & \text{if } t\in[0,t^{**})\\[2mm] \dfrac{5-7t}{12},\ \dfrac{1}{2} & \text{if } t\in[t^{**},\bar{t}],\end{cases}$$
$$x_B,y_B=\begin{cases}\dfrac{2+5t}{12},\ \dfrac{2-7t}{12} & \text{if } t\in[0,t^{**})\\[2mm] \dfrac{1+t}{6},\ 0 & \text{if } t\in[t^{**},\bar{t}].\end{cases}$$

The profit, the total union utility, and the consumer surplus are

$$\pi^A_{FN}=\frac{100(1-t)+169t^2}{288},\ \pi^B_{FN}=\frac{4-4t+37t^2}{72},$$
$$u^A_{FN}+u^B_{FN}=\frac{(2-t)^2}{48},\ CS_{FN}=\frac{49(2-t)^2}{1152}.$$

for $t\in[0,t^{**})$, and

$$\pi^A_{FN}=\frac{61-70t+49t^2}{144},\ \pi^B_{FN}=\frac{(1+t)^2}{36},$$
$$u^A_{FN}+u^B_{FN}=\frac{(1+t)^2}{24},\ CS_{FN}=\frac{(7-5t)^2}{288}.$$

for $t\in[t^{**},\bar{t})$.

(F-FDI, P-FDI): Without loss of generality, suppose that firm A is the one to undertake full FDI. Each firm's problem is defined as

$$\max_{x_A,y_A} \ (1-(x_A+x_B)-t)x_A + (1-(y_A+y_B))y_A$$
$$\max_{x_B,y_B} \ (1-(x_A+x_B)-w_B)x_B + (1-(y_A+y_B))y_B.$$

Solving the first-order conditions, the optimal quantities are obtained as

$$x_A, y_A = \frac{1+w_B-2t}{3}, \frac{1}{3}; \quad x_B, y_B = \frac{1-2w_B+t}{3}, \frac{1}{3}.$$

Since firm A does not have plants at the domestic market, only the union of firm B exists. The union maximizes

$$\max_{w_B} \ w_B x_B = \frac{w_B(1-2w_B+t)}{3}.$$

With some algebra, the equilibrium wage is given by

$$w_B = \frac{1+t}{4}.$$

The equilibrium quantities are

$$x_A, y_A = \frac{5-7t}{12}, \ \frac{1}{3}; \quad x_B, y_B = \frac{1+t}{6}, \ \frac{1}{3}.$$

The profit, the total union utility, and the consumer surplus are

$$\pi^A_{FP} = \frac{41-70t+49t^2}{144}, \ \pi^B_{FP} = \frac{5+2t+t^2}{36},$$
$$u^A_{FP} + u^B_{FP} = \frac{(1+t)^2}{24}, \ CS_{FP} = \frac{(7-5t)^2}{288}.$$

(F-FDI, F-FDI): This case is quite simple as it is reduced to a standard Cournot model with no union. Each firm's problem is defined as

$$\max_{x_A,y_A} \ (1-(x_A+x_B)-t)x_A + (1-(y_A+y_B))y_A$$
$$\max_{x_B,y_B} \ (1-(x_A+x_B)-t)x_B + (1-(y_A+y_B))y_B.$$

Solving the first-order conditions, the optimal quantities are obtained as

$$x_A, y_A = \frac{1-t}{3}, \frac{1}{3}; \quad x_B, y_B = \frac{1-t}{3}, \frac{1}{3}.$$

The profit and the consumer surplus are

$$\pi^i_{FF} = \frac{2-2t+t^2}{9}, \ CS_{FF} = \frac{2(1-t)^2}{9}.$$

Appendix B: Extensions

In the analysis thus far, we have only considered a particular environment to make our points. In this appendix, we extend the basic setup in two different ways to show the basic insight is robust to these alternations.

B.1 The case with a foreign firm

We introduce a foreign firm into the baseline case, along with one or two firms in the domestic market. The foreign firm, denoted by F, produces its product with a constant marginal cost which is normalized to zero and supplies its products to both markets if it chooses to do so. Every other aspect of the model follows the baseline case in the main text. To make comparison easier, all the results are summarized in figures 1F-7F, each of which corresponds to figures 1-7 for the baseline case.

(N-FDI, N-FDI): With both of the firms remaining in the home country, each firm maximizes

$$\max_{x^i, y^i} (1-(x^i+x^{-i}+x^F)-w^i)x^i+(1-(y^i+y^{-i}+y^F)-w^i-t)y^i,$$
$$\max_{x^F, y^F} (1-(x^A+x^B+x^F)-t)x^F+(1-(y^A+y^B+y^F))y^F.$$

Solving the first-order conditions, the optimal quantities are obtained as

$$x^i, y^i = \frac{1+t-3w^i+w^j}{4}, \frac{1-2t-3w^i+w^j}{4}, ;$$
$$x^F, y^F = \frac{1-3t+w^A+w^B}{4}, \frac{1+2t+w^A+w^B}{4}.$$

Each union thus maximizes

$$\max_{w^i} w^i(x^i+y^i) = \frac{w^i(2-t-6w^i+2w^j)}{4}.$$

The equilibrium wages and quantities are given by

$$w^i = \frac{(2-t)}{10}; \quad x^i, y^i = \frac{3(1+2t)}{20}, \frac{3(1-3t)}{20}.$$

Let π^i_{jk}, u^i_{jk}, CS_{jk} denote the (equilibrium) profit, the union utility and the consumer surplus when the pair of FDI choices is given by (j,k), $j,k \in \{N,P\}$. With some algebra, we obtain

$$\pi^i_{NN} = \frac{2-2t+13t^2}{72}, \; u^i_{NN} = \frac{3(2-t)^2}{200}, \; CS_{NN} = \frac{(13-4t)^2}{800}.$$

(P-FDI, N-FDI): In this situation, firm B may choose not to export, depending on the wage set by union B. Suppose first that the wage set by union B is low enough for firm B to export. The first-order conditions then imply that

$$x^A, y^A = \frac{1+t-3w^A+w^B}{4}, \frac{1+t+w^B}{4}; \quad x^B, y^B = \frac{1+t-3w^B+w^A}{4}, \frac{1-3t-3w^B}{4}.$$

The maximization problem for each union becomes

$$\max_{w^A} \; w^A x^A = \frac{w^A(1+t-3w^A+w^B)}{4},$$
$$\max_{w^B} \; w^B(x^B+y^B) = \frac{w^B(2-2t-6w^B+w^A)}{4}, \quad s.t. \quad \frac{1-3w^B-3t}{4} \geq 0.$$

If $t < 8/45$, the constraint is not binding, the optimal wage is

$$w^A, w^B = \frac{14+10t}{71}, \frac{13-11t}{71}.$$

We can then show that

$$x_A, y_A = \frac{23+57t}{142}, \frac{3(7-5t)}{71}; \quad x_B, y_B = \frac{3(7+5t)}{142}, \frac{8-45t}{71}.$$

It follows from these that the union's utility is

$$u^I = \frac{3(13-11t)^2}{10082}. \tag{B.6}$$

Now suppose that union B raises the wage to the level that makes firm B unable to export. Solving the first-order conditions, we have

$$x^A, y^A = \frac{1+t-3w^A+w^B}{4}, \frac{1}{3}; \quad x^B, y^B = \frac{1+t-3w^B+w^B}{4}, 0.$$

The maximization problem for each union now becomes

$$\max_{w^A} \; w^A x^A = \frac{w^A(1+t-3w^A+w^B)}{4},$$
$$\max_{w^B} \; w^B x^B = \frac{w^B(1+t-3w^B+w^A)}{4}, \quad s.t. \quad \frac{1-3t-3w^B}{4} < 0.$$

If $t > 1/9$, the constraint is not binding and the optimal wages and quantities are given by

$$w^i = \frac{1+t}{5}, \quad x^A = x^B = \frac{3(1+t)}{20}.$$

It follows from these that the union's utility is

$$u^i = \frac{3(1+t)^2}{100}. \tag{B.7}$$

The union then chooses the latter strategy, which prevents firm B from exporting, if (B.7) exceeds (B.6), i.e.,

$$\frac{3(1+t)^2}{100} - \frac{3(13-11t)^2}{10082} > 0, \quad \Rightarrow \quad t > \frac{12191 - 8520\sqrt{2}}{1009} \sim 0.0981 \equiv t^F.$$

The profit, the union utility, and the consumer surplus are

$$\begin{aligned} \pi^A_{PN} &= \frac{90(49+70t+25t^2)}{40328}, \ \pi^B_{PN} = \frac{1570 - 516t + 22698t^2}{40328}, \\ u^A_{PN} &= \frac{3(7+5t)^2}{5041}, \ u^B_{PN} = \frac{3(13-11t)^2}{10082}, \ CS_{NP} = \frac{(93-35t)^2}{40328}, \end{aligned}$$

for $t \in [0, t^F)$ and

$$\pi^A_{PN} = \frac{481 + 162t + 81t^2}{3600}, \ \pi^B_{PN} = \frac{9(1+t)^2}{400}, \quad u^i_{PN} = \frac{3(1+t)^2}{100}, \ CS_{PN} = \frac{(13-7t)^2}{800},$$

for $t \in [t^F, \bar{t})$.

(P-FDI, P-FDI): Suppose that firm B follows firm A and sets up a plant in the foreign market. When each of the firms has two plants, each firm maximizes

$$\max_{x^i, y^i} (1 - (x^i + x^{-i} + x^F) - w^i)x^i + (1 - (y^i + y^{-i} + y^F))y^i.$$

Solving the first-order conditions, we obtain

$$x^i, y^i = \frac{1 + t - 3w^i + w^j}{4}, \frac{1}{4}.$$

In this case, the wage set by each union has no effect on the foreign market. Each union simply maximizes

$$\max_{w^i} \ w^i x^i = \frac{w^i(1 + t - 3w^i + w^j)}{4}.$$

It is straightforward to obtain

$$w^i = \frac{1+t}{5}; \quad x^i, y^i = \frac{3(1+t)}{20}, \frac{1}{4}.$$

The profit, the union utility, and the consumer surplus are

$$\pi^i_{PP} = \frac{34 + 18t + 9t^2}{400}, \ u^i_{PP} = \frac{3(1+t)^2}{100}, \ CS_{PP} = \frac{(13-7t)^2}{800}.$$

B.2 The case with an integrated union

We now consider the case where all domestic workers are represented by an integrated union. The integrated union provides labor force and unilaterally offers a common wage w^I to the downstream firms. The fact that the unions are integrated is the only departure from the baseline case. Again, to make comparison easier, all the results are summarized in figures 1I-7I, each of which corresponds to figures 1-7.

(N-FDI, N-FDI): With both of the firms remaining in the home country, each firm maximizes

$$\max_{x^i, y^i} (1 - (x^i + x^{-i}) - w^I)x^i + (1 - (y^i + y^{-i}) - w^I - t)y^i.$$

Solving the first-order conditions, the optimal quantities are obtained as

$$x^i, y^i = \frac{1 - w^I}{3}, \frac{1 - t - w^I}{3}.$$

Each union thus maximizes

$$\max_{w^I} 2w^I(x^i + y^i) = \frac{2w^i(2 - t - 2w^i)}{3}.$$

The equilibrium wages and quantities are given by

$$w^i = \frac{(2 - t)}{4}; \quad x^i, y^i = \frac{2 + t}{12}, \frac{2 - 3t}{12}.$$

Let π^i_{jk}, u^i_{jk}, CS_{jk} denote the (equilibrium) profit, the union utility and the consumer surplus when the pair of FDI choices is given by (j, k), $j, k \in \{N, P\}$. With some algebra, we obtain

$$\pi^i_{NN} = \frac{4 - 4t + 5t^2}{72}, \ u^I_{NN} = \frac{(2 - t)^2}{12}, \ CS_{NN} = \frac{(2 + t)^2}{72}.$$

(P-FDI, N-FDI): In this situation, firm B may choose not to export, depending on the wage set by the integrated union. Suppose first that the wage set by the union is low enough for firm B to export. The first-order conditions then imply that

$$x^A, y^A = \frac{1 - w^I}{3}, \frac{1 + w^I}{3}; \quad x^B, y^B = \frac{1 - w^I}{3}, \frac{1 - 2w^I - 2t}{3}.$$

The maximization problem for each union becomes

$$\max_{w^I} w^I(x^A + x^B + y^B) = \frac{w^I(3 - 4w^I - 2t)}{3}, \quad s.t. \ \frac{1 - 2w^I - 2t}{3} \geq 0.$$

If $t < 1/6$, the constraint is not binding, the optimal wage is

$$w^I = \frac{3-2t}{8}.$$

We can then show that

$$x_A, y_A = \frac{5+2t}{24}, \frac{11+6t}{24}; \quad x_B, y_B = \frac{5+2t}{24}, \frac{1-6t}{12}.$$

It follows from these that the union's utility is

$$u^I = \frac{(3-2t)^2}{48}. \tag{B.8}$$

Now suppose that union B raises the wage to the level that makes firm B unable to export. Solving the first-order conditions, we have

$$x^A, y^A = \frac{1-w^I}{3}, \frac{1}{2}; \quad x^B, y^B = \frac{1-w^I}{3}, 0.$$

The maximization problem for each union now becomes

$$\max_{w^I} \; w^B(x^A + x^B) = \frac{w^I(2-w^I)}{3}, \quad s.t. \;\; \frac{1-2w^I-2t}{3} < 0.$$

For any t, the constraint is not binding and the optimal wages and quantities are given by

$$w^I = \frac{1}{2}, \quad x^A = x^B = \frac{1}{6}.$$

It follows from these that the union's utility is

$$u^I = \frac{1}{6}. \tag{B.9}$$

The union then chooses the latter strategy, which prevents firm B from exporting, if (B.9) exceeds (B.8), i.e.,

$$\frac{1}{6} - \frac{(3-2t)^2}{48} > 0, \quad \Rightarrow \quad t > \frac{3-2\sqrt{2}}{2} \sim 0.0858 \equiv t^I.$$

The profit, the union utility, and the consumer surplus are

$$\pi^A_{PN} = \frac{73+76t+20t^2}{288}, \; \pi^B_{PN} = \frac{29-28t+148t^2}{576}, \; u^I_{PN} = \frac{(3-2t)^2}{48}, \; CS_{NP} = \frac{(5+2t)^2}{288},$$

for $t \in [0, t^I)$ and

$$\pi^A_{PN} = \frac{5}{18}, \; \pi^B_{PN} = \frac{1}{36}, \; u^I_{PN} = \frac{1}{6}, \; CS_{PN} = \frac{1}{18},$$

for $t \in [t^I, \bar{t})$.

(P-FDI, P-FDI): Suppose that firm B follows firm A and sets up a plant in the foreign market. When each of the firms has two plants, each firm maximizes

$$\max_{x^i, y^i} (1 - (x^i + x^{-i}) - w^I)x^i + (1 - (y^i + y^{-i}))y^i.$$

Solving the first-order conditions, we obtain

$$x^i, y^i = \frac{1 - w^i}{3}, \frac{1}{3}.$$

In this case, the wage set by the integrated union has no effect on the foreign market. The union simply maximizes

$$\max_{w^I} \; w^I(x^A + x^B) = \frac{w^I(2 - 2w^I)}{3}.$$

It is straightforward to obtain

$$w^I = \frac{1}{2}, \quad x^i, y^i = \frac{1}{6}, \frac{1}{3}.$$

The profit, the union utility, and the consumer surplus are

$$\pi^i_{PP} = \frac{5}{36}, \; u^I_{PP} = \frac{1}{6}, \; CS_{PP} = \frac{1}{18}.$$

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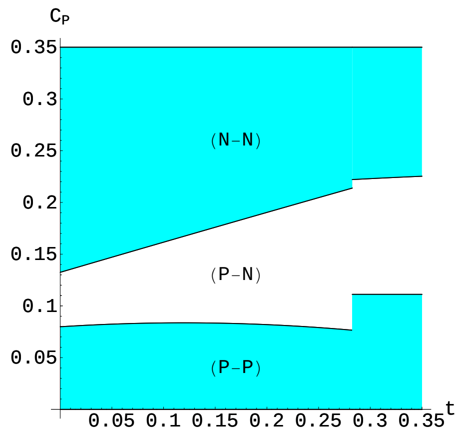


Figure 1: Equilibrium

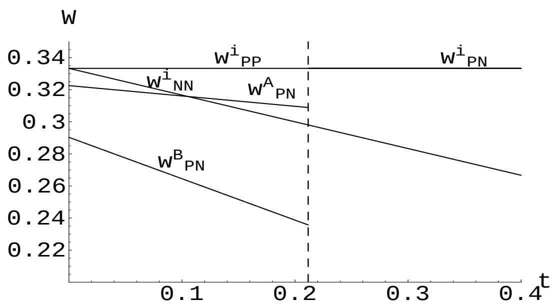


Figure 2: Equilibrium wages

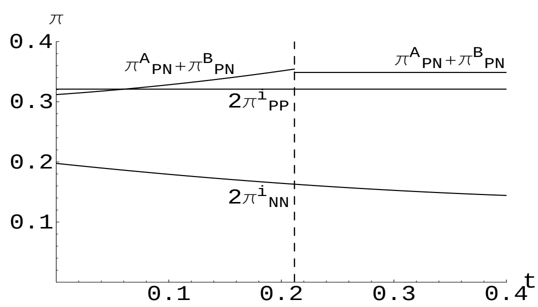


Figure 3: Total profit

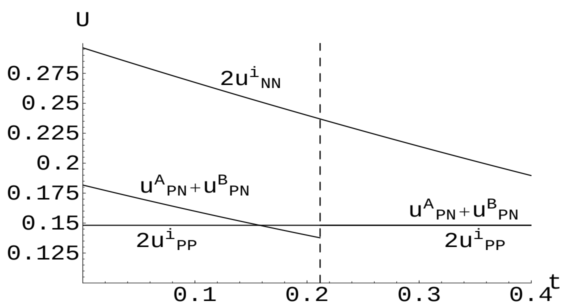


Figure 4: Total union utility

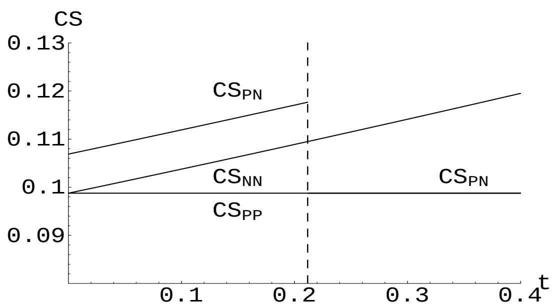
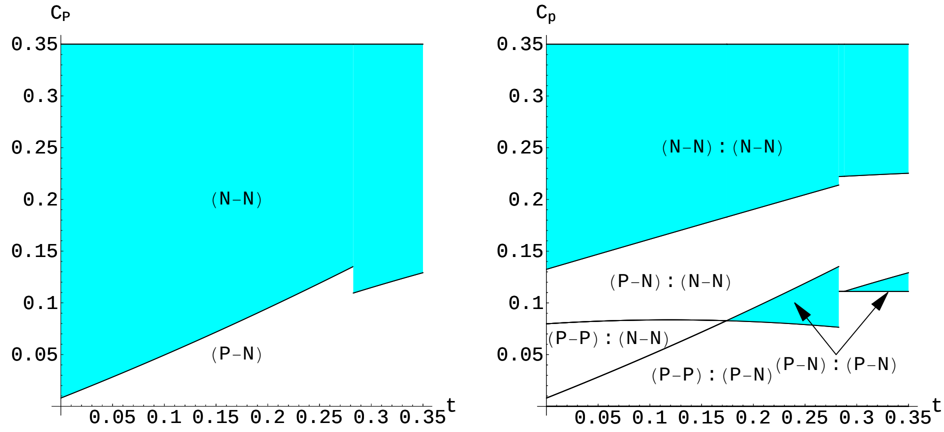


Figure 5: Domestic consumers surplus



social efficiency

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Figure 6: Social efficiency and equilibrium with two domestic firms

Note: $(i-j):(i'-j')$ indicates that the equilibrium is $(i-j)$ while the socially efficient outcome is $(i'-j')$.

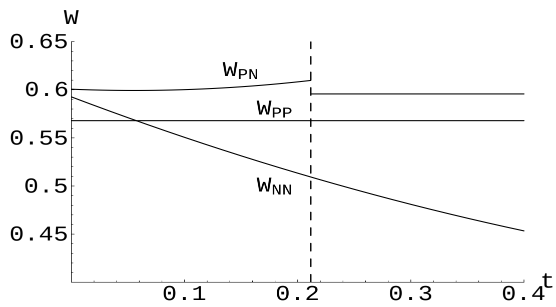

Figure 7: Domestic welfare

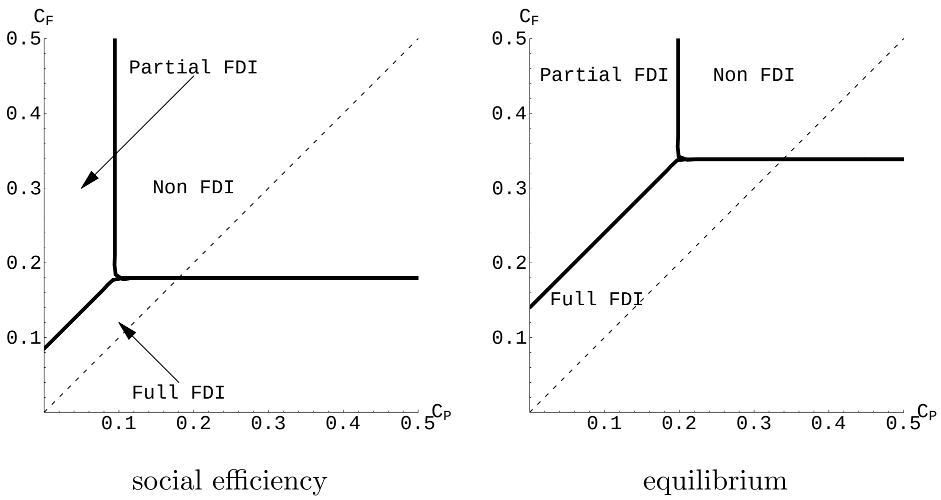

Figure 8: Social efficiency and equilibrium with one domestic firm: the case with full FDI

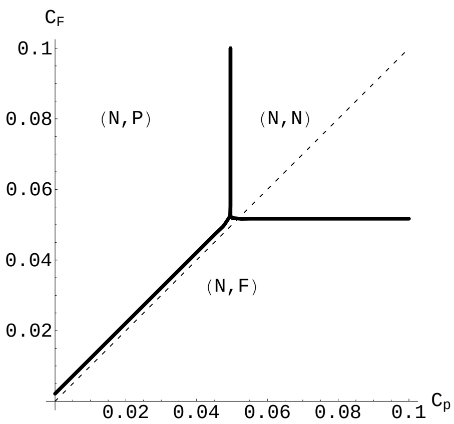

Figure 9: Social efficiency with two domestic firms: the case with full FDI

Figures related to Appendix B.1: The case with a foreign firm

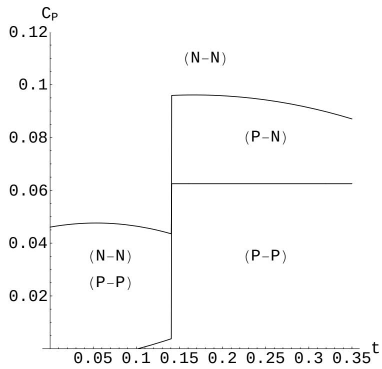

Figure 1F: Equilibrium with a foreign firm

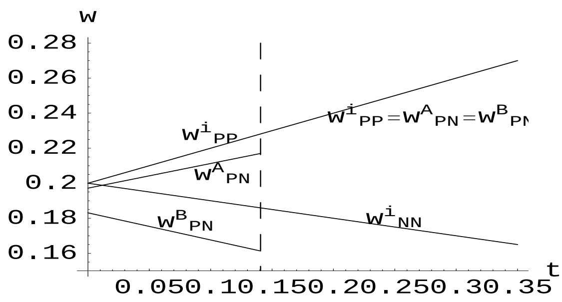

Figure 2F: Equilibrium wages

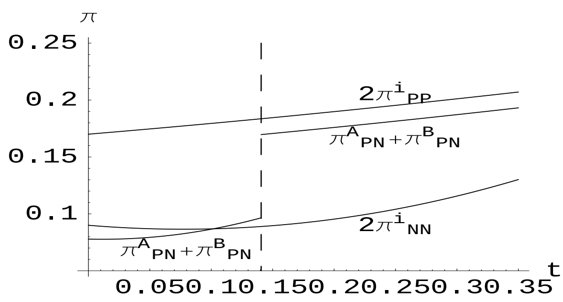

Figure 3F: Total profit

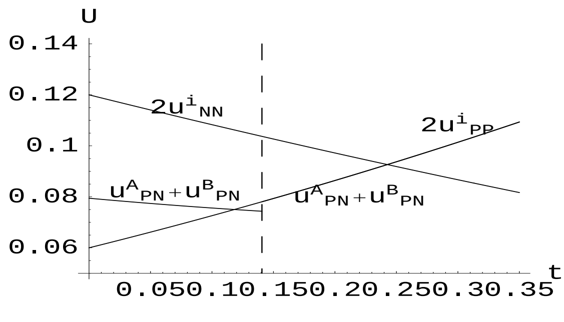

Figure 4F: Total union utility

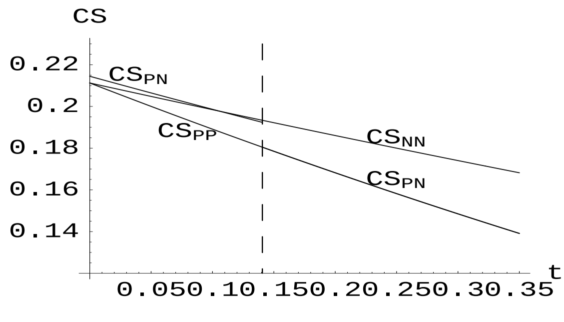

Figure 5F: Domestic consumers surplus

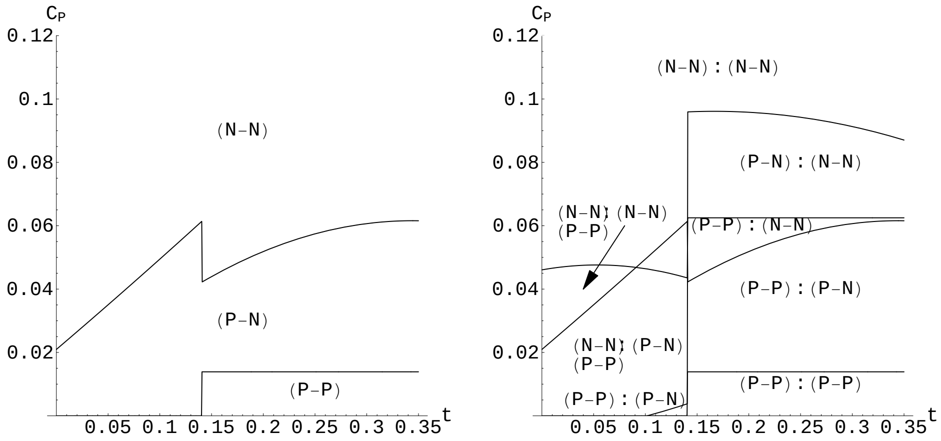

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Figure 6F: Social efficiency and equilibrium with two domestic firms

Note: $(i-j):(i'-j')$ indicates that the equilibrium is $(i-j)$ while the socially efficient outcome is $(i'-j')$.

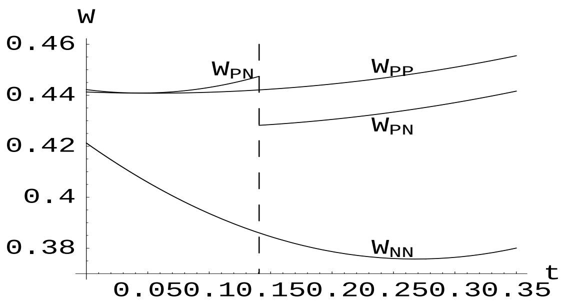

Figure 7F: Domestic welfare

Figures related to Appendix B.2: The case with an integrated union

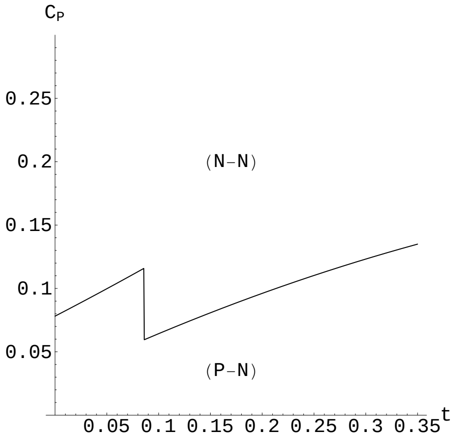

Figure 1I: Equilibrium with an integrated union

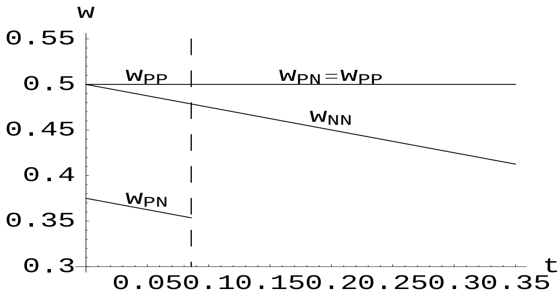

Figure 2I: Equilibrium wages

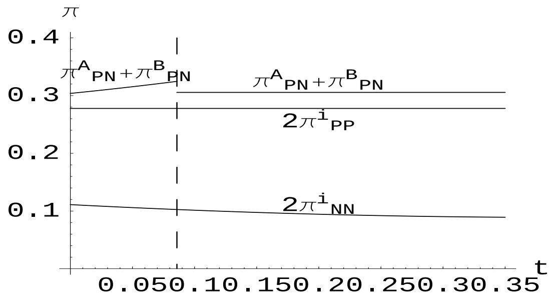

Figure 3I: Total profit

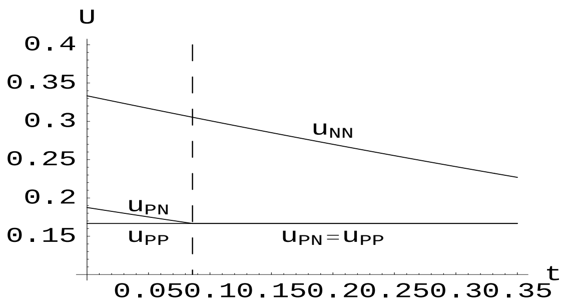

Figure 4I: Total union utility

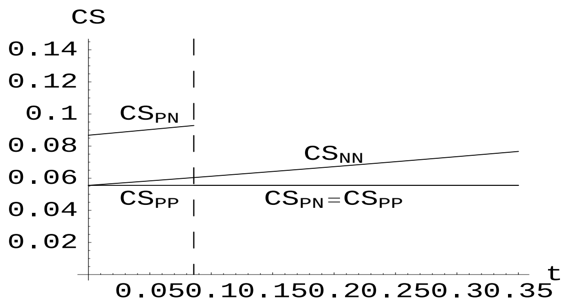

Figure 5I: Domestic consumers surplus

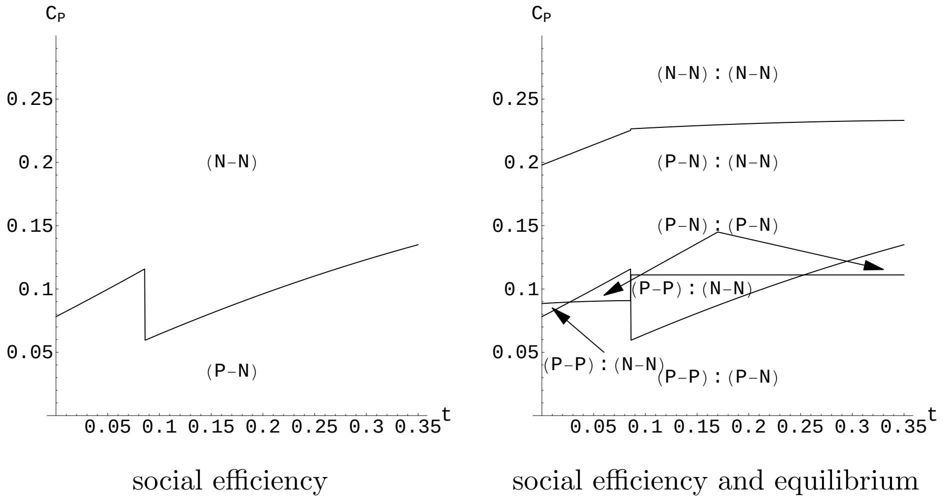

Figure 6I: Social efficiency and equilibrium with two domestic firms

Note: $(i-j):(i'-j')$ indicates that the equilibrium is $(i-j)$ while the socially efficient outcome is $(i'-j')$.

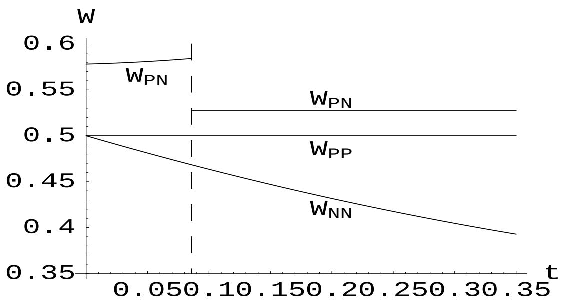

Figure 7I: Domestic welfare