Trade Liberalization and Strategic Outsourcing*

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Abstract

This paper develops a theory of strategic outsourcing. With trade liberalization, a domestic firm may choose to purchase a key intermediate good from a more efficient foreign producer, who also competes with the domestic firm in the final-good market. This could have a collusive effect on competition that results in higher prices for both the intermediate and final goods. In contrast to that in final goods, trade liberalization in intermediate goods may also increase the prices of both goods. Therefore, in the presence of strategic outsourcing, trade liberation can either lower or raise consumer prices, depending on the relative tariff reductions for intermediate and final goods.

Key Words: Imperfect competition, Multi-market contact, Outsourcing

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1. INTRODUCTION

One of the most significant effects of trade liberalization on patterns of production and trade during the last decade is the phenomenon of international 'outsourcing' and/or 'fragmentation'. Although it is hard to clearly distinguish these two terminologies, we use fragmentation to describe the break-up of a production process and outsourcing a firm's decision of its production structure. International outsourcing and fragmentation have been well documented, and their effects on production and input markets are the subject of many recent empirical studies.[1] They are often viewed as a way for firms to look for cheaper suppliers (especially from lower wage countries) to cope with increasing international competition.

It was quite recently that the development of rigorous theories in this area began. Those theories are broadly based on two approaches. The first approach, which is adopted in most studies in the literature, focuses on perfectly or monopolistically competitive market structure, especially regarding the intermediate product market [e.g., Jones (2000), Jones and Kierzkowski (2001)].[2] The second approach, which has its origin in the industrial organization literature, focuses on the issues associated with transaction cost and incomplete contract [e.g., McLaren (2000)]. Under these theories the effects of outsourcing are pro-competitive and economically efficient, in the sense that they result in lower prices for both intermediate and final products.

In this paper, we consider an unnoticed feature of outsourcing, namely, that outsourcing firms sometimes purchase a key intermediate input from more efficient suppliers that are also their rivals in the markets for final products. International outsourcing of this nature is common in many industries, such as computer and automobile industries (see discussion later). We argue that in these situations the usual cost-saving motive for outsourcing could be accompanied by a strategic motive, and that the *strategic outsourcing* in response to

[1] For example, see Feenstra and Hanson (1996a, 1996b), Hanson (1996), Slaughter (1995), and many others.

[2] Arndt and Kierzkowski (2001), and Cheng and Kierzkowski (2001) are recent two volums on fragmention. Also, among others, Harris (2001), and Long, Riezman and Soubeyran (2001) model services as intermediate inputs to investigate fragmentation.

trade liberalization in intermediate goods can result in *higher* prices for both intermediate and final goods. Our basic insight is that outsourcing enables competitors to form customer-supplier relationships, which can have a collusive effect on competition.

We consider a model where two firms, one domestic and one foreign, produce a differentiated product using a homogenous intermediate input and compete only in the domestic market. The foreign firm has a lower (marginal) cost, m_F, in producing the intermediate input and thus always stays integrated. The domestic firm, however, can either produce the intermediate input itself at a higher cost, m_D ($m_D > m_F$), or purchase the intermediate input from the integrated foreign firm. Recognizing that these two firms may compete in the final-product market, we allow the domestic firm to behave strategically in choosing its input suppliers. In a two-stage game where the choice of the supplier of the intermediate input is determined in the first stage and then the two firms engage in Bertrand competition in the final-product market, we establish the following three main results.

First, strategic outsourcing occurs in equilibrium if and only if the level of the import tariff on the intermediate product is smaller than $m_D - m_F$, the difference between the two firms' costs of producing the intermediate good. Therefore, trade liberalization would lead to such outsourcing. But when outsourcing occurs, the domestic firm may actually pay more (including the tariff) for the intermediate input than it would cost to produce the good domestically. To understand this counter-intuitive result, one needs to recognize that the foreign firm would have less incentive to cut its price in the final-good market when it supplies the domestic firm. This motivates the domestic firm to buy the intermediate input from the foreign firm even if the import cost is the same as, or slightly higher than, the domestic cost of production. Thus, trade liberalization in the intermediate good creates an opportunity for multi-market interdependence between competitors in the final-product market, resulting in a collusive effect.

Second, in the outsourcing equilibrium a further reduction of import tariffs on the intermediate good would increase what the domestic firm actually pays (including the tariff) for the intermediate input. It is intuitive that the foreign firm would raise the (producer) price of the intermediate good when the import tariff decreases. But it is surprising that the

foreign firm would be able to increase the (producer) price more than proportionately when it has multi-market contact with its rival. This result is important because it also implies that the prices of the differentiated final products could become higher when trade in the intermediate input is being liberalized. Therefore, in contrast to the common view in the current literature, trade liberalization in intermediate products could have anti-competitive effects on consumer prices.

Third, in the outsourcing equilibrium trade liberalization in the final good would reduce the prices of the final goods but the effect on the price of the intermediate input depends on the characteristics of the final goods. It would increase (*resp.* decrease) the price of the intermediate input if the final differentiated products are what we shall call "weak substitutes" (*resp.* "strong substitutes"). These results also suggest that with trade liberalization in the final good market, strategic outsourcing is more (*resp.* less) likely to occur if the final goods are weak (*resp.* strong) substitutes.

There is considerable evidence for the kind of international outsourcing similar to that we discuss in this paper. For example, it is well known that Taiwanese PC producers (e.g., Acer) supply mother boards, PCBs, and other inputs to other foreign PC producers. Similar practices can also be found in automotive industries. Traditionally, the production of engines has been kept in-house and engines are only used in the manufacturer's *own* vehicles. This practice is not difficult to understand given that engines are the most important component in automobiles. However, according to *Automotive Industries* (July 1999), Mitsubishi is now poised to sign a series of deals with Fiat Auto and it is likely that Mitsubishi's GDI (gasoline direct injection) engines will power several new Fiat models. Also, a Japanese newspaper (*Nihon Keizai Shimbun, 2* April 2001) reports that Peugeot supplies about 60,000 diesel engines every year to Nissan, Suzuki, Volkswagen, etc. More interestingly, Honda is famous for its unique DCR (direction of crankshaft rotation) engines and their superior quality but the company recently has decided to abandon DCR and will incorporate its technology to produce more conventional GDI engines that are suitable for installation in other carmakers' models. "From now on we will be able to sell our engines to other carmakers", said a Chief Executive Hiroyuki Yoshino of Honda Motor Co. (*Automotive News Europe, 25* October

1999).

To our knowledge, there are no studies in the literature that explore the collusive incentives of international outsourcing and its potential anti-competitive effects associated with trade liberalization. Using the 'transaction cost' and 'incomplete contract' approach, McLaren (2000) and Grossman and Helpman (2001) are the recent studies that focus on trade liberalization and vertical structure under imperfect competition.[3] For example, McLaren shows how globalization would lead to changes in firms' vertical organization, and how outsourcing arises in equilibrium. The contribution is made possible because McLaren incisively recognizes that trade liberalization lowers transaction costs and makes it easier for an input supplier to find an attractive buyer abroad, which strengthens its bargaining power *ex post* and thus makes an arm's-length arrangement more attractive. Trade liberalization therefore unambiguously enhances efficiency because of thickening of the market.

Zhao (2001) also considers outsourcing and the vertical (and horizontal) structure of a multinational firm. The paper, however, focuses on the effects of domestic unionization, particularly how unionization in vertically related markets can make firms become both vertically and horizontally related multinationals.

Our analysis is also related to studies that deal with some strategic aspects in the vertically related markets such as Spencer and Jones (1991, 1992), Spencer and Raubitschek (1996), and Ishikawa and Lee (1997), among many others. In particular, Spencer and Raubitschek (1996) shows that domestic producers faced with monopoly pricing by a foreign supplier of a key input, may choose to form a domestic joint venture to produce part of the input at an even higher cost than the monopoly price. The joint venture provides a commitment for domestic firms to buy part of the input domestically (at a higher cost), which reduces the demand for imported supplies. The purpose of their paper is to show that the reduction in demand may sufficiently reduce the price charged by the foreign monopolist to overcome the domestic cost disadvantage. The collusive effect of the kind we investigate is not captured in their study, since Spencer and Raubitschek mainly focus on Cournot producers.

[3] Raff and Schmitt (2000) investigates how trade liberalization would affect the type of retailling contracts (such as vertical restraints).

The rest of the paper is organized as follows. Section 2 characterizes the equilibrium under no-outsourcing and under outsourcing. Section 3 analyzes the effects of trade liberalization on the equilibrium outcome (outsourcing versus no-outsourcing) and on the prices of the intermediate and final products. Section 4 discusses some alternative assumptions and the robustness of our results. Section 5 provides some concluding remarks.

2. THE MODEL

There are two firms: firm D is located in the *domestic* country and firm F is located in the *foreign* country. These firms produce a differentiated final product, Y, using a homogenous intermediate good, X. There is potential trade in both goods and two firms compete in the *domestic* market only.[4] The (domestic) demand for the two firms' products is $q^i(p_i, p_j)$, $i, j = D, F$. We assume that the products are imperfect substitutes and demand for a product is more responsive to its own price than to the price of the other product, i.e., $0 < \partial q^i(p_i, p_j)/\partial p_j < -\partial q^i(p_i, p_j)/\partial p_i$. The marginal cost of producing the intermediate good X is a constant, m_D for firm D and m_F for firm F, where $0 \leq m_F < m_D$. Thus the foreign firm is more efficient in producing the intermediate good. In the model we assume that only firm F produces the intermediate good X in the foreign country. Other costs of producing Y are normalized to zero, and to produce one unit of good Y requires one unit of the intermediate good X. In the domestic country, there are specific tariffs on imports of both goods: t_y for the final good Y and t_x for the intermediate good X. We do not introduce active domestic or foreign governments into the model since optimal trade policy is not the focus of this present paper. Our main interests are the effects of trade liberalization (which is represented by a reduction in t_x or t_y) on the equilibrium decision about outsourcing and on the prices of intermediate and final products.

The game proceeds as follows. In the first stage, with given t_x and t_y, firm F commits to a (producer) price, w, for the intermediate good (if it sells X); and firm D decides whether

[4]The foreign firm can also serve its own domestic market, but this would matter little as long as the two markets are segmented.

to contract to buy the intermediate good from firm F or to have it produced internally.[5] In the second stage firm D and firm F compete in price (Bertrand) for the differentiated final good Y in the domestic market (we will briefly discuss quantity competition in Section 4). We assume that prices are strategic complements in the usual sense. We also assume that outsourcing would be an equilibrium if no firm is worse off (since there is no transfer payment) and at least one firm better off under outsourcing.

The subgame perfect equilibrium of the model is solved by backward induction. We first characterize Nash equilibrium in the subgame where firm D chooses no-outsourcing. We then characterize the equilibrium in the subgame where firm D chooses outsourcing, that is, to purchase the intermediate good from firm F. The equilibrium outsourcing decision, as well as the equilibrium price for X (if D purchases from F) is then determined.

Equilibrium under no-outsourcing

If firm D produces the intermediate good by itself, the profit functions for firms D and F are

$$\pi^D = (p_D - m_D)q^D(p_D, p_F) \tag{1}$$

and

$$\pi^F = [p_F - (m_F + t_y)]q^F(p_F, p_D) \tag{2}$$

respectively.

The equilibrium prices, which are assumed to exist uniquely for any given parameter values m_D and t_y, are denoted as $p_i(m_D, t_y)$ and they satisfy the following first-order conditions[6]:

[5] Thus, we are assuming that D can commit to purchase all input from F. The implications of realxing this assumption is discussed in Section 4.

[6] Throughout the paper, we shall treat m_F as fixed exogeneously and shall thus not include it as an argument in any functional expressions.

$$q^D\left(p_D\left(m_D,t_y\right),p_F\left(m_D,t_y\right)\right)+p_D\left(m_D,t_y\right)-m_D)q_1^D\left(p_D\left(m_D,t_y\right),p_F\left(m_D,t_y\right)\right)=0, \tag{3}$$

$$q^F\left(p_F\left(m_D,t_y\right),p_D\left(m_D,t_y\right)\right)+[p_F\left(m_D,t_y\right)-(m_F+t_y)]q_1^F\left(p_F\left(m_D,t_y\right),p_D\left(m_D,t_y\right)\right)=0. \tag{4}$$

Denote the equilibrium profits of D and F by $\pi^D\left(m_D,t_y\right)$ and $\pi^F\left(m_D,t_y\right)$. Notice that $\pi^D\left(m_{D,}t_y\right)$ will be $D's$ fall-back level of profit when it decides whether or not to go outsourcing.

Equilibrium under outsourcing

If firm D contracts to buy the intermediate good X from firm F at price w (and pays the import tariff t_x), the profit functions for D and F are

$$\widetilde{\pi}^D=(p_D-w-t_x)q^D(p_D,p_F) \tag{5}$$

and

$$\widetilde{\pi}^F=[p_F-(m_F+t_y)]q^F(p_F,p_D)+(w-m_F)\,q^D\left(p_D,p_F\right) \tag{6}$$

respectively. The equilibrium prices, which are assumed to exist uniquely for any given parameter values t_x and t_y and for the relevant values of w, are denoted as $\tilde{p}_i\left(w+t_x,t_y\right)$ and they satisfy the following first-order conditions:

$$\begin{aligned} & q^D\left(\tilde{p}_D\left(w+t_x,t_y\right),\tilde{p}_F\left(w+t_x,t_y\right)\right)+ \\ & \left[\tilde{p}_D\left(w+t_x,t_y\right)-(w+t_x)\right]q_1^D\left(\tilde{p}_D\left(w+t_x,t_y\right),\tilde{p}_F\left(w+t_x,t_y\right)\right) \\ = \;& 0 \end{aligned} \tag{7}$$

$$
\begin{aligned}
& q^F\left(\tilde{p}_F(w+t_x,t_y),\tilde{p}_D(w+t_x,t_y)\right)+ \\
& [\tilde{p}_F(w+t_x,t_y)-(m_F+t_y)]q_1^F\left(\tilde{p}_F(w+t_x,t_y),\tilde{p}_D(w+t_x,t_y)\right)+ \\
& (w-m_F)\,q_2^D\left(\tilde{p}_D\left(w+t_x,t_y\right),\tilde{p}_F\left(w+t_x,t_y\right)\right) \\
= \;& 0 \qquad (8)
\end{aligned}
$$

Denote the equilibrium profits by $\tilde{\pi}^D\left(w+t_x,t_y\right)$ and $\tilde{\pi}^F\left(w+t_x,t_y\right)$. Clearly, in order for outsourcing to occur in equilibrium, we must have $\tilde{\pi}^i\left(w+t_x,t_y\right)\geq\pi^i\left(m_D,t_y\right)$, $i=D,F$.

Notice that $w+t_x$ is the effective marginal cost for firm D. Obviously, for any w that yields positive outputs for both firms, an increase in w would increase the prices for the final goods. That is,

$$
\frac{\partial\tilde{p}_i\left(w+t_x,t_y\right)}{\partial w}>0 \text{ and } \frac{\partial\tilde{p}_i\left(w+t_x,t_y\right)}{\partial t_j}>0 \text{ for } j=x,y. \qquad (9)
$$

It is less clear how $\tilde{\pi}^i\left(w+t_x,t_y\right)$ will change as w or the tariffs change. From the envelope theorem, we have

$$
\frac{\partial\tilde{\pi}^D\left(w+t_x,t_y\right)}{\partial w}=-q^D\left(p_D,p_F\right)+\left(p_D-w-t_x\right)\frac{\partial q^D\left(p_F,p_D\right)}{\partial p_F}\frac{\partial p_F\left(w+t_x,t_y\right)}{\partial w},
$$

where the first term is negative while the second term is positive. A higher input price for D has the direct effect of cost increase on D, which reduces $D's$ profit; but it also has the indirect effect of increasing $F's$ price for the final good, which benefits D. However, as in Chen (forthcoming) and others, the direct effect dominates provided that $0<\partial q^i\left(p_i,p_j\right)/\partial p_j<-\partial q^i\left(p_i,p_j\right)/\partial p_i$ (an assumption discussed earlier). Thus, $D's$ equilibrium profit decreases in its input costs:

$$
\frac{\partial\tilde{\pi}^D\left(w+t_x,t_y\right)}{\partial w}<0 \text{ and } \frac{\partial\tilde{\pi}^D\left(w+t_x,t_y\right)}{\partial t_x}<0. \qquad (10)
$$

Similarly,

$$\begin{aligned}
&\frac{\partial \tilde{\pi}^F\left(w+t_x,t_y\right)}{\partial w} \\
= \;& \{[p_F-(m_F+t_y)]\frac{\partial q^F(p_F,p_D)}{\partial p_D}+(w-m_F)\frac{\partial q^D(p_F,p_D)}{\partial p_D}\}\frac{\partial p_D\left(w+t_x,t_y\right)}{\partial w}+q^D\left(p_D,p_F\right),
\end{aligned}$$

which again can have ambiguous signs but will be assumed positive for the w that is in the relevant range of our analysis.[7] That is, we assume

$$\frac{\partial \tilde{\pi}^F\left(w+t_x,t_y\right)}{\partial w}>0, \tag{11}$$

or $F's$ equilibrium profit increases in w when it sells the input to D. We shall later provide an example of linear demand where both conditions (10) and (11) hold, together with other assumptions of the model.

As mentioned before, outsourcing would be an equilibrium if no firm is worse off and at least one firm has higher profit under outsourcing. This means that given the game specified above, in any equilibrium that involves $D's$ outsourcing from F, firm F will optimally choose its w (in stage 1) such that D's profit under outsourcing is the same as if it produces the input internally.[8] We therefore have:

Lemma 1 *The equilibrium price of the intermediate good, denoted as $w(t_x)$, satisfies $\tilde{\pi}^D\left(w(t_x)+t_x,t_y\right)=\pi^D\left(m_D,t_y\right)$ and $\tilde{\pi}^F\left(w(t_x)+t_x,t_y\right)>\pi^F\left(m_D,t_y\right)$.*

Furthermore, notice that the first-order conditions in equations (7) and (8) would be the same as those in equations (3) and (4) when both $w=m_F$ and $w+t_x=m_D$ hold. This means that $\tilde{p}_i\left(m_D,t_y\right)=p_i\left(m_D,t_y\right)$ and $\tilde{\pi}^i\left(m_D,t_y\right)=\pi^i\left(m_D,t_y\right)$, $i=D,F$, when $w=m_F$. Therefore, we obtain the following result.

Lemma 2 *(i) Since $\tilde{\pi}^i\left(m_D,t_y\right)=\pi^i\left(m_D,t_y\right)$ when $w=m_F$ and $w+t_x=m_D$, in equlibrium it must be true that $w(t_x)>m_F$; (ii) when $w>m_F$, we have $\tilde{p}_i\left(m_D,t_y\right)>p_i\left(m_D,t_y\right)$, $i=D,F$.*

[7] Notice that the sign is positive when the difference between w and m_F is not too large.

[8] Thus, we are assuming that firm F has all the bargaining power. The implications of a more general Nash bargaining solution are discussed in Section 4.

Proof: (i) Since $\tilde{\pi}^i(m_D, t_y) = \pi^i(m_D, t_y)$ when $w = m_F$ and $w + t_x = m_D$, from (11) and Lemma 1 we immediately obtain $w(t_x) > m_F$. (ii) Compare the two first-order conditions in (7) and (8) with those in (3) and (4). With $(w - m_F) > 0$, it must be true that $\tilde{p}_i(m_D, t_y) > p_i(m_D, t_y)$ since $\partial q^D / \partial p_F > 0$ and prices are strategic complements. ■

The intuition for part (ii) is as follows. Suppose firm F's best response function is $\pi_1^F(p_F, p_D) = 0$ when firm F does not supply firm D. Then it becomes $\widetilde{\pi}_1^F(p_F, p_D) = \pi_1^F(p_F, p_D) + (w - m_F)\frac{\partial q^D}{\partial p_F} = 0$ when firm F suplies firm D. Since $(w - m_F)\frac{\partial q^D}{\partial p_F} > 0$, it shifts up firm F's reaction function, resulting in higher prices.

Now we are ready to derive the following lemma.

Lemma 3 *When $w + t_x = m_D$ and $t_x < m_D - m_F$, we obtain that $\tilde{\pi}^D(m_D, t_y) > \pi^D(m_D, t_y)$.*

Proof: Since $w = m_D - t_x > m_F$, from Lemma 2 we have $\tilde{p}_F(m_D, t_y) > p_F(m_D, t_y)$. Now suppose $\widetilde{\pi}^D(m_D, t_y) = [\tilde{p}_D(m_D, t_y) - m_D] q^D(\tilde{p}_D(m_D, t_y), \tilde{p}_F(m_D, t_y))$. Since $\tilde{p}_D(m_D, t_y)$ is the profit-maximizing price, $\widetilde{\pi}^D(m_D, t_y)$ must be higher than

$[p_D(m_D, t_y) - m_D] q^D(p_D(m_D, t_y), \tilde{p}_F(m_D, t_y))$. The latter, however is greater than

$\pi^D(m_D, t_y) = [p_D(m_D, t_y) - m_D] q^D(p_D(m_D, t_y), p_F(m_D, t_y))$ since $p_F(m_D, t_y) < \tilde{p}_F(m_D, t_y)$.

■

The intuition for the result is the following. When firm D contracts to purchase from firm F at some price $w > m_F$, F will make profit in selling the intermediate good. This in turn makes F less willing to cut the price of its final product. Therefore, althought D's input cost would be the same as if it produces it internaly, it has a higher equilibrium profit due to the strategic effect on the pricing incentive of F for the final good.

3. THE EFFECTS OF TRADE LIBERALIZATION

3.1 Trade liberalization in the intermediate good

Now we solve for the equilibrium decision in stage 1 and show how trade liberalization might affect the subgame perfect equilibrium (i.e., outsourcing or no-outsourcing). Although

we only discuss import tariffs in this model, we interpret a decrease in their level more broadly as a reduction in trade barriers and/or an increase in the degree of globalization (i.e., reduction in trade costs in general). More specifically, we focus on the effects of a reduction in the import tariff on the intermediate good, t_x. First we find that the level of t_x will determine what kind of equilibrium we have, as characterized by the next proposition.

Proposition 1 *There is equilibrium outsourcing if and only if* $t_x < m_D - m_F$.

Proof: We first show that there is equilibrium outsourcing if $t_x < m_D - m_F$. Suppose that $t_x < m_D - m_F$ but there is no outsourcing. Then F can offer some w that is slightly higher than m_F but still $w + t_x < m_D$. Then contracting to purchase the intermediate input from F will increase $D's$ profit from Lemma 3 and condition (10); and it will also increase $F's$ profit due to Lemma 2 and condition (11). Thus $F's$ offer would be accepted, a contradiction.

We next show that $t_x < m_D - m_F$ is also necessary for equilibrium outsourcing to occur. Now suppose that $t_x \geq m_D - m_F$ but there is outsourcing. Notice that if $t_x \geq m_D - m_F$, we would have

$$w(t_x) + t_x \geq w(t_x) - m_F + m_D > m_D,$$

where the last inequality is due to $w(t_x) > m_F$ from Lemma 2 . But since from Lemma 2 $\tilde{\pi}^D(m_D, t_y) = \pi^D(m_D, t_y)$ if $w = m_F$, and since $\tilde{\pi}^D(w + t_x, t_y)$ is decreasing in $w + t_x$ from (10), we would have $\tilde{\pi}^D(w(t_x) + t_x, t_y) < \pi^D(m_D, t_y)$. Therefore, outsourcing would not occur, a contradiction. ■

We define $\bar{t}_x = m_D - m_F$ and call $\bar{t}_x$ the prohibitive level of tariff. When $t_x \geq \bar{t}_x$, the equilibrium is no-outsourcing - firm D produces the intermediate good by itself. When $t_x < \bar{t}_x$, the equilibrium is outsourcing - firm D purchases the intermediate good from firm F at price $w(t_x)$, the equilibrium price for the intermediate good. Therefore, if t_x is initially sufficiently high to deter trade in the intermediate good, we could observe that firm D moves from the no-outsourcing regime to the outsourcing regime as the tariff on the intermediate good decreases.

From Proposition 1, one may think that it should also be true that $w(t_x) + t_x < m_D$ in the outsourcing equilibrium. That is, firm D would pay less (including the tariff) for the intermediate good when it decides to go outsourcing. However, as the next proposition makes clear, this is not the case.

Proposition 2 *When the outsourcing equilibrium obtains, we have* $w(t_x) + t_x > m_D$ *and* $\tilde{p}_i(w(t_x) + t_x, t_y) > p_i(m_D, t_y)$ *for* $i = D, F$.

Proof: From Proposition 1, $t_x < m_D - m_F$ when there is equilibrium outsourcing. It follows that $\tilde{\pi}^D(m_D, t_y) > \pi^D(m_D, t_y)$ from Lemma 3. Since frim D will accept any offer of w from F such that $\tilde{\pi}^D(w + t_x, t_y) = \pi^D(m_D, t_y)$, and since $\tilde{\pi}^F(w + t_x, t_y)$ is increasing in w and $\tilde{\pi}^D(w + t_x, t_y)$ is decreasing in w, in equilibrium F must offer $w(t_x)$ such that $\tilde{\pi}^D(w(t_x) + t_x, t_y) = \pi^D(m_D, t_y)$, which implies $w(t_x) + t_x > m_D$.

Finally, since $w(t_x) + t_x > m_D$ (and $w(t_x) > m_F$), from Lemma 2 and (9), we must have $\tilde{p}_i(w(t_x) + t_x, t_y) > p_i(m_D, t_y)$. ■

It is surprising that, when moving to outsourcing, firm D actually pays more for the intermediate good than its own cost to produce the good. To understand this result, one needs to recognize that the condition for firm D to decide to go outsourcing is $\tilde{\pi}^D(w(t_x) + t_x, t_y) \geq \pi^D(m_D, t_y)$ rather than $w(t_x) + t_x < m_D$. More importantly, notice that firm F would have less incentive to cut its price in the final-good market if it supplies the intermediate good to D. This implies that firm D would strictly prefer to buy the intermediate input from firm F if the cost of outsourcing is the same as that of its own production. This then enables firm F to raise the price of the intermediate good. Consequently, the prices of the final products are also higher under outsourcing than under no-outsourcing. Therefore, here outsourcing has a strategic effect: it changes the competition in the final-good market and results in less competition there.

We have shown that strategic outsourcing can arise when trade in the intermediate product is liberalized. Now, if there is already outsourcing in equilibrium, what would be the effects of further trade liberalization in the intermediate good? When $t_x < \bar{t}_x$ and the sub-game perfect Nash equilibrium is outsourcing, a further reduction of t_x increases the

equilibrium price of the intermediate good but surprisingly, it would also increase what firm D pays for the intermediate good (i.e., $w(t_x)+t_x$) and the prices of the final goods.

Proposition 3 *In the equilibrium of outsourcing, a reduction of t_x increases $w(t_x)+t_x$ (i.e., $|dw(t_x)/dt_x|>1$) and the prices of the final product.*

Proof: Suppose that $t_x''<t_x'(<\bar{t}_x)$. From Lemma 1, notice that in equilibrium firm F will always choose w such that

$$\tilde{\pi}^D\left(w\left(t_x''\right)+t_x'',t_y\right)=\tilde{\pi}^D\left(w\left(t_x'\right)+t_x',t_y\right)=\pi^D\left(m_D,t_y\right).$$

holds. Then it must be true that $w(t_x'')>w(t_x')$ (or, $w(t_x'')>w(t_x')>m_F$) since otherwise a reduction of t_x' would lower $\tilde{\pi}^D$. Changing from $w(t_x')$ to $w(t_x'')$ shifts up firm $F's$ reaction function and thus for any given price of firm D in the final-good market, firm $F's$ price for its final good will be higher under $w(t_x'')$ than under $w(t_x')$. Therefore, if $w(t_x'')+t_x''\leq w(t_x')+t_x'$, we would have $\tilde{\pi}^D(w(t_x'')+t_x'',t_y)>\tilde{\pi}^D(w(t_x')+t_x',t_y)$, a contradiction. This proves that $w(t_x'')+t_x''>w(t_x')+t_x'$. From (9) it then follows that the equilibrium prices in the final-good market are higher under t_x'' than under t_x' . ■

The intuition of the result is as follows. The initial reduction of t_x increases firm D's profit. This allows firm F to raise w. When w increases, firm F cares more about the profit from selling the intermediate good and hence further softens its competition with firm D in the final-product market, which has an effect on increasing $\tilde{\pi}^D$. This allows firm F to raise w even further. Since in equilibrium firm D's profit is always kept to its level under no-outsourcing, π^D, the combined forces would allow firm F to raise w more than proportionately.

Thus, Proposition 3 demonstrates that trade liberalization in the intermediate good could have an anti-competitive effect on both intermediate and final product markets.

For illustration of these results, we shall consider a linear-demand example:

Example Suppose

$$q^i(p_i,p_j)=1-p_i+\beta(p_j-p_i);\ i,j=D,F,\ \beta\in(0,\infty). \tag{12}$$

Following eqs. 3 and 4, we obtain the equilibrium prices of the final product under no-outsourcing:

$$p_D(m_D, t_y) = \frac{2 + 3\beta + 2(1+\beta)^2 m_D + \beta(1+\beta)(m_F + t_y)}{(2+\beta)(2+3\beta)} \tag{13}$$

for firm D and

$$p_F(m_D, t_y) = \frac{2 + 3\beta + 2(1+\beta)^2 (m_F + t_y) + \beta(1+\beta) m_D}{(2+\beta)(2+3\beta)} \tag{14}$$

for firm F. Also, it is straightforward to obtain that

$$\pi_D(m_D, t_y) = (1+\beta)\frac{[2 + 3\beta - (2 + 4\beta + \beta^2) m_D + \beta(1+\beta)(m_F + t_y)]^2}{(2+\beta)^2(2+3\beta)^2}. \tag{15}$$

Following eqs 7 and 8, we obtain the corresponding equilibrium prices under outsourcing:

$$\widetilde{p}_D(w + t_x, t_y) = \frac{2(1 + w + t_x) + \beta\{3 + m_F + t_y + 4(w + t_x) + \beta[t_y - t_x + 3(w + t_x)]\}}{(2+\beta)(2+3\beta)} \tag{16}$$

and

$$\widetilde{p}_F(w + t_x, p_y) = \frac{\beta\{2(2+\beta)(m_F + t_y) - 2(1+\beta)(m_F + t_x) + 3[1 + w + t_x + \beta(w + t_x)]\}}{(2+\beta)(2+3\beta)} + \frac{2(1 + m_F + t_y)}{(2+\beta)(2+3\beta)} \tag{17}$$

And the equilibrium profit for firm D becomes,

$$\widetilde{\pi}_D(w + t_x, t_y) = (1+\beta)\frac{\{\beta[3 + \beta(t_y - t_x) + (m_F + t_y) - 4(w + t_x)] - 2(w + t_x - 1)\}^2}{(2+\beta)^2(2+3\beta)^2}. \tag{18}$$

Therefore, from Lemma 1 the equilibrium price for the intermediate product is obtained by setting $\widetilde{\pi}_D(w + t_x, t_y)$ equal to $\pi_D(m_D, t_y)$, which is

$$w(t_x) + t_x = m_D + \frac{\beta^2(m_D - m_F - t_x)}{4\beta + 2} \tag{19}$$

Notice that $w(t_x) + t_x > m_D$ because $t_x < m_D - m_F$. Also, it is straightforward to show that $dw/dt_x = -(\beta^2 + 4\beta + 2)/(4\beta + 2) < -1$, and $d\widetilde{p}_D/dt_x < 0$ and $d\widetilde{p}_F/dt_x < 0$. These results are also illustrated by the diagrams in Figure 1.

Figure 1 here

3.2 Trade liberalization in the final good

In this section we focus on the effects of trade liberalization in the final good, which can be analyzed by examining the effects of a reduction in the tariff of the final good. Here we focus our analysis on the equilibrium under outsourcing although we will also discuss how trade liberalization in the final good might affect the outcomes of sub-game perfect Nash equilibrium: outsourcing versus no-outsourcing.

The effect of a reduction of t_y is straightforward. Since t_y is the marginal cost for firm F, from (9) this will reduce the prices of the final goods.

Proposition 4 *A reduction of t_y reduces the prices of good Y ($\widetilde{p}_D$ and $\widetilde{p}_F$). More generally, $d\widetilde{p}_i/dt_y > 0, i = D, F$.*

Therefore, unlike that in the intermediate good, trade liberalization in the final good has an unambiguously competitive effect on the final-product market.

Proposition 4, however, does not suggest that a reduction of t_y would also unambiguously lower the price of the intermediate input. The next proposition makes it clear that the effects of a reduction of t_y on w depend on the characteristics of the differentiated final products (below we will always use w, rather than $w(t_x)$, to denote the equilibrium price of the intermediate good X).

Proposition 5 *(i) $dw/dt_y > 0$ if $d^2(q^D)/d(p_F)^2 > 0$ (goods Y are 'strong substitutes'); (ii) $dw/dt_y = 0$ if $d^2(q^D)/d(p_F)^2 = 0$ (linear demand); (iii) $dw/dt_y < 0$ if $d^2(q^D)/d(p_F)^2 < 0$ (goods Y are 'weak substitutes').*

Proof: Notice that $\widetilde{\pi}^D(w+t_x, t_y)$ and $\pi^D(m_D, t_y)$ are both indirectly affected by t_y. Changes in t_y affect firm F's marginal cost, which in turn shift its reaction function curve. To determine the sign of dw/dt_y we must compare $d\widetilde{\pi}^D(w+t_x, t_y)/dt_y$ with $d\pi^D(m_D, t_y)/dt_y$ since in equilibrium firm F will use w to satisfy that $\widetilde{\pi}^D(w+t_x, t_y) = \pi^D(m_D, t_y)$. Therefore, the equilibrium level of w crucially depends on how a change in t_y shifts firm F's reaction function curves under no-outsourcing with respect to outsourcing. We write the two first-order conditions for eq. 2 and 6 as $\partial\pi^F/\partial p_F = 0$ and $\partial\pi^F/\partial p_F + (w - m_F)\,\partial q^D/\partial p_F = 0$, respectively. Then for a given level of p_D, we can obtain:

$$\frac{\partial p_F(m_D)}{\partial t_y} = \frac{\frac{\partial^2\pi^F}{\partial p_F \partial t_y}}{-\frac{\partial^2\pi^F}{\partial p_F^2}} > 0 \tag{20}$$

under no-outsourcing and

$$\frac{\partial \widetilde{p}_F(w+t_x)}{\partial t_y} = \frac{\frac{\partial^2\pi^F}{\partial p_F \partial t_y} + (w - m_F)\frac{\partial^2 q^D}{\partial p_F^2}}{-\frac{\partial^2\pi^F}{\partial p_F^2}} > 0 \text{ (Proposition 4)} \tag{21}$$

under outsourcing. Therefore, for example, an increase in t_y would shift up firm F's reaction curve under the outsourcing equilibrium more (*resp.* less) than that in the no-outsourcing equilibrium if $\partial^2(q^D)/\partial(p_F)^2 > 0$ (*resp.* $\partial^2(q^D)/\partial(p_F)^2 < 0$). That is, for any given price of firm D for its final good, firm $F's$ price for its final good will be higher under outsourcing if $\partial^2(q^D)/\partial(p_F)^2 > 0$ but lower if $\partial^2(q^D)/\partial(p_F)^2 < 0$. This will then affect firm D's profits in both cases. To satisfy the condition $\widetilde{\pi}^D(w+t_x, t_y) \geq \pi^D(m_D, t_y)$ [or rather, $\widetilde{\pi}^D(w+t_x, t_y) = \pi^D(m_D, t_y)$] for outsourcing to be an equilibrium, firm F will raises (*resp.* lower) w accordingly. With a linear demand function (where $\partial^2(q^D)/\partial(p_F)^2 = 0$), we have $\partial\widetilde{p}_F(w+t_x)/\partial t_y = \partial p_F(m_D)/\partial t_y$ and therefore w will be unchanged. Similarly, we can prove the results with a reduction of t_y. ■

Notice that the sign of $\partial q^i/\partial p_j$ tells the extent (and the direction) at which a demand function shifts. In our model $\partial q^i/\partial p_j > 0$ since differentiated goods Y are substitutes. The sign of the second derivative $\partial^2(q^i)/\partial(p_j)^2$, however, tells whether the demand function shifts at an increasing or decreasing rate. For example, a rise of p_j would increase q^i at an

increasing (*resp.* a decreasing) rate if $\partial^2(q^i)/\partial(p_j)^2 > 0$ (*resp.* $\partial^2(q^i)/\partial(p_j)^2 < 0$). Thus we name goods Y 'strong substitutes' (*resp.* 'weak substitutes') when $\partial^2(q^i)/\partial(p_j)^2 > 0$ (*resp.* $\partial^2(q^i)/\partial(p_j)^2 < 0$). Therefore, the effects of trade liberalization in the final goods market on the equilibrium price of the intermediate good will depend on the characteristics of the differentiated final goods. A reduction of t_y would lower w if goods Y were strong substitutes, but it would increase w if goods Y were weak substitutes.

Moreover, the following should be noted. The intuition of Proposition 5 is similar to those of Propositions 2 and 3. In Proposition 5, however, a change in t_y affects not only $\widetilde{\pi}^D(w + t_x, t_y)$ but also $\pi^D(m_D, t_y)$. A decrease in t_y lowers both $\pi^D(m_D, t_y)$ and $\widetilde{\pi}^D(w + t_x, t_y)$. But with strong substitute, for example, the decrease in $\widetilde{\pi}^D(w + t_x, t_y)$ is greater than that in $\pi^D(m_D, t_y)$. This is basically because the shift in firm D's derived demand for the intermediate good becomes larger as $\partial^2(q^D)/\partial(p_F)^2$ becomes larger. When t_y decreases, the derived demand shrinks and hence the intermediate-good market becomes less attractive for firm F. This in turn makes firm F cut p_F and hence the competition in the final-good market is reinforced. Firm F then has to reduce w to keep firm D indifferent between outsourcing and no-outsourcing. When goods Y are weak substitute, we obtain the converse.

Although these effects on the price of the intermediate good would also have some "feedback" effect on the prices of the final good, they are only of second-order. More importantly, the above discussion about the effects of a reduction of t_y on the price of the intermediate good has implications for the equilibrium outcome of outsourcing and no-outsourcing. Notice that, for outsourcing to be an equilibrium, w cannot be smaller than m_F. Thus a reduction in w would make outsourcing less likely to occur. Therefore we can make the following remark.

Remark 1 *With trade liberalization in the final-good market, strategic outsourcing is more (resp. less) likely to occur if the final goods are weak (resp. strong) substitutes.*

4. DISCUSSION

In this section we discuss how our results will (or will not) change under some alternative assumptions. First, it is important to realize that the collusive effect of strategic outsourcing identified in this paper relies on firm F taking into account the profit from the intermediate-good market. Specifically, firm F realizes how its price of the final good will affect the quantity sold by the other firm (and hence the quantity of the intermediate good that firm D would purchase from firm F). Therefore such a collusive effect would not arise in Cournot competition (with a homogeneous final product).[9] With Cournot assumption, firm F takes firm $D's$ output as given when deciding its own output. Therefore, if one believes that firm F would realize that its strategic action in the final product market could affect its profit from the intermediate good market, then the Cournot assumption would seem inappropriate for our analysis.

Nevertheless, it is not difficult to see that the collusive effect of strategic outsourcing could still arise in quantity competition if firm F is a Stackelberg leader in quantity in the final-good market. As a Stackelberg leader, firm F would then incorporate the effect of its strategic action in the final-good market on its profit of selling the intermediate good to firm D. Thus the collusive incentive of strategic outsourcing can again arise.

Second, we only have two firms in our model. In the no-outsourcing equilibrium firm D produces the intermediate good by itself at cost m_D. However, this is not the only interpretation of the set-up. In the context of international outsourcing, this is equivalent to that firm D initially purchases the intermediate good from a competitive domestic supplier at price m_D. When moving to outsourcing, firm D switches its purchase of the intermediate good from the domestic supplier to firm F. Our results would not be changed with this modification of the model.

Finally, in the model, firm F is the only integrated foreign firm that has lower marginal cost to produce the intermediate good and hence we have assumed that firm F has all

[9] As in Spencer and Jones (1991,1992), vertical supply could occur under Cournot competitition but there is no collusive effect.

the bargaining power in the intermediate good market. Such a strong bargaining power [i.e., firm F makes a "take-it-or-leave-it" offer and sets price w such that $\widetilde{\pi}^D(w + t_x, t_y) = \pi^D(m_D, t_y)$] will be weakened if there were more than one efficient foreign firms or suppliers of the intermediate good. The implications for allowing firm D to have some bargaining power are mainly the following. First, the assumption used in the paper allows us to derive the results in a very clear way. However, it is not difficult to see that, as long as firm F's bargaining power is sufficiently strong, the qualitative nature of our results will not change in a more general bargaining framework.[10] It is possible for firm F to have a sufficiently strong bargaining/market power in the intermediate market if other firms are much less efficient. Second, if firm D has a strong bargaining power, this will affect both the price and the quantity of the intermediate good that firm D would choose to purchase from firm F.[11] Consequently, we would not have the surprising results and the anti-competitive effects of trade liberalization in the intermediate good. Therefore, our analysis has an important policy implication, namely, trade liberalization in key intermediate goods markets should be accompanied by market reform if significant market power exists in some area/industries similar to that we discuss and document in the introduction.

5. CONCLUDING REMARKS

In this paper we have identified a strategic incentive for international outsourcing, which arises from multi-market interactions among firms. It is shown that trade liberalization may create opportunities for multi-market interdependence and cause strategic outsourcing to occur. Unlike the outsourcing motivated by cost saving, strategic outsourcing has anti-competitive effects in the intermediate-good and final-good markets. In the presence

[10] This is the reason why we use still the term *strategic outsourcing* in the title although in the model firm D "does not benefit" from outsourcing, which would not be true as long as firm D has some bargaining power.

[11] However, notice that the collusive effect would not arise if firm D does not buy the intermediate good from firm F. The more significant is the profit from selling the intermediate good, the more collusive behavior firm F would seek.

of strategic outsourcing, further trade liberalization in the intermediate-product market could also produce an anti-competitive effect in both markets. Therefore, trade liberalization in the intermediate good market could have a very different effect compared to trade liberalization in the final good market.

It is well-known that the majority of total world trade are intermediate products/components and this trend has been growing continuously. More importantly, trade in intermediate products is concentrated in a relatively few product groups. Within the OECD countries, for example, "4 of the 44 SITC product groups account jointly for over 70 percent of total trade in components with parts of motor vehicles alone accounting for over 91 billion, or about one-quarter of the total exchange in these goods " (Yeats, 2001). Some of the markets for key inputs/components have significant market power. Thus, the analysis in the current paper is relevant and may have important policy implications. As discussed in Section 4, the anti-competitive effects of strategic outsourcing depend on the foreign firm having strong bargaining power in the intermediate-good market. Therefore, in order to achieve its potential benefits, trade liberalization in those intermediate-good markets, where exists significant market power, should be accompanied by market reform.

REFERENCES

[1] Arndt, Sven W. and Henryk Kierzkowski. 2001, *Fragmantation: New Production Patterns in the World Economy,* Oxford University Press, London.

[2] Chen, Yongmin, "On vertical mergers and their competitive effects." *RAND Journal of Economics*, forthcoming.

[3] Cheng, Leonard K. and Henryk Kierzkowski. 2001, *Global Production and Trade in East Asia,* Kluwer Academic Press: London.

[4] Feenstra, Robert C. and Gordon H. Hanson. 1996a, "Foreign direct investment, outsourcing and relative wages." in R.C. Feenstra, G.M. Grossman and D.A. Irwin eds., *Political Economy of Trade Policy: Eassays in Honor of Jagdish Bhagwati.*MIT Press, Cambridge, Mass.

[5] Feenstra, Robert C. and Gordon H. Hanson. 1996b, "Globalization, outsourcing and wage inequalit." *American Economic Review,* 86(2), p240-245.

[6] Grossman, G. and E. Helpman. 2001, "Outsourcing in a global economy", Priceton University.

[7] Hanson, Gordon H. 1996, "Localization Economics, Vertical Organization, and Trade." *American Economic Review*, 86(5), p1266-1278.

[8] Harris, R. 2001, "A communication based model of global production fragmentation" in Sven W. Arndt and Henryk Kierzkowski, eds, *Fragmantation: New Production Patterns in the World Economy,* Oxford University Press, London.

[9] Ishikawa, Jota and Ki-Dong Lee. 1997, "Backfiring tariffs in vertically related markets." *Journal of International Economics* 42, p395-423.

[10] Jones, Ronald W. 2000, *Globalization and the Theory of Input Trade*, Cambridge, MASS: MIT Press.

[11] Jones, Ronald W. and Henryk Kierzkowski. 2001, "Globalization and the consequences of international fragmentation." in R. Dornbusch, G. Calvo, and M. Obstfeld, eds., *Money, Factor Mobility, and Trade: The Festschrift in Honor of Robert A. Mundell*, Cambridge, Mass: MIT Press.

[12] Long, N V., R. Riezman, and A. Soubeyran. 2001 "Fragmentation and Services", mimeo. MigGill University.

[13] McLaren, John. 2000, "Globalization' and Vertical Structure." *American Economic Review,* 90(5), p1239-1254.

[14] Raff, H. and N. Schmitt. 2000, "Endogenous vertical restraints in international trade", Discussion Paper No. 00-4, Department of Economics, Simon Fraser University.

[15] Slaughter, Mathew. 1995, "Multinational corporations, outsourcing, and American wage divergence." NBER Working Paper No. 5253..

[16] Spencer, Barbara, and Ronald W. Jones. 1991, "Vertical foreclosure and international trade theory." *Review of Economic Studies,* January 1991, 153-170.

[17] Spencer, Barbara, and Ronald W. Jones. 1992, "Trade and protection in vertically related markets." *Journal of International Economics* 32, 31-55.

[18] Spencer, Barbara J. and Ruth S. Raubitschek. 1996, "High-cost domestic ventures and international competition: Do domestic firms gain?". *International Economic Review* 37, 315-340.

[19] Yeats, A. J. 2001, "Just how big is global production sharing?" in in Sven W. Arndt and Henryk Kierzkowski, eds, *Fragmantation: New Production Patterns in the World Economy,* Oxford University Press, London.

[20] Zhao, Laixun. 2001, "Unionization, vertical markets, and outsourcing." *Journal of International Economics 55, 187-202.*

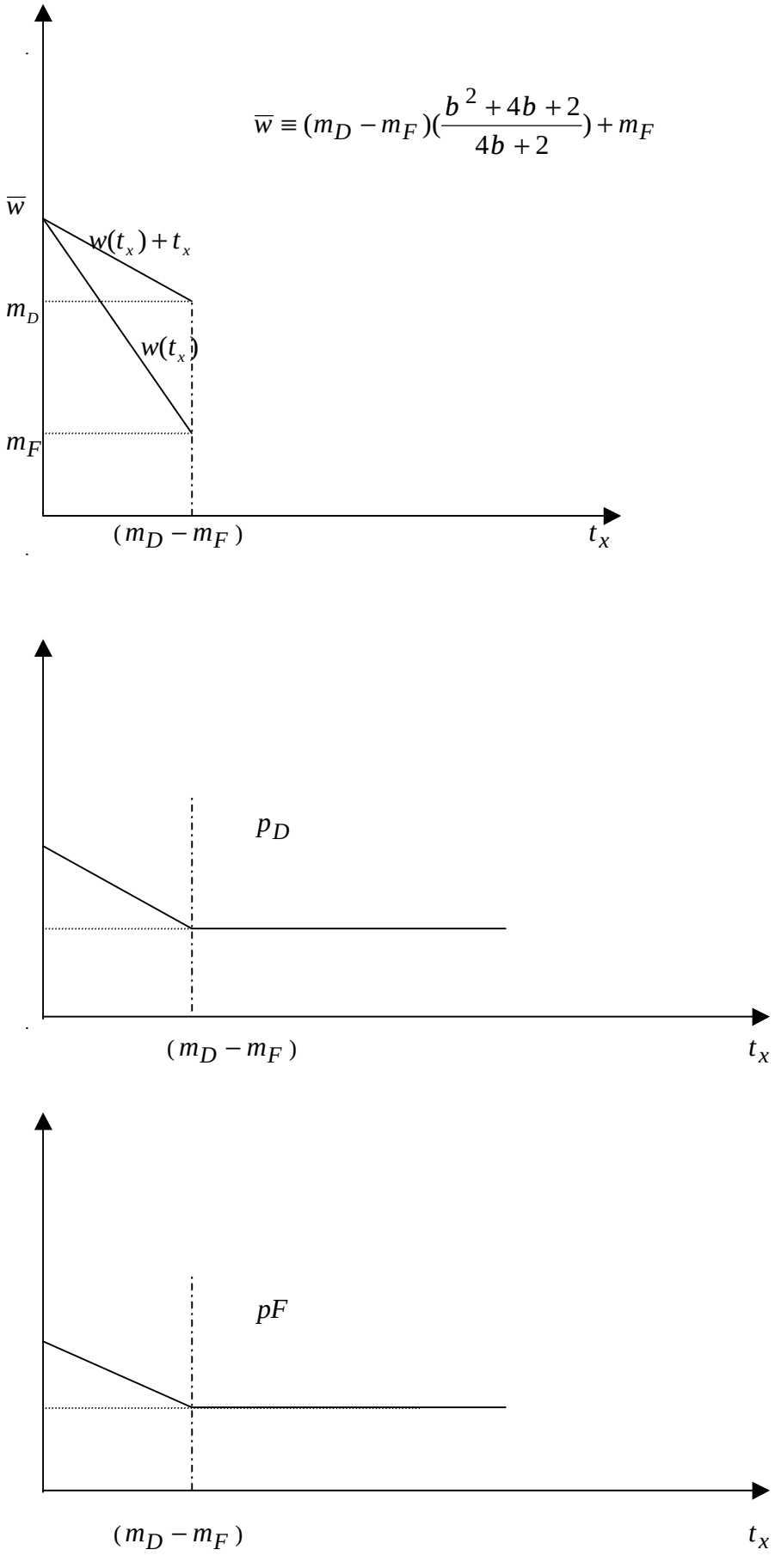
$\overline{w} \equiv (m_D - m_F)(\frac{b^2 + 4b + 2}{4b + 2}) + m_F$
$\overline{w}$
$w(t_x) + t_x$
m_D
$w(t_x)$
m_F
$(m_D - m_F)$
t_x
p_D
$(m_D - m_F)$
t_x
pF
$(m_D - m_F)$
t_x

Figure 1