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Protection and International Sourcing

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Abstract
We study the impact of import protection on relationship-specific investments, organizational choice and welfare. We show that a tariff on intermediate inputs can improve social welfare through mitigating hold-up problems. It does so if it discriminates in favor of the investing party, thereby improving its bargaining position. On the other hand, a tariff can prompt inefficient organizational choices if it discriminates in favor of less productive firms or if integration costs are low. Protection distorts organizational choices because tariff revenue, which is external to the firms, drives a wedge between the private and social gains to offshoring and integration.

Keywords: International trade, tariffs, hold-up problem, sourcing, organizational form
JEL codes: F13, L23, D23

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1 Introduction

International trade in intermediate goods has become increasingly important worldwide, accounting for about a third of the increase in global trade flows in recent years (Hummels, Ishii and Yi 2001). Yet trade in intermediate goods is not only quantitatively important; it is also qualitatively different from trade in final goods, since it often involves tailor-made components that command a lower value from parties not involved in the transaction. If contracts are incomplete, this tends to discourage relationship-specific investments, leading to underinvestment due to the fear of future "hold-ups." In this setting, we study the implications of protection for investment, organizational structure, and welfare, and ask the following questions: Is protection necessarily bad? Can protection affect the *social* desirability of domestic *vs.* offshore supply of inputs and of arm's-length trading *vs.* vertical integration? And does protection distort the efficiency of equilibrium organizational forms?

We show that a tariff can improve social welfare through mitigating hold-up problems. By increasing the cost of substitute generic foreign inputs, tariffs motivate domestic specialized suppliers to increase investments in technology improvements. Essentially, the tariff improves the supplier's bargaining position by lowering the value of the downstream buyer's option to purchase generic inputs. Since under free trade a domestic specialized supplier would underinvest due to the hold-up problem, a tariff that is not too high (i.e., does not generate excessive deadweight losses by artificially inflating the price of substitutes) improves welfare. By contrast, protection does not promote investment by foreign specialized suppliers, because it does not discriminate in their favor. Since a tariff affects the price of generic substitutes in the same way, it does not improve the foreign supplier's bargaining position.

Tariffs also create welfare-reducing organizational externalities. Because firms do not capture tariff revenue, protection drives a wedge between the private and social gains of using a domestic specialized supplier and of vertically integrating. Since the tariff discriminates in favor of domestic suppliers, buyers (ignoring the country's lost tariff revenue) will choose to deal with such suppliers even in some cases where a foreign supplier would be more productive. Furthermore, since weaker hold-up problems under vertical integration induce an upstream buyer to use fewer generic imports when integrated than it does when trading at arm's length, buyers will choose to vertically integrate even in cases where the cost of integration is too high relative to its (social) benefits through reducing hold-up problems.

Overall, our findings suggest that the effects of tariffs on welfare are far more nuanced than normally believed. First, organizational forms are (conditionally) socially efficient under free trade but free trade may not maximize welfare. Indeed, if we observe domestic outsourcing under free trade, some protection would be socially desirable. Second, observing offshoring under a very protectionist regime would provide evidence that the economy would benefit from free trade. Third, since policy discrimination is key for attenuating hold up problems, under the World Trade Organization principle of National Treatment,[1] domestic taxation, unlike import tariffs, would not

[1] Namely, that "imported and locally produced goods should be treated equally after the foreign goods have entered the market" (http://www.wto.org/english/theWTO_e/whatis_e/tif_e/fact2_e.htm).

affect investment incentives. This highlights a rather rare circumstance where trade taxes dominate domestic taxation.[2] Fourth, there is a qualitative difference between the effects of tariffs and of unrecoverable trade costs on organizational form. While the latter generally affect organizational choices (see e.g. Antràs and Helpman 2004), they do not distort supply or ownership decisions away from social optima. In contrast, our model predicts that countries with high tariffs tend to have too much domestic sourcing and too many integrated firms, relative to the socially optimal.

To make our points as clearly as possible, we design our model so that all standard motivations for active trade policy are shut down. Additionally, we restrict attention to dual sourcing of inputs: the downstream buyer purchases both customized inputs from a (foreign or domestic) specialized supplier and generic inputs from a foreign competitive fringe. Dual, or "second," sourcing has been common practice for decades in several industries.[3] However, our emphasis on dual sourcing is mainly pedagogical, as it generates the simplest environment in which a tariff always affects the buyer's costs from at least one source of supply and to which we can easily add endogenous organizational form. This assumption allows us to present our results sharply, avoiding a cumbersome taxonomy. It also sacrifices surprisingly little generality. The qualitative results from our model carry over, for example, into an environment where only one source of supply is ultimately chosen but there is ex ante uncertainty about which supplier will have the lowest price, i.e. where two sources "expect" to produce inputs with some probability.[4]

Our work is directly related to the burgeoning literature using models of incomplete contracts to study optimal sourcing decisions and organizational form in an international context.[5] It contributes also to the law-and-economics and industrial organization literatures that seek to identify contractual and institutional "solutions" to the hold-up problem. These solutions usually require either a commitment to not renegotiate contracts or the ability of courts to punish contract breach.[6] If renegotiation cannot be prevented and courts cannot always enforce contracts, the standard underinvestment problem remains. We show that import tariffs can, sometimes, be useful in that context.[7]

But our most direct contribution is to the trade policy literature. First, we identify, and qualify, a novel circumstance where protection can enhance welfare—mitigating hold-up problems.

[2] As is well known, for most other reasons that could justify policy intervention, there are usually other "less inefficient" domestic instruments available (Rodrik 1995).

[3] Two prominent examples are defense contracting (Lyon 2006) and semiconductors (Shepard 1987; Farrell and Gallini 1988). Researchers have argued that dual sourcing may help to prevent bottlenecks, to induce competition among oligopolistic suppliers, and to achieve commitment from buyers. We abstract from commitment issues and strategic competition among suppliers by modeling the second source as a purely competitive "fringe."

[4] In previous work (Ornelas and Turner 2008), we use a "single source under uncertainty" model to show that tariffs have multiple potential effects on trade flows under contractual incompleteness.

[5] See for example McLaren (1999, 2000), Antràs and Helpman (2004, 2008), Grossman and Helpman (2005), and Ornelas and Turner (2008).

[6] For example, Rogerson (1992) shows that the hold-up problem may be solved with properly specified initial contracts as long as it is possible to prohibit renegotiation, whereas Spier and Whinston (1995) and Edlin and Reichelstein (1996) show that well-tuned fixed-price contracts may solve the investment problem depending on the breach remedy enforced by courts.

[7] In a closed economy, Rosenkranz and Schmitz (2007) show that government intervention, though domestic taxation, may solve hold-up problems caused by bilateral spillovers of one-sided investments.

Second, and in contrast, we uncover a new channel through which protection promotes inefficiency—distorting organizational choices.

The independent work by Antràs and Staiger (2008) relates to our first point. They build on the modeling framework developed by Antràs and Helpman (2004) to identify a new role for international trade agreements in correcting international hold-up problems and preventing inefficient manipulation of unilateral trade policies aimed at affecting bargaining over supply prices. To highlight their main points, Antràs and Staiger focus on a single source of supply and treat organizational form as exogenous (all upstream firms outsource abroad). In contrast, we design our model to explicitly eliminate the need for trade agreements. This allows us to isolate the differential effects of tariffs depending on the location of specialized suppliers and the ownership structure, as well as their role in defining those organizational choices, from confounding forces that arise when governments set trade policies actively. But as we discuss in the conclusion, expanding our setting to consider the role of trade agreements presents itself as a natural, and potentially very interesting, extension.

In turn, the recent paper by Conconi, Legros and Newman (2008) relates to our second point that international trade can affect the efficiency of organizational choices. Their environment, reasoning and predictions are entirely different from ours, however. In their setting, inefficient organizations arise because managers care about the private costs of their actions, and this leads to insufficient coordination between related firms. By affecting coordination incentives, international trade may induce either socially inefficient integration or socially inefficient disintegration.

After describing the model, we study the effect of specific tariffs on investment decisions under each possible organizational form (section 2). In section 3 we compare the welfare impact of protectionist policies under each type of organization, taken as given. In section 4 we then analyze the welfare implications of protectionist policies taking into account also their effects on organizational forms. In section 5 we extend the analysis to the case of ad valorem tariffs. We conclude in section 6.

2 Model

2.1 Basic Structure

There are two final goods. A numéraire good x is traded freely and enters in the objective function of (identical) consumers linearly; consumption of a differentiated good y increases the utility of consumers at a decreasing rate. Thus, if consumers purchase any amount of x, any extra income is directed to the consumption of that good. We assume the price of good y is such that consumers purchase both goods.

Production of one unit of good x requires one unit of labor, and the market for good x is perfectly competitive. This effectively sets the wage rate in the economy to unity whenever good x is produced. Production of y requires transforming an intermediate input under conditions of decreasing returns to scale. There is a single producer of good y in the Home economy, but he has no market power because the price of y is determined in the world market, which the Home producer cannot influence.

At the current price of good y, the Home producer—whom we call *the buyer*, B—obtains revenue $V(Q)$ when he purchases Q units of inputs, with $V' > 0$ and $V'' < 0$. Trade taxes and subsidies shift B's demand for inputs, $V'(Q)$, but do nothing else. Since we are concerned with the effects of protection *in the market for inputs*, we assume hereafter that any trade taxes/subsidies in the market of good y are already factored in V and do not change throughout the analysis. It is immaterial for the analysis whether Home is an importer or an exporter of good y.

The buyer has two sourcing options. He can purchase customized inputs from a specialized supplier at a price they negotiate. This supplier, which we denote by S^j, could be either domestic ($j = d$) or foreign ($j = f$). Alternatively, B can purchase standardized inputs in the world market at price p^w. In that case, the buyer also has to incur a (specific) tariff t, so the cost of each imported unit of a generic input for him is $p^w + t$.[8] Since these generic inputs may require adaptation costs, they will in general have a lower value for B than the specialized inputs. We normalize units to take these differences into account, so that the buyer becomes indifferent between one unit of generic input and one unit of customized input. To ensure that B always buys at least some inputs under free trade, we assume $V'(0) > p^w$.

To use specialized inputs, the buyer has to adapt his technology toward the inputs of either S^d or S^f. If B adapts toward S^j, the inputs of S^i, $i \neq j$, become worthless to him. The inputs of S^j have the same value to B regardless of the identity of j, conditional on B adapting toward S^j. The cost of the adaptation, which is independent of the supplier, is normalized to zero. Before specializing, B makes a take-it-or-leave-it request for a transfer from the chosen supplier. This allows the buyer to capture all surplus from the supplier. This assumption, made for convenience, shuts down any revenue-stealing implications of tariffs. Without it, the analysis would be identical if we focused instead on *world*'s welfare to define efficient choices.[9]

Production of inputs requires labor. In labor units, S^j's cost of producing specialized inputs is $C^j(q, i)$, where q denotes the quantity produced and $i \in [0, \bar{\imath}]$ represents a cost-reducing investment carried out by S^j in anticipation of future trade. If S^j does not produce specialized inputs, she produces the numéraire good and earns a payoff of zero. Function C^j satisfies $C^j_q > 0$, $C^j_i < 0$ and $C^j_{qi} < 0$, where subscripts denote partial derivatives. Furthermore, $C^j_q(0, 0) < p^w$ and $C^j_{qq} > 0$, so S^j has a cost advantage relative to the world market at low levels of q, but her technology's marginal costs increases with q. The supplier's investment costs $I(i)$ labor units, with $I(0) = 0$, $I'(0) = 0$, $I' > 0$ for $i > 0$ and $I'' > 0$. Thus, S^j's total cost function is $\Gamma^j(q, i) \equiv C^j(q, i) + I(i)$. To ensure the second-order necessary condition for S^j's investment choice is satisfied, we assume $\Gamma^j(q, i)$ is convex in q and i.

If firms B and S^j trade at arm's length, S^j chooses her investment according to the impact of i on S^j's own expected profit. If B and S^j vertically integrate, we follow Hart and Tirole (1990)

[8] In subsection 5 we consider the case of ad valorem tariffs.

[9] See also the discussion in footnote 11.

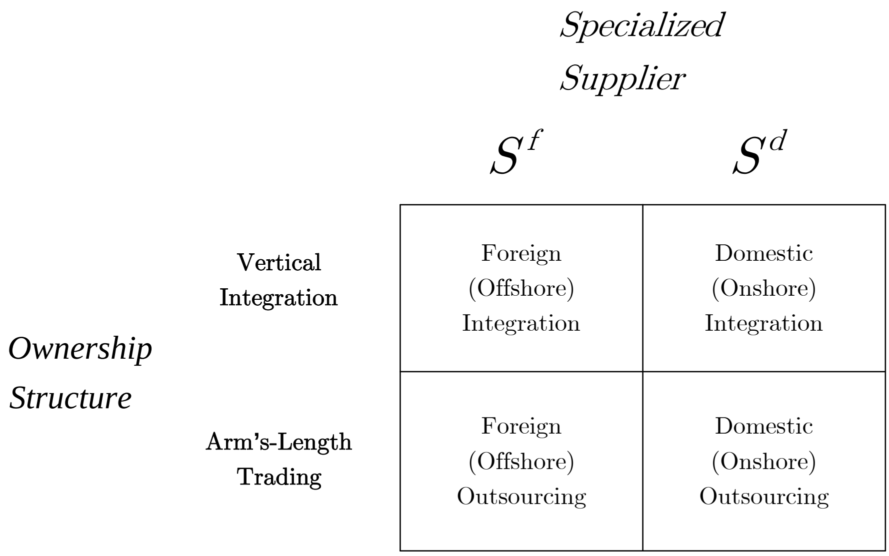

Figure 1: Organizational Form

in assuming that they choose investment to maximize total profit. On the other hand, the firms incur higher governance costs under vertical integration, which we model as a fixed cost of $K > 0$ labor units. To facilitate exposition, we say firm B makes all decisions under integration, bearing all costs and receiving all profits. Figure 1 shows the four possible organizational forms, along with terminology we use to describe them.

Whenever we observe dual sourcing, where B buys both specialized inputs from S^j and standardized inputs from the rest of the world, B's total demand for inputs, Q^*, equalizes the marginal gain and the marginal cost from acquiring an extra input from S^j:

$$V'(Q^*) = p^w + t. \tag{1}$$

Dual sourcing is efficient when the tariff is sufficiently low, relative to the marginal cost of S^j. To highlight how import tariffs affect organizational form and welfare, and to avoid an extensive taxonomy, we restrict the analysis to such cases. Assumption $A1$ is a sufficient condition for this:

$$A1 : t < \min\left\{\overline{t^d}, \overline{t^f}\right\},$$

where $\overline{t^j}$ is the tariff that (just) forecloses trade of generic inputs when $i = \bar{i}$ and the specialized supplier is S^j. These tariffs are defined implicitly by

$$\begin{aligned} C_q^d(Q^*(\overline{t^d}), \bar{i}) &\equiv p^w + \overline{t^d} \text{ and} \\ C_q^f(Q^*(\overline{t^f}), \bar{i}) &\equiv p^w. \end{aligned}$$

Hence, for any $t < \overline{t^d}$ and $i \in [0, \bar{i}]$, $C_q^d(Q^*(t), i) > p^w + t$, and it is efficient to import some generic inputs when B chooses S^d. Similarly, for any $t < \overline{t^f}$ and $i \in [0, \bar{i}]$, $C_q^f(Q^*(t), i) > p^w$, and it is efficient to purchase some generic inputs when B chooses S^f.

Having B's total demand for inputs pinned down by $p^w + t$ according to (1) leaves only one element of sourcing to be determined, namely how B chooses the *mix* of generic and customized inputs in each case. This offers the advantage of simplifying the analysis while not surrendering too much generality. If, for example, p^w were uncertain for the firms before the investment decision, our main insights would carry through even if we imposed single sourcing *ex post*, provided that the firms anticipated positive probabilities of generic and customized sourcing.

Absent integration, the parties cannot use contracts to ensure efficient decisions. Thus, as is standard in the incomplete contracts literature, investment is observed by both B and S^j, but is not verifiable by an outside observer such as a court; hence, it is non-contractible. Furthermore, B and S^j cannot use contracts to affect their trade decision.[10]

The timing of the game we analyze is as follows. The tariff is given exogenously. In the first period, firm B chooses organizational form, i.e. between the domestic and the foreign specialized supplier, and between outsourcing and vertical integrating. Upon the choice of supplier, firm B specializes toward her. Under integration, B pays the fixed cost of integration K and chooses the level of the relationship-specific investment of the supplier and the volume of specialized inputs to produce. Under outsourcing, B requests a transfer from the specialized supplier, who keeps control of her assets and chooses her relationship-specific investment. After investment has been sunk, the buyer and the specialized supplier bargain over price and quantity of customized inputs. In all types of organizations, B buys generic inputs on the world market while trading customized inputs with the specialized supplier.

We analyze this problem recursively. First, we take investment and the identity of the specialized supplier as given and study production and sourcing decisions conditional on investment. We return to the choice of investment later in this section, and study the choice of organization form in section 4.

2.2 Sourcing

Consider first the case where B has adapted toward the domestic supplier, S^d. Privately efficient sourcing requires that he purchase q^d units from S^d, where q^d satisfies

$$C_q^d(q^d, i) = p^w + t. \tag{2}$$

Hence, S^d produces up to the point where her marginal cost of production equalizes the world price, inclusive of the tariff (notice that, under $A1$, $q^d < Q^*$).

[10] This would be the case, for example, if S^j could produce either high-quality or low-quality specialized inputs, with low-quality inputs entailing a negligible production cost for the seller but being useless to the buyer. Similar assumptions have been used by several authors studying the impact of incomplete contracts on international trade—e.g. Grossman and Helpman (2002), Antràs (2003), Antràs and Staiger (2008).

Consider now the case where B is specialized toward the foreign supplier, S^f. We assume the Home country is a member of the World Trade Organization and has to abide by the principle of non-discrimination across different sources of imports. Thus, any tariff the Home government applies has the same effect on the cost of specialized and standardized inputs. Privately efficient sourcing, which is also socially efficient in this case, requires that

$$C_q^f(q^f, i) = p^w, \tag{3}$$

where q^f denotes the quantity of specialized inputs purchased from S^f. Since in this case B has no domestic sourcing option, he must pay the tariff on all Q^* units regardless of how many specialized inputs he purchases. Thus, B and S^f trade up to the point where S^f's marginal cost of production equalizes the world price, *not* including the tariff.

2.3 First-best Investment

Before studying investment decisions, we calculate the first-best level of investment—conditional on the tariff—a benchmark for the analysis of equilibrium investment under each organizational form.

We first define *total profit*, U^j, as the sum of B's and S^j's payoffs. When S^d is chosen, total profit is given by

$$U^d(i,t) = V(Q^*) - (p^w + t)(Q^* - q^d) - C^d(q^d, i) - I(i). \tag{4}$$

When S^f is chosen, total profit is defined instead by

$$U^f(i,t) = V(Q^*) - (p^w + t)(Q^* - q^f) - tq^f - C^f(q^f, i) - I(i). \tag{5}$$

Besides the potentially distinct cost functions, the difference between the two expressions is that specialized inputs incur in the tariff only if S^f is the specialized supplier.

We next define *national surplus.* Notice first that labor income is fixed, given by the population size times the unit wage rate, which is the price of the numéraire good. Since the price of final good y is fixed throughout the analysis, changes in income affect only the consumption of the numéraire good, which enters linearly in the utility function of consumers. Changes in national surplus/welfare are therefore equivalent to changes in national income. Assuming tariff revenue is rebated back to consumers in a lump-sum fashion, national surplus (omitting constant terms) is $W^j(i,t) = U^j(i,t) + tM^j(t)$, where $M^j(t)$ represents B's imports of inputs when supplier S^j is chosen. The difference between U^j and W^j is that the latter concept recognizes that the tariff duties paid by B do not constitute a social loss.[11]

[11] Notice that, given our assumptions that the buyer has full ownership and control of the integrated firm, and that under arm's length he can make a take-it-or-leave-it offer to the supplier before specializing toward her, the buyer absorbs the total profit generated in this sector under all organizational forms. Accordingly, Home's national welfare always incorporates B-S^j's total profit U^j. Those assumptions are not critical for our results, however. Without

Using (4), we rewrite national surplus under domestic specialized supply as

$$W^d(i,t) = V(Q^*) - p^w(Q^* - q^d) - C^d(q^d, i) - I(i). \tag{6}$$

The first-best level of investment maximizes (6) conditional on the tariff. When tariffs are positive, the following condition guarantees a unique, interior first-best investment:

$$A2 : C^j_{iq} \text{ is constant.}$$

Under $A2$, a marginal increase in investment brings the marginal cost curve down, but does not affect its slope or curvature. Taking the first-order condition for (6) with respect to i and using condition (2) for privately optimal sourcing, we obtain an expression defining the first-best level of investment, i^d_{fb}:

$$-C^d_i(q^d, i^d_{fb}) = I'(i^d_{fb}) + t\frac{dq^d}{di}. \tag{7}$$

A marginal increase in investment lowers the cost of production by C^d_i.[12] On the other hand, the extra investment costs I', and the increase in investment raises domestic production at the expense of imports. This has no social cost in the absence of tariffs. But if $t > 0$, society saves p^w on the marginal imported unit to spend C^d_q producing an extra unit. Since $C^d_q > p^w$ when $t > 0$, this is inefficient, implying a lower socially-optimal level of investment.

If B adapts instead toward S^f, the expression for national surplus, $W^f(i,t)$, is analogous to equation (6), but replaces q^d with q^f and $C(.)$ with $C^f(.)$. Using condition (3) for privately optimal sourcing, we find that the first-best level of investment in this case, i^f_{fb}, satisfies

$$-C^f_i(q^f, i^f_{fb}) = I'(i^f_{fb}). \tag{8}$$

The convexity of Γ^f ensures that i^f_{fb} corresponds to a maximum. Since the tariff does not distort sourcing decisions when the specialized supplier is abroad, it has no impact on i^f_{fb}.

2.4 Investment and Protection

To study equilibrium choices of investment, we consider each organizational form in turn. We look first at the cases where B and S^j operate at arm's length; we then move to the case where they are vertically integrated. When pertinent, we add subscript $k \in \{a, v\}$ to q^j, i^j and M^j to distinguish between equilibria under arm's-length (a) and vertically integrated (v) relationships.

them, we could define *global* welfare and carry out precisely the same analysis.

[12] Under $A2$, the second-order necessary condition associated with i^d_{fb} being a maximum of (6) is satisfied, as it corresponds to $SONC^d_{fb} \equiv \left(C^d_{iq}\right)^2 / \left(C^d_{qq} - C^d_{ii} - I''\right) < 0$, where the negative sign follows from the convexity of Γ^d.

2.4.1 Domestic Outsourcing

Under arm's-length trading, firm B cannot commit, *ex ante*, to purchase any quantity of standardized or specialized inputs. As a result, the two parties have to bargain *ex post* over their terms of trade. Since at that point S^d's investment is sunk, this allows B to "hold up" S^d by negotiating a price that takes advantage of the lower production cost due to S^d's investment, but without compensating S^d for the cost of her investment.

The quantity and price at which B and S^d trade are therefore determined by a bargain between the two parties in light of S^d's post-investment cost structure. If bargaining is successful, the parties implement the efficient sourcing decision described by (1) and (2), trading q^d units between themselves while B purchases the remaining $Q^* - q^d$ units from abroad. The bargaining price p^d divides the surplus generated by S^d selling q^d units to B (instead of B importing all Q^* units) according to exogenous bargaining power. We assume the generalized Nash bargaining solution applies, with α and $1-\alpha$ denoting S^d's and B's bargaining powers, respectively, where $\alpha \in [0,1]$. If B does not buy any specialized input from S^d, S^d obtains a payoff of zero. Thus, if negotiation breaks down, *ex post* payoffs are

$$\begin{cases} u_b^0 = V(Q^*) - (p^w + t)Q^* \\ u_s^0 = 0 \end{cases}$$

for B and S^d, respectively. By contrast, if the two parties agree in their negotiation, *ex post* payoffs are

$$\begin{cases} u_b^{1d} = V(Q^*) - (p^w + t)(Q^* - q^d) - p^d q^d \\ u_s^{1d} = p^d q^d - C^d(q^d, i). \end{cases} \tag{9}$$

Thus, B's gain from negotiating is his savings from purchasing q^d units of inputs at a price lower than the world price, inclusive of the tariff: $u_b^{1d} - u_b^0 = q^d(p^w + t - p^d)$. For S^d, the net gain is simply her profit from the transaction: $u_s^{1d} - u_s^0 = p^d q^d - C^d(q^d, i)$. Total negotiation surplus (NS^d) is therefore

$$\begin{aligned} NS^d &\equiv (u_b^{1d} - u_b^0) + (u_s^{1d} - u_s^0) \\ &= (p^w + t)q^d - C^d(q^d, i). \end{aligned} \tag{10}$$

According to the generalized Nash bargaining solution, the parties' negotiated price $\widetilde{p}^d$ satisfies

$$\widetilde{p}^d = \arg\max_p (u_b^{1d} - u_b^0)^{1-\alpha}(u_s^{1d} - u_s^0)^{\alpha}. \tag{11}$$

It is straightforward to find that

$$\widetilde{p}^d = (1-\alpha)C(q^d, i)/q^d + \alpha(p^w + t). \tag{12}$$

Thus, $\widetilde{p}^d$ is a weighted average of S^d's average cost of production and of the imported input unit cost, with a higher α implying that S^d absorbs a greater share of the saving costs from her *ex ante* cost-reducing investment. As the domestic supplier anticipates the outcome of the bargaining process, her ex ante payoff is given by

$$u_s^d(i,t) = \alpha \left[(p^w + t)q^d - C^d(q^d, i) \right] - I(i). \tag{13}$$

Or equivalently, S^d anticipates receiving a share α of the negotiation surplus NS^d while bearing the full cost of the investment.[13]

The domestic supplier chooses investment to maximize (13). Using equation (2), her choice of investment, i_a^d, satisfies

$$-\alpha C_i^d(q_a^d, i_a^d) = I'(i_a^d), \tag{14}$$

where $q_a^d(t) \equiv q^d(i_a^d(t), t)$ is the resulting number of inputs produced by S^d when she invests according to (14). The left-hand side of (14) denotes the fraction of the reduction in the cost of production induced by a marginal increase in i that is absorbed by S^d, whereas the right-hand side represents the cost of this extra unit of investment.[14]

Expression (14) is familiar from studies of the hold-up problem. If $\alpha = 0$, the hold-up problem is extreme and S^d does not have any incentive to invest. As α rises, the level of investment increases. A direct comparison between i_{fb}^d and i_a^d makes clear that, under free trade, the seller underinvests relative to the socially optimal level whenever $\alpha < 1$.

Under import protection ($t > 0$), however, S^d's investment can be either too little or too large, relative to the first best. While weak protection of supplier's investment ($\alpha < 1$) induces underinvestment, import protection fosters *over*investment, because when investing the seller does not internalize the social inefficiency from the displacement of imports caused by the subsequent increase in domestic production. The next proposition proves these points. All proofs are in the Appendix.

Proposition 1 *If* $\alpha = 0$*,* $i_a^d = 0$*. If* $\alpha > 0$*,* $i_a^d > 0$ *and is strictly increasing in* α *and in the tariff. Moreover,* $i_a^d(t^d) < i_{fb}^d(t^d)$ *if and only if* $\alpha < 1$ *and the tariff is sufficiently low.*

The possibility of hold up implies that the marginal benefit of S^d's investment is dampened under free trade whenever she has less-than-full bargaining power in the negotiation with B. However, Proposition 1 shows that, for $\alpha \in (0,1)$, a tariff could solve the hold-up problem, potentially raising investment to its first-best level, given the tariff. This is possible because the tariff increases the negotiation surplus (10) by worsening B's outside option. Since S^d's outside option is unaffected by the tariff, the higher NS^d unambiguously raises her incentive to invest, attenuating the hold-up problem unless it is insoluble—i.e., unless $\alpha = 0$, in which case S^d obtains none of NS^d. On the

[13] This equivalence does not hold when the tariff is ad valorem and the specialized supplier is foreign, as we explain in section 5.

[14] The second derivative of (13) with respect to i is $SONC^d \equiv \alpha \left[\frac{(C_{iq}^d)^2}{C_{qq}^d} - C_{ii}^d \right] - I''$. The convexity of Γ^d ensures that $SONC^d < 0$, so that i_a^d denotes indeed a maximum of (13).

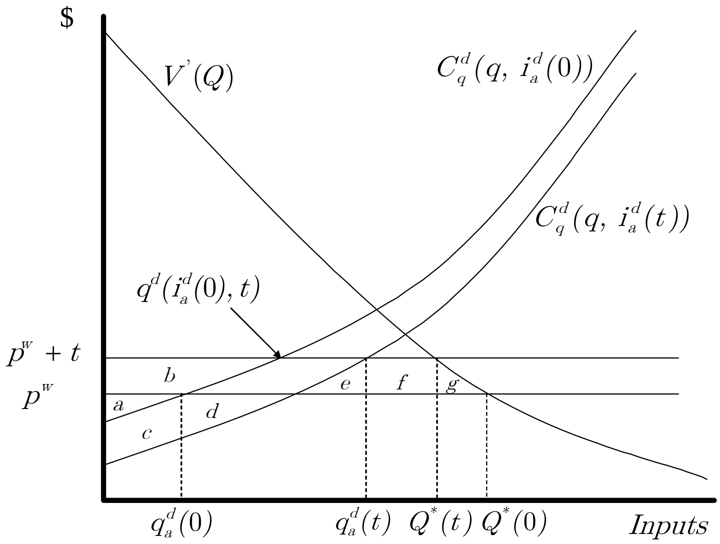

Figure 2: The Effects of a Tariff under Domestic Outsourcing

other hand, a tariff can also induce *too much* incentive for investment: if the tariff is sufficiently high, the seller invests more than is socially optimal. This is most easily seen by noting that, for $\alpha = 1$, any positive tariff induces investment that exceeds the first-best.

Figure 2 illustrates the effects of the tariff when $\alpha > 0$. It shows the supplier's marginal cost curve and optimal sourcing decisions under free trade and under a strictly positive tariff. Under free trade, the negotiation surplus is given by area a, between the horizontal line that represents p^w and the marginal cost curve $C_q^d(q, i_a^d(0))$. The optimal number of specialized inputs sold is $q_a^d(0)$. Any further investment would push the C_q^d curve down, increasing NS^d, but would also be costly for the supplier. The supplier's choice of investment, i_a^d, is such that α times the increase in NS^d brought about by a marginal increase in investment equals the cost of the additional investment.

Once a tariff is introduced, generic imported inputs become more expensive, worsening the outside option of the buyer. Then, at the initial level of investment, NS^d increases to include area b—hypothetically, S^d would produce $q^d(i_a^d(0), t)$ inputs if it were to continue to invest $i_a^d(0)$. However, S^d's marginal gain from increasing investment also jumps—unlike the investment cost, which is unrelated to the tariff. As a result, the supplier increases her investment until the point where her marginal gain and the marginal cost of investment are equalized again, $i_a^d(t)$. At that level of investment, S^d produces $q_a^d(t)$.

2.4.2 Foreign Outsourcing

The analysis is similar for arm's-length trading when S^f is chosen. At the bargaining stage between B and S^f, if bargaining breaks down, *ex post* payoffs are just as they were for B and S^d under domestic outsourcing. By contrast, if the two parties agree in their negotiation, *ex post* payoffs are

$$\begin{cases} u_b^{1f} = V(Q^*) - (p^w + t)Q^* + (p^w - p^f)q^f \\ u_s^{1f} = p^f q^f - C^f(q^f, i), \end{cases} \tag{15}$$

where p^f is the price reached under Nash bargaining. Thus, B's net gain from negotiating is his savings from purchasing q^f units of inputs at a price p^f, i.e. $u_b^{1f} - u_b^0 = q^f(p^w - p^f)$. For S^f, the net gain is her profit from the transaction: $u_s^{1f} - u_s^0 = p^f q^f - C^f(q^f, i)$. Total negotiation surplus (NS^f) is therefore

$$NS^f = p^w q^f - C^f(q^f, i). \tag{16}$$

Since S^f anticipates getting a fraction α of the negotiation surplus, her ex ante payoff is

$$u_s^f(i, t) = \alpha \left[p^w q^f - C^f(q^f, i) \right] - I(i). \tag{17}$$

The foreign supplier chooses investment to maximize this expression. Thus, S^f's choice of investment, i_a^f, is characterized by

$$-\alpha C_i^f(q_a^f, i_a^f) = I'(i_a^f), \tag{18}$$

where $q_a^f \equiv q^f(i_a^f)$ is the resulting number of inputs produced by S^d when she invests according to (18).[15]

Equation (18) has the same interpretation of equation (14). However, i_a^f is unaffected by the tariff. The reason is that, when the specialized supplier is abroad, a tariff has the same effect on B's payoff regardless of the success of the bargaining between the two parties. As a result, the negotiation surplus is not affected by the tariff, and neither is S^f's payoff, implying that in this case a tariff is incapable of promoting investment.

Proposition 2 *If $\alpha = 0$, $i_a^f = 0$. If $\alpha > 0$, $i_a^f > 0$ and is strictly increasing in α, with $i_a^f < i_{fb}^f$ unless $\alpha = 1$. However, i_a^f is unaffected by the tariff.*

Figure 3 shows, for a fixed supplier's investment, the effective marginal cost curves under free trade ($t = 0$) and a positive tariff $t > 0$. Because the tariff affects the cost of purchasing specialized inputs from S^f in the same way it affects the cost of purchasing standardized inputs in the world market, it does not affect B-S^f's negotiation surplus: area a is identical in size to area b. Hence, the tariff does not affect investment incentives.

2.4.3 Vertical Integration

Suppose now that B and S^j have vertically integrated prior to S^j's investment. Investment is then chosen to maximize total profit, defined in expression (4) if $j = d$ and in expression (5) if $j = f$.

[15] The second derivative of (17) with respect to i is $SONC^f \equiv \alpha \left[\frac{\left(C_{iq}^f\right)^2}{C_{qq}^f} - C_{ii}^f \right] - I''$. The convexity of Γ^f ensures that $SONC^f < 0$, so that i_a^f denotes indeed a maximum of (17).

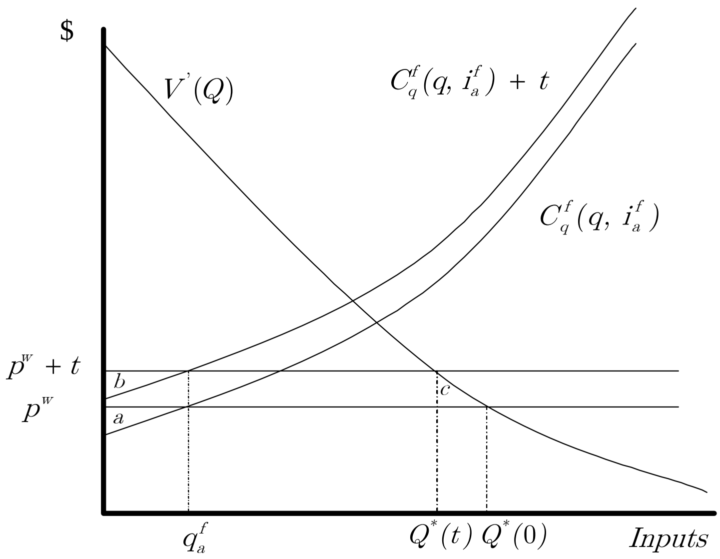

Figure 3: The Effects of a Tariff under Foreign Outsourcing

In both cases, equilibrium investment under integration, i_v^j, satisfies

$$-C_i^j(q_v^j, i_v^j) = I'(i_v^j), \tag{19}$$

where $q_v^j \equiv q^j(i_v^j)$ denotes specialized inputs produced when B integrates with S^j.

Under domestic supply, equilibrium investment under integration is larger than the first-best, $i_v^d(t) > i_{fb}^d(t)$, for any positive tariff, since the right-hand side of (19) is smaller than the right-hand side of (7) when $t > 0$. The domestic integrated firm does not internalize the full social costs from sub-optimal sourcing induced by the tariff, so it overinvests unless there is free trade. By contrast, investment under integration equals the first best under offshore specialized supply, when the tariff does not distort sourcing decisions.

3 Protection and Welfare

We can now study the welfare impact of protectionist policies. In this section we still take organizational form as given, analyzing the effect of tariffs in each of the four possible organization structures. In the next section we look at how protection influences equilibrium organizational forms.

3.1 Domestic Outsourcing

Taking into account how S^d chooses investment as a function of the tariff, we find the impact of protection on national welfare under domestic outsourcing by differentiating $W^d(i_a^d(t), t)$ with respect to t:

$$\begin{aligned} \frac{dW^d(i_a^d(t),t)}{dt} &= t\frac{dM_a^d(t)}{dt} - \frac{di_a^d(t)}{dt}\left[C_i^d(q_a^d, i_a^d(t)) + I'(i_a^d(t))\right] \\ &= t\left[\frac{dQ^*(t)}{dt} - \frac{dq_a^d(t)}{dt}\right] - \frac{di_a^d(t)}{dt}\left[C_i^d(q_a^d, i_a^d(t)) + I'(i_a^d(t))\right], \end{aligned} \tag{20}$$

where we have used equations (1) and (2) to simplify (20). For given investment, the tariff inefficiently reduces imports. The (negative) first term in the right-hand side of (20) represents this distortion. On the other hand, a tariff mitigates the inefficiency in investment decisions. Starting from free trade, and for a given level of imports, more investment is socially beneficial whenever $\alpha < 1$, because S^d invests too little due to hold up (equation 14). A tariff stimulates investment unless $\alpha = 0$ (Proposition 1). The second term in the right-hand side of (20) represents the social gain from a marginal increase in investment, and is strictly positive unless $\alpha = 1$ or $\alpha = 0$. Because of this effect, for $\alpha \in (0, 1)$ national welfare is maximized at a strictly positive tariff. Assuming for expositional simplicity that W^d is strictly concave, we denote this tariff as t_a^d.

Proposition 3 *If the hold-up problem is insoluble ($\alpha = 0$) or there is no hold-up problem ($\alpha = 1$), $t_a^d = 0$. Otherwise, $t_a^d > 0$.*

To our knowledge, this motivation for protection is entirely novel in the literature.[16] Here, all standard motivations for protection are absent. Still, a tariff can help by alleviating the supplier's underinvestment. The intuition for this result is very simple. With a tariff, the supplier anticipates earning rents from her investment on more sold units, so she increases her investment. Returning to Figure 2, we see that this higher investment lowers C_q^d, which further increases S^d's supply, to $q_a^d(t)$. As a result, national surplus increases by area c due to the supplier's lower marginal cost for the units she already produced. Because the supplier now produces more, national surplus increases also by area d, which corresponds to savings relative to the country's cost of imported inputs, p^w, on the extra units produced by S^d. In turn, national surplus falls by area e due to the wedge that the tariff drives between the private cost of foreign and domestic inputs. The tariff also causes the aggregate purchase of inputs, $Q^*(t)$, to fall, producing the additional deadweight loss shown in area g.[17] The investment cost also increases, as investment rises from $i_d(0)$ to $i_d(t)$. Still, for a sufficiently small tariff the social cost from inefficient sourcing is of second order, whereas the social net gain from the enhanced investment is of first order, warranting a strictly positive optimal tariff.

[16] The exception is the independent work of Antràs and Staiger (2008), who also study trade policy in the presence of hold-up problems, but under a very different model and with very different aims.

[17] Area f, which under free trade is absorbed by B, now goes to the government in the form of tariff revenue.

Note however that, although $t_a^d > 0$ whenever $\alpha \in (0,1)$, this tariff does *not* induce the first-best level of investment.

Proposition 4 $i_a^d(t_a^d) < i_{fb}^d(t_a^d)$ *for any non-extreme level of bargaining power.*

The reason is that solving the hold-up problem brings its own distortions. The tariff inefficiently reduces B's total purchases of inputs (area g in Figure 2) and promotes excessive domestic production (area e). Both effects work as "brakes" on how far protectionist policies can go in raising welfare in the presence of domestic hold-up problems.[18]

3.2 Domestic Integration

When B and S^d are vertically integrated, there is no hold-up problem. The salutary effect of the tariff vanishes and the welfare-maximizing policy is free trade. Differentiating $W_v^d(i_v^j(t), t)$ with respect to t, we find the marginal loss from protection:

$$\frac{dW^d(i_v^d(t), t)}{dt} = t\left[\frac{dQ^*(t)}{dt} - \frac{dq_v^d(t)}{dt}\right] \leq 0. \tag{21}$$

Hence $t_v^d = 0$.

3.3 Offshoring

Under offshoring, a tariff does not affect investment under any ownership k. Thus, since all standard motivations for active trade policy are absent, protection inefficiently lowers imports and does nothing else. Differentiating $W^f(i_k^f, t)$ with respect to t, we have:

$$\frac{dW^f(i_k^f, t)}{dt} = t\frac{dQ^*(t)}{dt} \leq 0. \tag{22}$$

Hence, $t_a^f = t_v^f = 0$. Figure 3 shows the deadweight loss from protection (area c).

3.4 The Impact of Protection under Different Organizational Structures

The welfare-maximizing organizational form satisfies

$$Max_{j\in\{d,f\},k\in\{a,v\}}\left\{U^j(i_k^j(t), t) + tM_k^j(t) - 1[k=v]K\right\}, \tag{23}$$

where $1[\bullet]$ denotes the indicator function. Our analysis makes clear that a tariff can affect the solution of this problem. Some protection is desirable under domestic specialized outsourcing

[18] This trade-off arises because, in the tradition of the property rights literature (e.g. Grossman and Hart 1986), we distinguish investment from production decisions. In this context, tariffs boost *ex ante* investment only at the cost of promoting excessive *ex post* domestic production. This trade-off does not arise in the setting of Antràs and Staiger (2008), where there is a one-to-one correspondence between investment and production. Internationally efficient trade taxes fully solve the hold-up problem in their setting.

but is harmful under the other types of organizations. We can also rank the (un)desirability of protection in those cases. Specifically, by comparing expressions (20), (21) and (22), we have that, for $t \in (0, t_a^d)$,

$$\frac{dW^d(i_v^d, t)}{dt} < \frac{dW^f(i_v^f, t)}{dt} = \frac{dW^f(i_a^f, t)}{dt} < 0 < \frac{dW^d(i_a^d, t)}{dt}. \tag{24}$$

The reason why protection is more harmful when B and S^d integrate than when B sources from S^f is simple. A tariff inefficiently lowers Q^* by the same amount in all cases, but under domestic supply it lowers imports further, by distorting sourcing toward S^d. Under arm's-length trading this additional inefficiency is more than compensated by the mitigation of the hold-up problem, but not under integration. The following example illustrates these points.

3.5 An Example

Consider this quadratic specification: $V(Q) = AQ - \frac{Q^2}{2}$, $C^j(q,i) = (C_0^j - i)q + \frac{q^2}{2}$, $I(i) = i^2$, with A set large relative to $\{C_0^j\}$. This yields linear "supply" (C_q^j) and "demand" (V') curves, with $C_0^j - i^j$ denoting the intercept of S^j's marginal cost curve. With this specification, it is straightforward to find Q^*, $\{q_k^j\}$, $\{i_k^j\}$ and t_a^d.

Consider then optimal organizational form. Under free trade, the foreign technology yields higher investment, conditional on ownership k, if $C_0^f < C_0^d$. In that case, $W^f > W^d$. Integration yields higher welfare than outsourcing if K is sufficiently low. Figure 4 shows how the socially optimal organizational form (i.e., the solution to (23)) varies with C_0^f and K. Domestic specialized supply is optimal if $C_0^f < C_0^d$, and integration is optimal when K is low. Conditional on $C_0^f < C_0^d$, the level of K such that foreign outsourcing yields higher welfare than foreign integration falls with C_0^f.[19] For $C_0^f > C_0^d$, domestic specialized supply is optimal and, for $K \geq K'$, outsourcing is optimal.[20]

Now consider the case where there is a tariff $t \in (0, t_a^d)$. Figure 5 shows optimal organization forms in this case, including dashed lines that show the corresponding regions from Figure 4. The tariff enhances the social surplus under domestic outsourcing relative to each other organizational form. Domestic outsourcing is now preferred to foreign outsourcing and foreign integration for some parameter values such that S^d's fundamental technology is worse than S^f's (i.e., in the range $C_0^f \in [C_0^d - \delta, C_0^d]$, $0 < \delta < t$). Intuitively, the tariff improves S^f's investment incentives to the point that its post-investment marginal cost curve is lower than S^f's post-investment marginal cost curve (not including the tariff).[21] In essence, the tariff gives S^d a *productivity advantage.*

[19] The maximum K under which vertical integration is optimal (conditional on offshoring) declines with C_0^f because, as C_0^f increases, q^f falls for given level of investment, lowering the return of investment. This makes the hold-up problem less severe, reducing the gains from vertical integration.

[20] The level of C_0^d also affects the cutoff value of K, but since C_0^d is fixed in Figure 4, the cutoff is represented by a horizontal line (as it does not depend on C_0^f in this region).

[21] This is most easily seen by considering the limiting case where C_0^f approaches C_0^d. With no tariff, S^d has the same investment incentives as S^f. With a positive tariff, S^d invests more than S^f, so its marginal-cost curve shifts down more.

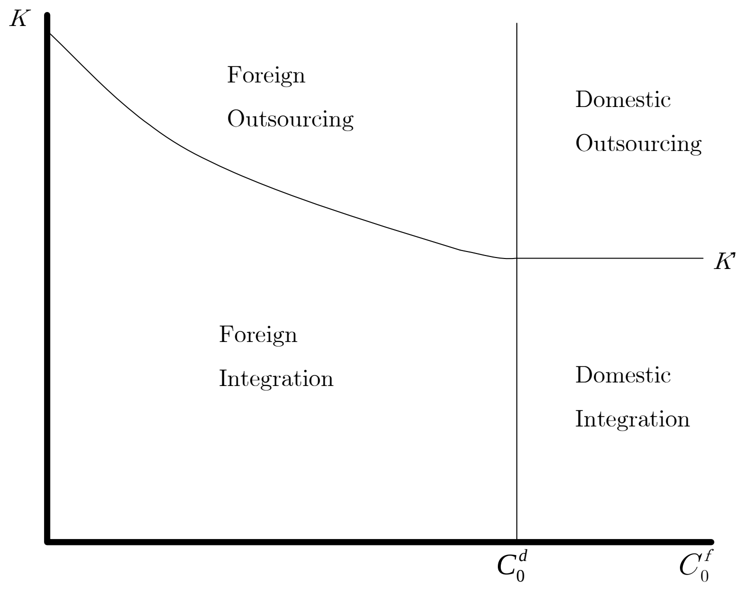

Figure 4: Socially Optimal Organizational Forms under Free Trade

Domestic outsourcing is also preferred to domestic integration in a range $K \in [K' - \Delta, K']$, $\Delta > 0$, in contrast to the situation under free trade. Finally, conditional on integration, the tariff tilts socially optimal supply toward offshoring, consistent with (24). In Figure 5, this happens for $C_0^f \in [C_0^d, C_0^d + \varepsilon]$, $\varepsilon > 0$.

4 Organizational Structure

We now study the *choice* of organizational form. We allow the buyer to choose between S^d and S^f and to decide whether to integrate. Under arm's-length trading, if B adapts toward S^d, he requires a transfer of $u_s^d(i_a^d, t)$, since he knows that S^d has no alternative better than producing the numéraire good. The supplier is willing to pay up to her total profit within the relationship, so the buyer's payoff is $U^d(i_a^d, t)$. Analogously, if B adapts toward S^f, he obtains a total payoff of $U^f(i_a^f, t)$. The buyer's payoff is given by $U^j(i_v^j, t)$ if he integrates with S^j.

The firms' organizational form problem is

$$Max_{j \in \{d,f\}, k \in \{a,v\}} \left\{ U^j(i_k^j(t), t) - 1[k = v]K \right\}. \tag{25}$$

This maximization problem is identical to (23) under free trade ($t = 0$), in which case the equilibrium organizational form is efficient. But when tariffs are positive, there are organizational externalities. Since tariff revenue is not captured by the firms, when it is different across organizational forms it may distort the firms' choice away from the welfare-maximizing one. The distortions arise in the supplier and in the ownership decisions.

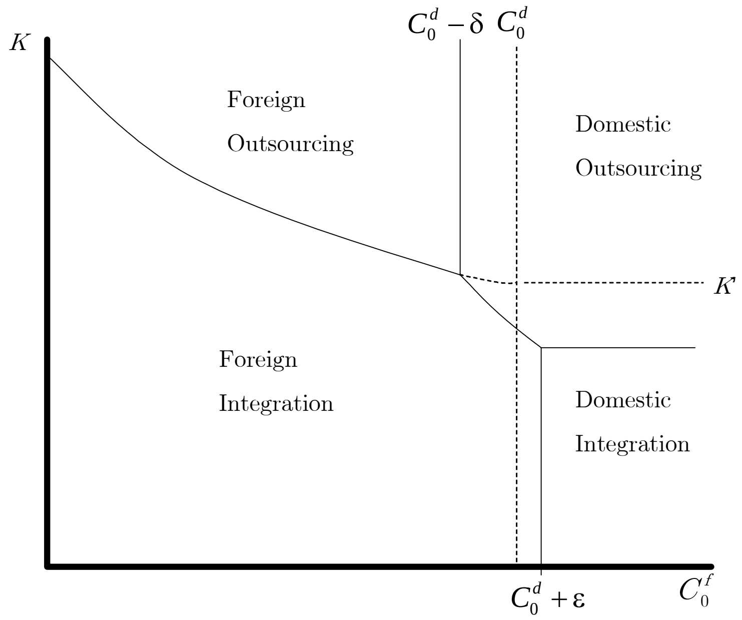

Figure 5: Socially Optimal Organizational Forms under Protection

For ease of exposition, consider first the ownership decision, conditional on specialized supplier S^j's being chosen. Assuming B chooses integration when the payoffs are the same, the firms integrate if and only if

$$\Delta U^j \equiv U^j(i_v^j(t), t) - U^j(i_a^j(t), t) \geq K, \tag{26}$$

that is, if the *private gains to integration*, ΔU^j, exceed the integration fixed cost. By contrast, integration maximizes national surplus if and only if

$$\Delta W^j \equiv U^j(i_v^j(t), t) - U^j(i_a^j(t), t) - t\left[M_a^j(t) - M_v^j(t)\right] \geq K, \tag{27}$$

that is, if the *social gains to integration*, ΔW^j, exceed the integration fixed cost.

Since tariffs do not affect investment under offshoring ($j = f$), the social gains to integration do not depend on the tariff. Furthermore, tariff revenue does not depend on whether integration is chosen in this case,[22] because all inputs are imported regardless $[M_a^f(t) = M_v^f(t) = Q^*(t)]$. The private gains to integration equal the social gains. Therefore, tariffs do not distort the integration decision when the specialized supplier is foreign.

On the other hand, integration does affect tariff revenue under onshoring ($j = d$). Since the number of specialized inputs sold is greater, imports and tariff revenue are lower under integration than under outsourcing $[M_a^d(t) = Q^*(t) - q_a^d(t) > Q^*(t) - q_v^d(t) = M_v^d(t)]$. Hence, when tariffs are

[22] This statement, and its implications, relies on the tariff being specific. When the tariff is ad valorem, the inefficiency of the ownership decision under onshoring observed below extends to offshore specialized supply. We show this in the section 5.

positive, the private gains to integrating exceed the social gains.

Proposition 5 *Under free trade, the equilibrium ownership decision is socially efficient. For any $t > 0$, if the firms choose outsourcing over integration, it is the socially efficient ownership structure. If the firms integrate, it is socially efficient if S^f is selected but may be inefficient if S^d is chosen.*

Consider next the supply decision, conditional on ownership k being chosen. Assuming B chooses S^d when the payoffs are the same, B specializes toward S^d if and only if

$$U^d(i_k^d(t), t) - U^f(i_k^f, t) \geq 0. \tag{28}$$

Again, the supplier decision need not be socially optimal because it disregards tariff revenue. For $t > 0$, imports and tariff proceeds are lower under onshore specialized supply because tariffs are paid on generic inputs only: $M_k^f(t) > M_k^d(t)$ for any k. As a result, the difference between firm B's total payoff and Home's national welfare is smaller under onshoring than under offshoring.

Proposition 6 *Under free trade, the equilibrium supply decision is socially efficient. For any $t > 0$, if S^f is chosen, it is the socially efficient supplier. If S^d is chosen, it may be inefficient under either outsourcing or integration.*

4.1 An Example, continued

Using the example described in subsection 3.5, we now consider *equilibrium* organizational form (i.e., the solution to (25)). Under free trade, the equilibrium organizational form is socially efficient. Due to propositions 5 and 6, onshore supply may be privately optimal but socially inefficient under protection, because the firms neglect the lost tariff revenue under domestic supply. This distortion is highlighted by the light gray region in Figure 6. Domestic outsourcing (when K is sufficiently high) is chosen for $C_0^f > C_0^d - t$ because the renegotiation surplus is higher and S^d chooses a higher investment.[23] However, domestic outsourcing is socially inefficient for $C_0^f < C_0^d - \delta$, because S^d produces at a higher marginal cost than S^f (not including the tariff). Intuitively, welfare is higher if B chooses S^f and the Home country captures some tariff revenue on specialized inputs. Because B does not get that tariff revenue, he chooses S^d.

In turn, domestic integration (when K is sufficiently low) is chosen for $C_0^f > C_0^d - t$ but is socially inefficient (relative to foreign integration) for $C_0^f < C_0^d + \varepsilon$. This distortion is represented by the dark gray region in Figure 6. Domestic outsourcing is inefficient for a smaller range than domestic integration because of the salutary effect of the tariff on investment under domestic outsourcing.

Tariffs also distort the integration decision in cases where S^d is chosen. This is highlighted by the dark gray area for intermediate levels of K. Since tariff revenue is lower under integration and

[23] The easiest way to see this is to note that, if $C_0^f = C_0^d - t$, the renegotiation surplus is the same under foreign and domestic outsourcing. Hence, investments by S^f and S^d are the same. As C_0^f increases, the renegotiation surplus under foreign outsourcing shrinks, so she invests less.

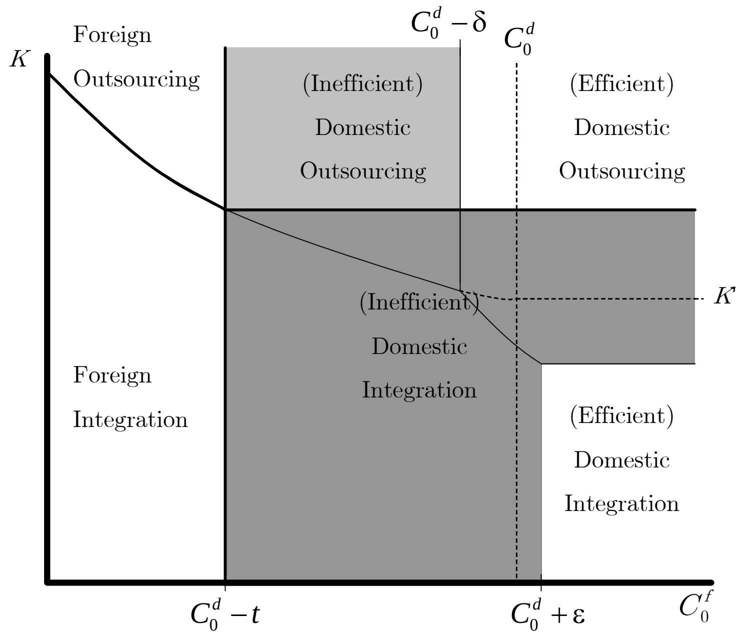

Figure 6: Equilibrium Organizational Forms under Protection

the firms do not factor this into their integration decision, they integrate for values of K that are too high from a social welfare standpoint.[24]

4.2 Trade Liberalization

Our paper shows that the nature of distortions caused by tariffs may be far more subtle than normally believed. Because tariffs may simultaneously encourage welfare-enhancing investments and welfare-detracting organizational choices, assessing the magnitude and direction of welfare changes due to changes in tariffs requires careful consideration of substitution between domestic and foreign inputs and between organizational forms. To highlight this, consider what propositions 5 and 6 imply for changes in trade flows, organizational structures and welfare resulting from trade liberalization.

[24] Note, however, that the dark gray area need not go beyond K', as it does in this example. That is, it is possible that some protection will prompt (welfare-maximizing) domestic outsourcing. The reason is that the private gains to integrating, conditional on domestic specialized supply, may either increase or decrease with tariffs. This result mirrors a finding by Ornelas and Turner (2008). As the tariff rises, S^d increases her investment under outsourcing. This lowers the gain from eliminating the hold-up problem, since this extra investment has a first-order positive effect on the firms' joint surplus under arm's length, when investment is inefficiently low, but not under vertical integration, when investment is chosen to maximize the firms' joint surplus. This *mitigation of the hold-up problem* lowers the private gains from integration when the tariff rises. Now, since an increase in the tariff makes imports more expensive, it lowers the joint surplus of the firms, but does so more prominently when they trade under arm's length, and imports levels are higher. Because of this *volume of trade effect*, ΔU^d increases when the tariff rises. In general, either of these two effects can dominate, implying that, conditional on onshore specialized sourcing, protection can induce either vertical integration or outsourcing.

Naturally, any model would indicate that, as tariffs fall, we should observe more offshoring relative to onshoring, increasing international trade flows. But our model suggests that this increase can be highly non-linear and disproportionately higher than the tariff changes because of organizational restructuring. This can help to explain the observed puzzling large response of trade flows to tariffs stressed for example by Yi (2003).[25] Furthermore, our model indicates that discrete jumps in trade flows due to organizational changes set off by falling tariffs do not require a change from domestic to foreign specialized partners. If trade liberalization prompts domestic 'disintegration' (in our example, this would happen if K were not much larger than K' and $C_0^d < C_0^f$), there would be a jump in the purchases of imported generic inputs even though the specialized supplier remains domestic.

Our analysis also implies that the welfare impact of trade liberalization is qualitatively different from what conventional models suggest. Organizational structure notwithstanding, welfare rises as tariffs fall due to the regular mechanism of increasing imports. But trade liberalization can also trigger organizational change. If organization structure under protection is $\{k, j\} \neq \{d, a\}$ but changes because of trade liberalization, then this would be evidence that tariff revenue externalities effectively distorted organizational choice under protection. Accordingly, the move to free trade would generate additional welfare gains due to the removal of these externalities.

The exception is when the organizational structure under protection is $\{d, a\}$. In that case, welfare gains from trade liberalization are not warranted. The reason is the loss of the productivity advantage brought about by the tariff. If $\{d, a\}$ remains the firms' choice under free trade—and the original tariff were not higher than t_a^d—the move to free trade necessarily implies a net welfare loss due to the consequent aggravation of the hold-up problem. If organization form changes as the tariff falls, welfare could go either up or down. In our example, it would go down if K were sufficiently high and $C_0^f \in [C_0^d - \delta, C_0^d]$, in which case the choice of organization would be efficient regardless of the tariff, but the productivity advantage introduced by the tariff would be lost under free trade.

The following corollary summarizes this discussion.

Corollary 1 *As the tariff falls from $t < t_a^d$ to zero:*

a) welfare falls if both the initial and the final organizational structure is $\{d, a\}$;

b) welfare rises when the initial organizational structure is $\{k, j\} \neq \{d, a\}$, especially if an organizational change is triggered;

c) welfare can either increase or decrease if the initial organizational structure is $\{d, a\}$ and the fall in the tariff triggers a change.

5 Ad valorem tariffs

For simplicity, we have so far considered the case of specific import tariffs. As we show in this section, our results are broadly equivalent when the import tariff is ad valorem—although some

[25] We make a similar point in Ornelas and Turner (2008).

qualifications are warranted.

To see that, denote the ad valorem tariff by τ and consider first the case of domestic outsourcing. Privately efficient sourcing requires now that

$$C_q^d(q^d, i) = p^w(1+\tau). \tag{29}$$

As before, $u_s^{1d} - u_s^0 = p^d q^d - C^d(q^d, i)$, whereas now $u_b^{1d} - u_b^0 = q^d\left[(1+\tau)p^w - p^d\right]$. Thus, the surplus from negotiation for the two parties becomes $NS^d = (1+\tau)p^w q^d - C^d(q^d, i)$. Using (29), it is then straightforward to see that S's choice of investment is again given by (14), which is the basis of propositions 1, 3 and 4.

The analysis is slightly more involved when B offshores specialized inputs at arm's length. The reason is that, with an ad valorem tariff, the division of surplus between B and S^f also affects their total gains from negotiating: while a lower p^f increases the firms' joint surplus—because it induces lower tariff payments on specialized components—it also reduces S^f's share of the surplus. As a result, splitting NS^f according to bargaining power is no longer equivalent to the generalized Nash bargaining solution.

Yet noticing that $u_b^{1f} - u_b^0 = (p^w - p^f)(1+\tau)q^f$, maximization of

$$\left(u_s^{1f} - u_s^0\right)^{\alpha}\left(u_b^{1f} - u_b^0\right)^{1-\alpha}$$

with respect to q^f and p^f still gives us the same solution as before: $C_q^f(q^f, i) = p^w$ as the privately efficient sourcing condition and negotiation price $\widetilde{p}^f = \alpha p^w + (1-\alpha)C^f(q^f, i)/q^f$. We are then back to (18), which is the basis of Proposition 2.

The possible drawback to this result is the incentive of the two parties to underreport their negotiation price, $\widetilde{p}^f$, as a way to lower tariff payments. If customs authorities can effectively prevent the firms from such misrepresentation of their actual trading price, our results would remain unaltered.

It is easy to see that, if firms B and S^j are vertically integrated, all of our results under a specific tariff carry through under an ad valorem tariff as well. Again, the only issue regards the incentive of firms to manipulate their transfer prices to reduce duty payments. As in the large literature on multinational firms—with the exception of those concerned specifically with transfer pricing—we sidestep this issue by considering (as it appears to be the case at least in the most developed countries) that custom authorities are able to satisfactorily limit transfer price manipulation.

Now, with respect to organizational choice, there *is* a qualitative difference when the tariff is ad valorem, rather than specific. It arises in the integration decision when the specialized supplier is abroad. The reason is that, unlike the situation with specific tariffs, now tariff revenue depends on the mix of generic/customized inputs, since they command different prices. Specifically (and assuming transfer price manipulation issues do not arise, so that B and S^f trade at $\widetilde{p}^f$ regardless of integration), vertical integration is socially optimal in this case if and only if

$$\Delta W^f \equiv U^f(i_v^f(t), t) - U^f(i_a^f(t), t) - (1+\tau)[(p^w - \widetilde{p}^f)(q_v^d(t) - q_a^d(t))] \geq K. \tag{30}$$

Since the expression in square brackets is strictly positive, a situation where $\Delta U^f \geq K > \Delta W^f$ is possible, in which case B and S^f integrate when it is socially inefficient. Hence, with ad valorem tariffs there is a bias toward too much integration also under offshoring.[26]

Since the integration decision under onshoring is just as before, the analog of Proposition 5 under an ad valorem tariff is as follows.

Proposition 7 *Let any tariff be assessed on an ad valorem basis. Under free trade, the equilibrium ownership decision is socially efficient. For any $t > 0$, if the firms choose outsourcing over integration, it is the socially efficient ownership. If the firms integrate, it may be socially inefficient under either onshoring or offshoring.*

On the other hand, the (in)efficiency of the supply decision is not fundamentally altered by the type of tariffs in use. Accordingly, Proposition 6 holds just as before.

6 Conclusion

Economists have long known that tariffs distort resource allocation by driving a wedge between the cost of imports and the cost of domestic alternatives. We show that the nature of these distortions can be far more subtle than standard trade theory implies.

First, tariff distortions can improve overall welfare if they help to economize on transactions costs stemming from incomplete contracts. In this sense, our analysis offers a lesson that applies regardless of how governments set trade policies. If protectionist policies are in place, motivated by reasons other than economic efficiency (e.g. politics), our results imply that they are likely to be less harmful (and perhaps even beneficial) from a social standpoint than current theories suggest—if applied on sectors where asset specificity and incomplete contracts are important, and outsourcing is mainly from domestic firms.

Second, protection distorts organizational decisions. Government intervention drives a wedge between the private and the social value to domestic sourcing and to vertical integration. As a result, firms may inefficiently outsource domestically or have inefficiently large boundaries under protection. By contrast, free trade induces firms to choose the "right" organizational form.

Our model allows us to uncover these novel implications of protectionist policies in a strikingly simple way. But inevitably, and as in most incomplete-contracts models, this requires some restrictions on the industrial organization of the buyer and suppliers. Relaxing those restrictions would affect some results. For example, if the downstream firm has market power in final-good sales, trade

[26] If firms were more able to engage in transfer price manipulations when they are integrated than when they trade at arm's length, as it is likely to be the case, the size of the square bracket in (30) would be even larger. This would reinforce the bias toward too much integration.

policy will affect both hold-up problems and final-good distortions. Hence, industry concentration could affect the extent to which differentiated-input product markets benefit or suffer from tariffs. Additionally, if the downstream firm could simultaneously source from both foreign and domestic specialized suppliers, tariffs would worsen hold-up problems with foreign suppliers. In that case, the welfare effects of a domestic tariff would depend on the relative productivities of the suppliers.

Still, it is clear that our main insights about how discriminatory policies affect the severity of hold-up problems and about how protection distorts organization decisions are not an artifact of our stylized environment. In fact, as we point out throughout the text, relaxing our main simplifying assumptions (allowing single sourcing, banning lump sum transfers between the firms, permitting trade taxes on final goods, introducing ad valorem tariffs) would have no impact on our fundamental findings. On the other hand, the parsimony of the model makes it amenable to several promising extensions, as we discuss below.

We identify welfare-maximizing tariffs for given organizational form, but do not characterize optimal trade policy when organizational form is endogenous. Acknowledging the endogeneity of organizational form is nevertheless central if one wants to study optimal trade policy, as a government must recognize that a tariff may prompt inefficient organizations. This can be challenging. For example, under domestic specialized supply, optimal tariffs are positive under outsourcing, but they can trigger inefficient vertical integration. Hence, if integration is privately preferred under protection, the first-best combination of organizational form and trade policy may be impossible to achieve.

We consider that the Home country is small in world markets, unable to affect the world price of generic inputs. That assumption allows us to focus on the new implications of protection that we identify. But considering the case where Home is "large" could prove interesting, especially when specialized outsourcing is mainly domestic. In that case, a tariff would lower the world price of generic inputs, and this would reduce the tariff's impact on the outside option of the buyer. As a result, the hold-up problem would not be helped as much. Thus, to mitigate hold-up problems to a certain extent, the government would have to raise the tariff by more than the current analysis suggests, with the resulting lower world price hurting the exporters of generic inputs. This would suggest a greater need for international trade agreements than the standard view proposes (e.g. Bagwell and Staiger 1999), as a large country would seek to affect world prices not only to extract surplus from trade partners, but also to curb purely domestic inefficiencies. By relaxing the assumption that the buyer can make ex ante take-it-or-leave-it offers, our framework would also permit the study of the role of trade agreements in overcoming organizational externalities.

One could extend our environment to study also *preferential* trade agreements, such as free trade areas (FTAs). Due to its discriminatory nature, an FTA could be particularly helpful in attenuating hold-up problems and raising welfare among countries that share a significant number of cross-border vertically related (but independent) firms. Intuitively, by favoring "inside" options relative to "outside" options, the FTA would yield *efficiency-enhancing* trade diversion. Intriguingly, multilateral liberalization would *not* help hold-up problems in this case, because it would remove the possibility of discriminatory tariffs. In this sense, regionalism could provide a benign alternative to multilateralism, helping to justify—although with an entirely different reasoning—the "natural trading partners" rationale for preferential liberalization (see e.g. Frankel 1997).

We do not explore varying levels of contract enforcement across countries either. This is potentially important. As Antràs and Helpman (2008) show, different levels of input contractibility can affect organizational form. Indeed, Nunn (2007) presents empirical evidence that the strength of contract enforcement helps to explain patterns of international trade in goods with differentiated intermediate inputs. Bernard, Jensen, Redding and Schott (2008) show further that the interaction between product contractability and national levels of contract enforcement helps to explain different levels of intra-firm trade. Our framework offers the possibility to study whether contract enforcement and tariffs are strategic complements or substitutes, a topic that has received little attention.[27] Intuitively, stronger contracts would weaken hold-up problems and the need for integration, favoring arm's-length trade and free trade. However, as we show, tariffs are useless if parties cannot enforce contracts and hold-up problems are extreme. As the strength of contract enforcement increases, this could enhance the role of tariffs in promoting relationship-specific investments. The efficacy of tariffs will, however, depend crucially on how damage remedies influence the way parties deal with contract breach.[28] We look forward to further progress in these areas.

7 Appendix

Proof of Proposition 1. If $\alpha = 0$, it follows directly from (13) that investment is worthless for S^d, and therefore $i_a^d = 0$. Otherwise, $i_a^d > 0$ because $I'(0) = 0$, and satisfies (14). As α rises, the convexity of Γ ensures that i_a^d increases. Investment also increases with the tariff whenever $\alpha > 0$:

$$\frac{di_a^d}{dt} = \frac{\alpha C_{qi}^d / C_{qq}^d}{SONC^d} > 0, \tag{31}$$

where we use the fact that $\partial q^d / \partial t = 1/C_{qq}^d$, which follows from the definition of q^d in (2), and where $SONC^d$ is defined in footnote 6.

Finally, from the first-order conditions that define i_{fb}^d and i_a^d (equations 7 and 14, respectively), it follows that $i_a^d < i_{fb}^d$ if and only if

$$-\alpha C_i^d < -C_i^d - t\frac{dq^d}{di} = -C_i^d + \frac{C_{iq}^d}{C_{qq}^d} t,$$

[27] To our knowledge, Diez (2008) is the only empirical attempt at testing the impact of tariffs on organizational choices.

[28] For example, starting with Shavell (1980), several studies have shown that the "expectation damages" remedy produces outcomes different than the "reliance damages" remedy. This literature also shows that assumptions about renegotiation and the costliness of disputes are crucial.

or equivalently iff

$$t < \frac{(1-\alpha)C_i^d C_{qq}^d}{C_{iq}^d}.$$

Since the right-hand side is finite and non-negative, this completes the proof. ■

Proof of Proposition 2. The proof of the statements in the first two sentences of the proposition is entirely analogous to the proof of Proposition 1. To see that i_a^f is independent of the tariff, notice that, by (3), q^f is unaffected by the tariff. It then follows from (18) that i_a^f is also unaffected by the tariff. ■

Proof of Proposition 3. Using (14), we can write the effect of a marginal increase in the tariff on national welfare as

$$\frac{dW^d(i_a^d(t),t)}{dt} = t\frac{dM_a^d(t)}{dt} - \frac{di_a^d(t)}{dt}(1-\alpha)C_i^d(q_a^d, i_a^d(t)). \tag{32}$$

Suppose that $\alpha \in (0,1)$. Then, the second term of (32) is strictly positive, because $\frac{di_a^d}{dt} > 0$ and $C_i^d < 0$. Hence, $\frac{dW^d}{dt} > 0$ if the first term is non-negative. Since $\frac{dM_a^d(t)}{dt} < 0$, that term is nonnegative for any $t \leq 0$. Thus it cannot be true that $t_a^d \leq 0$. Hence $t_a^d > 0$.

Next suppose that $\alpha = 0$. By Proposition 1, $\frac{di_a^d(t)}{dt} = 0$, so (32) collapses to $t\frac{dM_a^d(t)}{dt}$. Since $\frac{dM_a^d(t)}{dt} < 0$, $sgn(32) = sgn(t)$. Hence $t_a^d = 0$. If $\alpha = 1$, the second term of (32) vanishes and once again $\frac{dW^d(i_a^d(t,0),t)}{dt} = t\frac{dM_a^d(t)}{dt}$. The same logic follows. ■

Proof of Proposition 4. From the proof of Proposition 1 we know that $i_a^d(t_a^d) < i_{fb}^d$ if and only if $t_a^d < \frac{(1-\alpha)C_i^d C_{qq}^d}{C_{iq}^d}$. Equating (20) to zero and developing it, one finds

$$t_a^d = \frac{\alpha(1-\alpha)C_i^d C_{iq}^d V''}{C_{qq}^d SONC^d + V''\left(\alpha C_{ii}^d + I''\right)}.$$

Thus, if $\alpha < 1$, $t_a^d < \frac{(1-\alpha)C_i^d C_{qq}^d}{C_{iq}^d}$ and $i_a^d(t^d) < i_{fb}^d$ if and only if

$$\begin{aligned}
\frac{\alpha(1-\alpha)C_i^d C_{iq}^d V''}{C_{qq}^d SONC^d + V''\left(\alpha C_{ii}^d + I''\right)} &< \frac{(1-\alpha)C_i^d C_{qq}^d}{C_{iq}^d} \\
\iff \frac{\alpha\left(C_{iq}^d\right)^2 V''}{C_{qq}^d} &> C_{qq}^d SONC^d + V''\left(\alpha C_{ii}^d + I''\right) \\
\iff V''\left[\alpha\left(\frac{\left(C_{iq}^d\right)^2}{C_{qq}^d} - C_{ii}^d\right) - I''\right] &> C_{qq}^d SONC^d \\
\iff V'' &< C_{qq}^d,
\end{aligned}$$

which is always true. ■

Proof of Proposition 5. If $t = 0$, there is no difference between the private and social gains to vertical integration, given by expressions (26) and (27) respectively, so the equilibrium ownership decision is clearly efficient.

Now, while the right-hand sides of (26) and (27) are identical, the left-hand side of (26) is greater than the left-hand side of (27) whenever $M_a^j(t) > M_v^j(t)$. Under offshore supply, $M_v^f(t) = M_a^f(t)$ because all inputs are imported regardless of whether the firms integrate. Hence, there is no difference between (26) and (27) in that case. Under onshore supply, $i_v^d > i_a^d$ implies $C_q^d(i_v^d) < C_q^d(i_a^d)$, which in turn implies $M_a^d(t) > M_v^d(t)$. Hence, if condition (27) is satisfied, condition (26) is satisfied as well for any $t \geq 0$. On the other hand, if $t > 0$ there could be situations where

$$U^d(i_v^d(t), t) - U^d(i_a^d(t), t) \geq K > U^d(i_v^d(t), t) - U^d(i_a^d(t), t) - t\left[M_a^d(t) - M_v^d(t)\right],$$

in which case B and S^d integrate even though vertical integration is not socially optimal. ■

Proof of Proposition 6. If $t = 0$, there is no difference between private and social gains to offshoring, so the equilibrium supply decision is clearly efficient. For any tariff $t \geq 0$, B chooses the domestic supplier if inequality (28) holds, whereas national surplus is higher under domestic specialized sourcing if

$$U^d(i_k^d(t), t) - U^f(i_k^f, t) - t\left[M_k^f(t) - M_k^d(t)\right] \geq 0. \tag{33}$$

The right-hand sides of (33) and (28) are both zero, but the left-hand side of (33) is smaller than the left-hand side of (28), since imports are obviously higher when B sources specialized inputs from the foreign supplier. Hence, if condition (33) is satisfied, condition (28) is satisfied as well for any $t \geq 0$. On the other hand, if $t > 0$ there could be situations where

$$U^d(i_k^d(t), t) - U^f(i_k^f, t) \geq 0 > U^d(i_k^d(t), t) - U^f(i_k^f, t) - t\left[M_k^f(t) - M_k^d(t)\right],$$

in which case B sources domestically even though offshoring would be socially optimal. ■

Proof of Corollary 1. Part a) follows from (24). Part b) follows from (24) and propositions 5 and 6. If foreign supply is initially chosen, the tariff does not affect the integration decision. Since a fall in the tariff makes foreign supply more appealing, no organizational change will occur. By (24), welfare rises as the tariff falls. If domestic integration is initially chosen, then a change in suppliers due to falling tariffs is clearly efficiency enhancing by Proposition 5. If a drop in the tariff leads to domestic outsourcing, then it is also efficiency enhancing by Proposition 5. Part c) is shown by noting that, on one hand, a falling tariff lowers social welfare conditional on domestic outsourcing by (24). However, a change from domestic outsourcing to foreign outsourcing would, in and of itself, enhance efficiency by Proposition 6. Hence, welfare could either rise or fall as the tariff falls. ■

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