

Protection and International Sourcing*

Emanuel Ornelas[†]
London School of Economics

John L. Turner[‡]
University of Georgia

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Abstract

In an incomplete contracts model where there are otherwise no social motives for protection, we show that protection is socially beneficial when a buyer outsources customized inputs from a specialized domestic supplier while also purchasing generic inputs from the world market. The reason is that a tariff worsens the outside option of the buyer, thereby increasing the supplier's incentives to invest. Since under free trade the supplier would underinvest due to hold-up problems, welfare rises with protection for relatively low tariff levels. But protection always distorts sourcing decisions, and is ineffective at altering investment incentives whenever the specialized supplier is foreign, as in that case tariffs have no effect on the parties' negotiation surplus. Tariffs can be particularly harmful when the firms have curbed opportunism through vertical integration, as in that case they distort sourcing and induce excessive investment. Furthermore, protection promotes inefficient organizational choices. The reason is that tariff revenue, which is external to firms, drives a wedge between the private and the social gains of both offshoring and vertical integration, leading to excessive domestic integration.

COMMENTS AND SUGGESTIONS WELCOME

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[†]Managerial Economics and Strategy Group, London School of Economics, Houghton Street, London WC2A 2AE. E-mail: e.a.ornelas@lse.ac.uk.

[‡]Department of Economics, University of Georgia, Brooks Hall 5th Floor, Athens, GA 30602-6254. E-mail: jltturner@uga.edu.

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 with a lower value for parties not involved in the transaction. In an environment with incomplete contracts, relationship-specific investments will tend to be inefficiently low—i.e. the hold-up problem of underinvestment arises. In this setting, we study the implications of protection for investment and organizational structure, 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 organizational forms?

To answer these questions, we develop an incomplete contracts model where none of the standard reasons for active trade policy exist. A downstream domestic buyer purchases inputs from both a specialized supplier, which may be either domestic or foreign, and from a competitive fringe, located abroad. We begin by contrasting the case where tariffs favor the specialized inputs of the domestic supplier over generic imported inputs (domestic supply) with the case where tariffs do not discriminate across inputs (foreign supply under a most-favored-nation environment). A tariff always inefficiently lowers imports, but in the former case it can improve social welfare by mitigating hold-up problems. The reason is that the tariff worsens the outside option of the downstream firm, permitting the domestic specialized supplier to capture a greater share of the returns on her investment. In the latter, non-discriminatory case, tariffs affect outside and inside options identically. As a result, they do not affect hold-up problems and necessarily reduce welfare. Therefore, when a tariff favors a supplier—and only then—it gives that supplier an *efficiency* advantage over other suppliers. Intuitively, protection lowers the transactions costs of incomplete contracts under domestic supply, promoting this pattern of production.

Tariffs introduce other distortions, however. Because firms do not capture tariff revenue, protection introduces organizational externalities in the choice of which upstream specialized supplier to use (the *supplier* decision) and the choice of whether to trade at arm’s-length or to vertically integrate (the *ownership* decision). Since tariff revenue is greater under foreign supply (because all inputs are subject to the tariff), the private gains to choosing domestic supply exceed the social gains, implying that downstream buyers choose domestic suppliers "too often." Specifically, downstream buyers choose domestic specialized supply in some cases where the foreign supplier holds the fundamental efficiency advantage, even factoring in the salutary effects of the tariff on the domestic supplier’s investment.

Modelling integration as reducing transaction costs (to zero) at a fixed cost, a similar inefficiency arises in the decision to vertically integrate when the domestic supplier is chosen. Since the domestic supplier invests more in variable-cost reduction under integration, she

provides more inputs to the downstream buyer in equilibrium. This crowds out imported generic inputs. Hence, tariff revenue is lower under integration, making the private gains exceed the social gains to integration. As a result, firms choose integration "too often." Specifically, firms integrate in some cases where the fixed cost of integration, combined with lost tariff revenue, more than offsets the efficiency gains from solving hold-up problems.

There are several implications of our findings. First, organizational forms are 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 clear evidence that the economy would benefit from free trade. Third, there is a qualitative difference between the effects of tariffs and unrecoverable trade costs on organization form. While such trade costs generally affect organizational form (Antràs and Helpman 2004), they do not distort supply or ownership decisions away from social optima. Our results suggest that countries with high tariffs tend to have too little international trade *and* too many integrated firms, relative to the socially optimal.

Our model restricts attention to the case of dual sourcing of inputs. Dual, or "second," sourcing has been common practice for decades in several industries, including 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." This is useful from a modeling standpoint in that it generates an environment where tariffs always affect the buyer's costs from at least one source of supply (and possibly both) while keeping the analysis focused on the impact of protection on hold-up problems and organization externalities. It is also more general than it appears at first. Specifically, if one were to set up a model where only one source of supply is ultimately chosen but there is ex ante uncertainty about which supplier will have the lowest price, then two sources "expect" to produce inputs with some probability. Results from our model carry over into this type of environment. Hence, the model can also be interpreted as an heuristic method for studying single sourcing under uncertainty.

Our work contributes to the burgeoning literature that studies optimal sourcing decisions and organizational form in an international, incomplete contracts context.¹ [*extend discussion*] Our work relates also to the industrial organization and law-and-economics literatures. Focusing on incomplete contracts stemming from either direct costs or unverifiable investments, several authors have identified theoretical situations where efficiency can be achieved with simple contracts, but such solutions to the hold-up problem usually require either a commitment to not renegotiate contracts or the ability of courts to punish contract breach.²

¹See for example McLaren (2000), Antràs and Helpman (2004, 2008), Grossman and Helpman (2005), Schwartz and Van Assche (2007), Grossman and Rossi-Hansberg (2008).

²For example, Rogerson (1992) shows that the hold-up problem may be solved with properly specified

If renegotiation cannot be prevented and courts cannot always enforce contracts, the standard underinvestment problem remains. We show that import tariffs can be useful in that context. We also add to the trade policy literature. First, we identify a novel circumstance where protection can enhance welfare—mitigating hold-up problems. Second, and in contrast, we uncover a new channel through which protection promotes inefficiency—distorting organizational choices.

To our knowledge, Conconi, Legros and Newman (2008) are the only others to point out that international trade can affect the efficiency of organizational choices. Their reasoning is entirely different to ours, however, and so are their predictions. In the model of Conconi et al., inefficient organizations arise because managers care about the private costs of their actions, and this leads to insufficient coordination between related firms. In that context, international trade can induce either socially inefficient integration or socially inefficient disintegration.

Similarly, we are familiar with only one other paper that addresses trade policy implications of incomplete contracts, the recent independent and complementary work of Antràs and Staiger (2007). Building on the modeling framework developed by Antràs and Helpman (2004), Antràs and Staiger also identify a role for active trade policy in correcting hold-up problems. Most notably, they show how international *trade agreements* correct inefficiencies generated by the hold-up problem and by unilateral trade policies. To highlight their main points, Antràs and Staiger permit governments to use trade policy to shift surplus across countries (through taxes/subsidies on trade of intermediate as well as final goods) but treat organizational form as exogenous. As our primary interest is the welfare impact of protectionist policies through sourcing and organizational decisions, we shut down all other motivations for protection, including surplus shifting, but permit the final good producer to establish a relationship with a specialized supplier that can be either domestic or foreign. We also permit integration. These possibilities allow us to carefully identify the role played by tariffs in yielding an efficiency advantage to domestic suppliers and to highlight organizational externalities, due to tariffs, that do not emerge in the Antràs-Staiger model.

This paper also relates to our previous work (Ornelas and Turner 2008). There are two important qualitative differences between the two papers. Using a "single source under uncertainty" model, Ornelas and Turner (2008) study the multiple effects that falling tariffs have on expected international trade flows through changes in investment and integration decisions. Those multiple effects remain in the current dual-sourcing model, but we focus here on the implications of tariffs for the choice of alternative specialized suppliers and for welfare. Furthermore, the outside option of the buyer in Ornelas and Turner (2008) is to purchase generic inputs available domestically—as in a large country. In this paper, we model generic inputs as being available abroad—as in a small country—to highlight the asymmetric

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.

effects of tariffs on domestic vs. foreign suppliers.

After describing the model, we study the effect of 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. We conclude in section 5.

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 of 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 standardized inputs in the world market at price (including adaptation costs) 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 $p^w + t$. To ensure that B always buys at least some inputs under free trade, we assume $V'(0) > p^w$. Alternatively, B can purchase customized inputs from a specialized supplier. This supplier, which we denote by S^j , could be either domestic ($j = d$) or foreign ($j = f$).

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.³

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 $i \in [0, \bar{i}]$ 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 $C_q^j > 0$, $C_i^j < 0$ and $C_{qi}^j < 0$, where subscripts denote partial derivatives. Furthermore, $C_q^j(0, 0) < p^w$ and $C_{qq}^j > 0$, 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 always 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) in assuming that they choose investment to maximize their total profits. 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. The four possible organizational forms are displayed in Figure 1, along with the 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:

$$A1 : t < \min \{ \bar{t}^d, \bar{t}^f \},$$

where \bar{t}^j is the tariff that (just) forecloses trade of generic inputs when $i = \bar{i}$ and the

³See also the discussion in footnote 5.

*Specialized
Supplier*

		S^f	S^d
<i>Ownership Structure</i>	Vertical Integration	Foreign (Offshore) Integration	Domestic (Onshore) Integration
	Arm's-Length Trading	Foreign (Offshore) Outsourcing	Domestic (Onshore) Outsourcing

Figure 1: Organizational Form

specialized supplier is S^j . The tariffs are defined implicitly by

$$C_q^d(Q^*(\bar{t}^d), \bar{i}) \equiv p^w + \bar{t}^d \quad \text{and}$$

$$C_q^f(Q^*(\bar{t}^f), \bar{i}) \equiv p^w.$$

Hence, for any $t < \bar{t}^d$ 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 $t < \bar{t}^f$ 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. Furthermore, as mentioned in the introduction, multi-sourcing of inputs is actually a widespread practice in many industries.

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.⁴

⁴This 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

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. Hence, we first take i and the identity of the specialized supplier as given and study production and sourcing decisions conditional on investment. We return to the choice of i 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 is defined implicitly by

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

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, $q^d < Q^*$).

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

$$C_q^f(q^f, i) = p^w, \quad (3)$$

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, a benchmark for the analysis of equilibrium investment under each organizational form.

on international trade—e.g. Grossman and Helpman (2002), Antràs (2003), Antràs and Staiger (2007).

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

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

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

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

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. Tariff revenue is rebated back to consumers in a lump-sum fashion, so national surplus (omitting constant terms) is $W^j(i, t) \equiv U^j(i, t) + tM^j(t)$, 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.⁵

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

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

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

$$A2 : C_{iq}^j \text{ is constant.}$$

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_{fb}^d :

$$-C_i^d(q^d, i_{fb}^d) = I'(i_{fb}^d) + t \frac{dq^d}{di}. \quad (7)$$

A marginal increase in investment lowers the cost of production by C_i^d .⁶ On the other hand,

⁵Notice 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 them, we could define *global* welfare and carry out precisely the same analysis.

⁶Under $A2$, the second-order necessary condition associated with i_{fb}^d being a maximum of (6) is satisfied,

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_q^d producing an extra unit. Since $C_q^d > p^w$ when $t > 0$, this is inefficient, implying a lower socially-optimal level of investment.

If B adapts 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 $C(\cdot)$ with $C^f(\cdot)$. Using condition (3) for privately optimal sourcing, we find that the first-best level of investment in this case, i_{fb}^f , satisfies

$$-C_i^f(q^f, i_{fb}^f) = I'(i_{fb}^f). \quad (8)$$

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

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.

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 bargaining powers. 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 bargaining breaks down, *ex post* payoffs are

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

as it corresponds to $SONC_{fb}^d \equiv (C_{iq}^d)^2 / (C_{qq}^d - C_{ii}^d - I'') < 0$, where the negative sign follows from the convexity of Γ^d .

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

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

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

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

According to the Nash bargaining solution, the negotiated price is such that it splits the negotiation surplus between the two parties according to bargaining powers. Clearly, the higher α , the more S^d absorbs 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

$$u_s^d(i, t) = \alpha \left[(p^w + t)q^d - C^d(q^d, i) \right] - I(i). \quad (11)$$

She chooses investment to maximize (11). Using equation (2), S^d 's choice of investment, i_a^d , is then characterized by

$$-\alpha C_i^d(q_a^d, i_a^d) = I'(i_a^d), \quad (12)$$

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 (12). The left-hand side of (12) 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.⁷

Expression (12) 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 *overinvestment*, 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*

⁷The second derivative of (11) 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 (11).

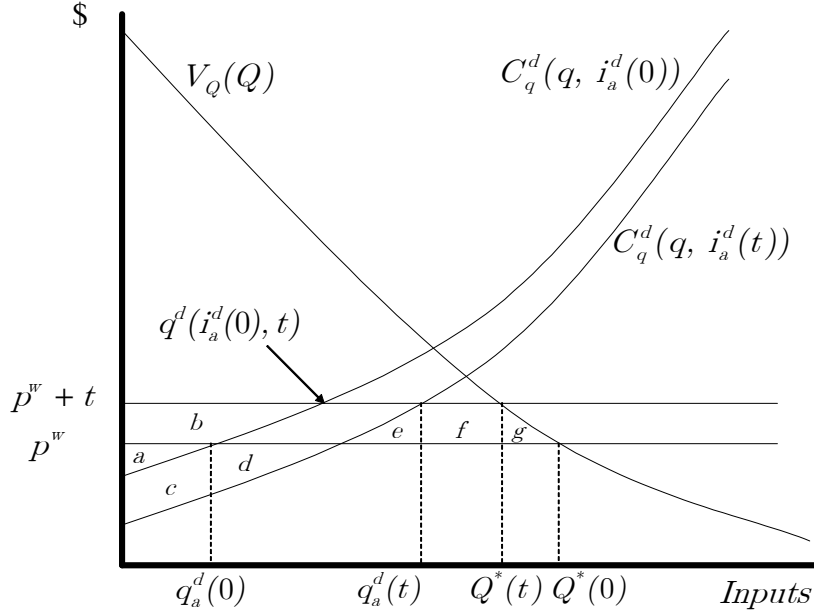


Figure 2: The Effects of a Tariff under Domestic Outsourcing

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 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 her cost, which is unrelated to the tariff. As a result, the supplier increases her investment until the point where marginal gain and 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

$$\begin{cases} u_b^{1f} = V(Q^*) - (p^w + t)Q^* + (p^w - p^f)q^f \\ u_s^{1f} = p^f q^f - C^f(q^f, i), \end{cases} \quad (13)$$

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

$$NS^f = p^w q^f - C^f(q^f, i). \quad (14)$$

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

$$u_s^f(i, t) = \alpha \left[p^w q^f - C^f(q^f, i) \right] - I(i). \quad (15)$$

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

$$-\alpha C_i^f(q_a^f, i_a^f) = I'(i_a^f), \quad (16)$$

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 (16).⁸

Equation (16) has the same interpretation of equation (12). 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,

⁸The second derivative of (15) with respect to i is $SONC^f \equiv \alpha \left[\frac{(C_{iq}^f)^2}{C_{qq}^f} - C_{ii}^f \right] - I''$. The convexity of Γ^f ensures that $SONC^f < 0$, so that i_a^f denotes indeed a maximum of (15).

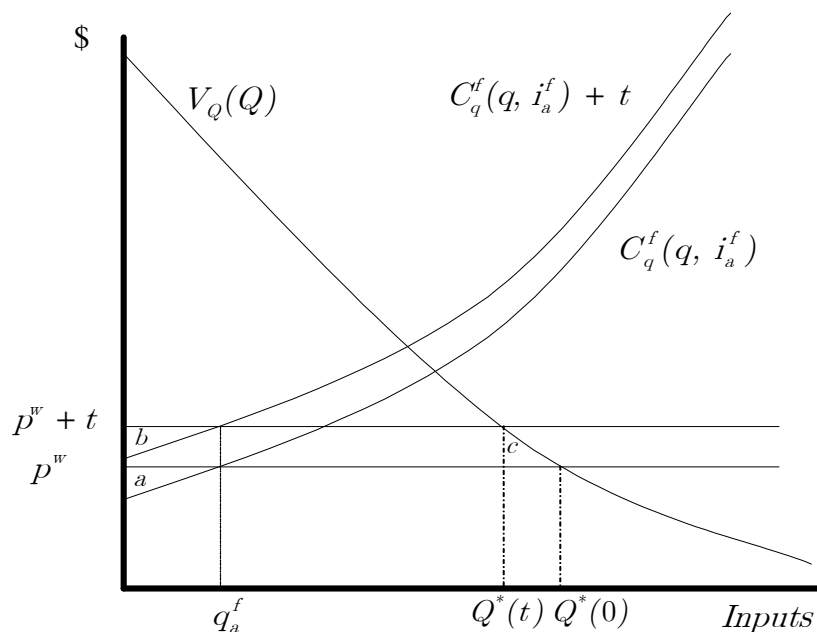


Figure 3: The Effects of a Tariff under Foreign Outsourcing

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 $j = d$, in expression (5) if $j = f$. In both cases, equilibrium investment under integration, i_v^j , satisfies

$$-C_i^j(q_v^j, i_v^j) = I'(i_v^j), \quad (17)$$

where $q_v^j \equiv q^j(i_v^j)$ denotes the number of 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 (17) 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 :

$$\begin{aligned} \frac{dW^d(i_a^d(t), t)}{dt} &= t \frac{dM_a^d(t)}{dt} - \frac{di_d(t)}{dt} \left[C_i^d(q_a^d, i_a^d(t)) + I'(i_a^d(t)) \right] \\ &= t \left[\frac{dQ^*(t)}{dt} - \frac{dq_a^d(t)}{dt} \right] - \frac{di_d(t)}{dt} \left[C_i^d(q_a^d, i_a^d(t)) + I'(i_a^d(t)) \right], \end{aligned} \quad (18)$$

where we have used equations (1) and (2) to simplify (18). For given investment, the tariff inefficiently reduces imports. The (negative) first term in the right-hand side of (18) 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 12). A tariff stimulates investment unless $\alpha = 0$ (Proposition 1). The second term in the right-hand side of (18) 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.⁹ Here, all standard rationales for protection are absent. Still, a tariff can help by alleviating the

⁹The sole exception is the independent work of Antràs and Staiger (2007), who, as we indicate in the introduction, also study trade policy in the presence of hold-up problems.

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 causes C_q^d to fall, 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 .¹⁰ There is also the cost of the increased investment, not shown in the figure, 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.

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. Thus, the tariff inefficiently reduces B 's total purchases of inputs (area g in Figure 2) and promotes excessive domestic production (area e in Figure 2). Both effects work as "brakes" on how far protectionist policies can go in raising welfare in the presence of domestic hold-up problems.¹¹

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:

$$\frac{dW^d(i_v^d(t), t)}{dt} = t \left[\frac{dQ^*(t)}{dt} - \frac{dq_v^d(t)}{dt} \right] \leq 0. \quad (19)$$

Hence $t_v^d = 0$.

¹⁰Area f , which under free trade is absorbed by B , remains in the country in the form of tariff revenue collected by the government.

¹¹This 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 can 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 (2007), 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.

3.3 Offshoring

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

$$\frac{dW^f(i_k^f, t)}{dt} = t \frac{dQ^*(t)}{dt} \leq 0. \quad (20)$$

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

$$\text{Max}_{j \in \{d, f\}, k \in \{a, v\}} \left\{ U^j(i_k^j(t), t) + tM_k^j(t) - 1[k = v]K \right\}, \quad (21)$$

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 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 (18), (19) and (20), we have that, for $t \in (0, t_a^d)$,

$$\frac{dW^d(i_v^d, t)}{dt} < \frac{dW^f(i_v^f, t)}{dt} = \frac{dW^f(i_a^f, t)}{dt} < 0 < \frac{dW^d(i_a^d, t)}{dt}. \quad (22)$$

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 (21)) 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

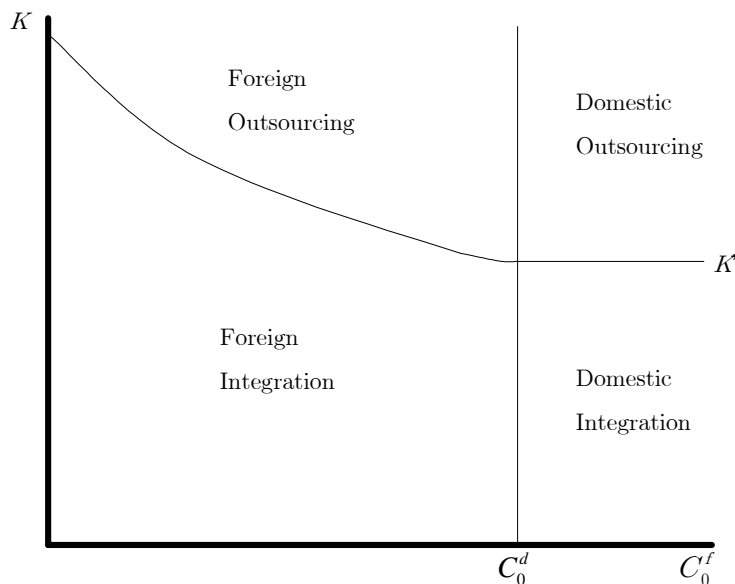


Figure 4: Optimal Organizations under Free Trade

welfare than foreign integration falls with C_0^f .¹² For $C_0^f > C_0^d$, domestic specialized supply is optimal and, for $K \geq K'$, outsourcing is optimal.¹³

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 $C_0^f \in [C_0^d - \delta, C_0^d]$, $0 < \delta < t$). This is due to the tariff improving the investment incentives under domestic outsourcing, but not under offshoring. 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 (22). In Figure 5, this happens for $C_0^f \in [C_0^d, C_0^d + \varepsilon]$, $\varepsilon > 0$.

4 Organizational Form

We now study the *choice* of organizational form. We allow the buyer to choose between S^d and S^f and decide whether to integrate. Under arm's-length trading, if B adapts toward

¹²The 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.

¹³Note that the level of C_0^d also affects the cutoff value of K . 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).

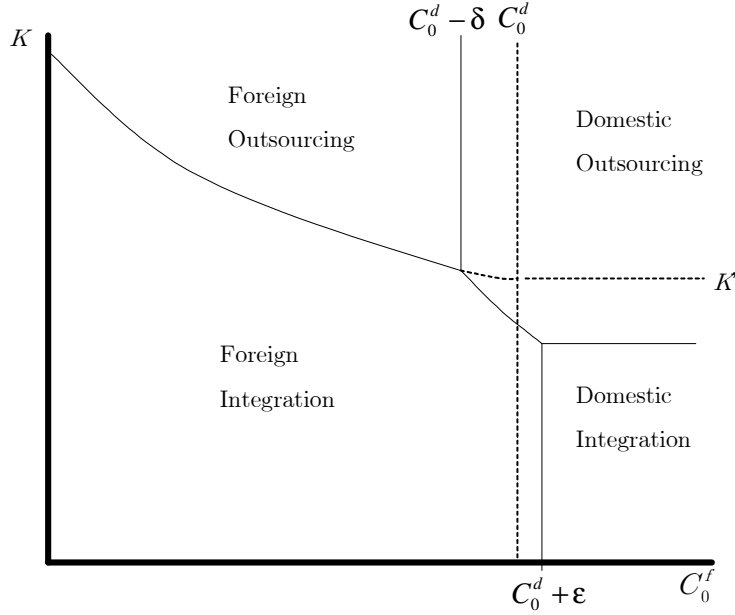


Figure 5: Optimal Organizations under Protection

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

$$\text{Max}_{j \in \{d, f\}, k \in \{a, v\}} \left\{ U^j(i_k^j(t), t) - 1[k = v]K \right\}. \quad (23)$$

This maximization problem is identical to (22) under free trade ($t = 0$), in which case the equilibrium organizational form is efficient. 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 are qualitatively distinct for the supplier and ownership decisions.

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

$$\Delta U^j \equiv U^j(i_v^j(t), t) - U^j(i_a^j(t), t) \geq K, \quad (24)$$

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

$$\Delta W^j \equiv U^j(i_v^j(t), t) - U^j(i_a^j(t), t) - t [M_a^j(t) - M_v^j(t)] \geq K, \quad (25)$$

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, 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 [$M_a^d(t) = Q^*(t) - q_a^d(t) > Q^*(t) - q_v^d(t) = M_v^d(t)$]. Hence, when tariffs are positive, the private gains to integrating exceed the social gains.

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

Consider next B 's criterion to pick the domestic supplier. Assuming he chooses S^d when the payoffs are the same, B specializes toward S^d if and only if

$$U^d(i_k^d(t), t) - U^f(i_k^f, t) \geq 0. \quad (26)$$

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 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.*

Given the nature of these biases, we can conclude the following about protection and welfare. First, if S^f is chosen in equilibrium under protection, then a move to free trade would enhance welfare, regardless of ownership, because protection biases the choice against offshoring and free trade maximizes welfare under offshoring. Second, if S^d and outsourcing are chosen in equilibrium under free trade, then some protection would increase welfare as long as it does not prompt inefficient integration. An interesting special case is when S^d and S^f have the same technology and K is high, so that integration is not optimal. It is

clear that some protection, and onshore supply, maximizes national surplus. In this sense, protection provides an *efficiency* advantage to domestic input production.

Third, if domestic integration is observed, it is always possible that it does not maximize national surplus. Obviously, if domestic integration is observed under protection, it may be inefficient due to the bias described in Proposition 5. On the other hand, if domestic integration is observed under free trade, it is possible that some protection might 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.¹⁴

4.1 An Example, continued

Using the example described in subsection 3.5, we consider now *equilibrium* organizational form (i.e., the solution to (23)).

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, because the firms neglect the lost tariff revenue under domestic supply. This distortion is highlighted in Figure 6. Domestic outsourcing (when K is sufficiently high) is chosen for $C_0^f > C_0^d - t$ but is socially inefficient (relative to foreign outsourcing) for $C_0^f < C_0^d - \delta$. This distortion is represented by the light gray region in Figure 6. 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 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 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.

5 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. Our paper shows that the

¹⁴This 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, an increase in the tariff also makes imports more expensive. This 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.

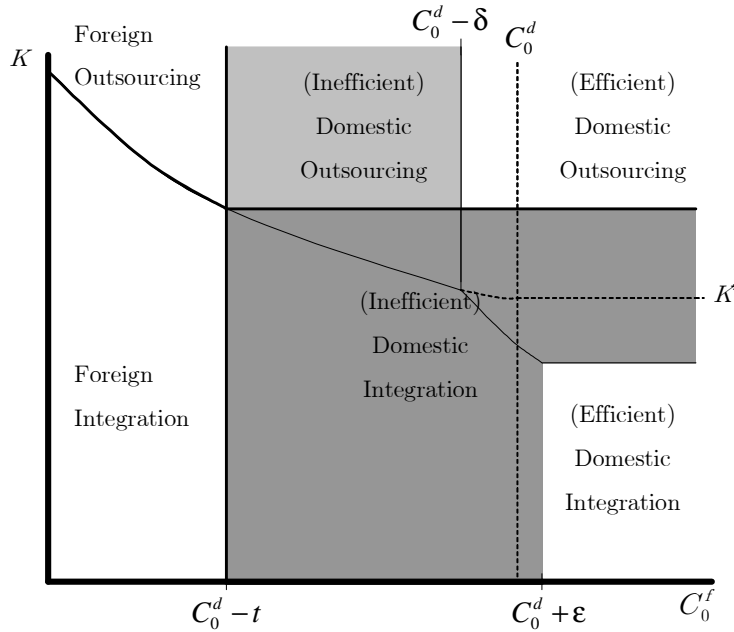


Figure 6: Equilibrium Organizational Forms under Protection

nature of these distortions may be far more subtle than normally believed.

First, we show that 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 standard trade theory suggests—if applied on sectors where asset specificity and incomplete contracts are important, and outsourcing is mainly among domestic firms.

Second, and in contrast, we show that protection distorts organization 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 be inefficiently domestic or have inefficiently large boundaries under protection. In contrast, free trade induces firms to choose the "right" organizational form.

We make this last point using tariffs in a model of international trade, but the logic about firm size could extend to other types of distortions introduced in markets for intermediate inputs. Hence, our point has implications also for entirely domestic industries where intermediate inputs are taxed or subsidized. To take one famous example, Coase (1937) argues that firms may expand or integrate to avoid taxes paid on market transactions of intermediate inputs. Our analysis suggests that if the cost of integration is sufficiently close to the taxes avoided, this type of integration will be socially inefficient.

Our model leaves several interesting extensions for future research. 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 very 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 the hold-up problem 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 significantly. 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 as a means to curb a purely domestic inefficiency. Our framework would also permit study of the role of trade agreements in overcoming the organizational externalities we identify. Studying these forces would further improve our understanding of the role of trade agreements in the context of incomplete contracts and relationship-specific investments, providing a complement to the analysis of Antràs and Staiger (2007).

To focus on the consequences, rather than the causes, of protection, 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. Since optimal tariffs are positive under outsourcing when the buyer chooses the domestic supplier, this would not confound optimal trade policy when domestic supply is efficient and integration is infeasible. However, tariffs can make vertical integration more attractive even in situations when it is inefficient. Hence, if integration is privately preferred under protection, the first-best combination of organizational form and trade policy may be impossible to achieve.

We do not explore varying levels of contract enforcement across countries either. This is potentially important, as Nunn (2007) shows that the strength of contract enforcement helps to explain patterns of international trade in goods with differentiated intermediate inputs, and as Antràs and Helpman (2008) show that different levels of input contractibility can affect organizational form. Moreover, the incomplete-contracts framework offers a potentially promising way to study whether contract enforcement and tariffs are strategic complements or substitutes, an important topic that has received little attention. Intuitively, stronger contracts would weaken the hold-up problem and the need for integration, favoring arm's-length trade and low tariffs. However, as we show, tariffs are useless if parties cannot enforce contracts and hold-up problems are extreme. As the likelihood of contract enforcement increases, this could enhance the ability of tariffs to promote relationship-specific investments. This will depend greatly on how damage remedies influence the ways parties can deal with contract breach.¹⁵

¹⁵For example, starting with Shavell (1980), several studies have shown that the "expectation damages"

Finally, by relaxing our assumptions about the industrial organization of the buyer and suppliers, one could study several related questions. We shut down distortions in final-goods markets because we wish to set up free trade as the first-best regime, excepting hold-up problems. However, if downstream firms have market power, tariffs/subsidies may 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, we do not model strategic competition between rival suppliers, nor do we consider investments made by downstream firms. These are particularly interesting issues to study in a dual-sourcing environment. Shepard (1987) and Farrell and Shapiro (1988) argue that dual sourcing in semiconductors was crucial for achieving commitment and investments from downstream firms. It would be worthwhile to compare how government intervention in intermediate markets would affect buyer behavior under dual sourcing and under single sourcing. We look forward to further progress in these areas.

6 Appendix

Proof of Proposition 1. If $\alpha = 0$, it follows directly from (11) that investment is worthless for S^d , and therefore $i_a^d = 0$. Otherwise, $i_a^d > 0$ because $I'(0) = 0$, and satisfies (12). As α rises, the convexity of Γ ensures that i_a^d increases. Investment also increases with the tariff whenever $\alpha > 0$:

$$\frac{di_a^d}{dt} = \frac{\alpha C_{qi}^d / C_{qq}^d}{SONC^d} > 0, \quad (27)$$

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 12, respectively), it follows that $i_a^d < i_{fb}^d$ if and only if

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

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 (16) that i_a^f is also unaffected by the tariff. ■

remedy produces outcomes different than the "reliance damages" remedy. This literature also shows that assumptions about renegotiation and the costliness of disputes are crucial.

Proof of Proposition 3. Using (12), we can write the effect of a marginal increase in the tariff on national welfare as

$$\frac{dW^d(i_a^d(t), t)}{dt} = t \frac{dM_a^d(t)}{dt} - \frac{di_a^d(t)}{dt} (1 - \alpha) C_i^d(q_a^d, i_a^d(t)). \quad (28)$$

Suppose that $\alpha \in (0, 1)$. Then, the second term of (28) 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 (28) collapses to $t \frac{dM_a^d(t)}{dt}$. Since $\frac{dM_a^d(t)}{dt} < 0$, $sgn(28) = sgn(t)$. Hence $t_a^d = 0$. If $\alpha = 1$, the second term of (28) 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 (18) to zero and developing it, one finds

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

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

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

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 (24) and (25) respectively, so the equilibrium ownership decision is clearly efficient.

Now, while the right-hand sides of (24) and (25) are identical, the left-hand side of (24) is greater than the left-hand side of (25) 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 (24) and (25) 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 (25) is satisfied, condition (24) 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 (26) holds, whereas national surplus is higher under domestic specialized sourcing if

$$U^d(i_k^d(t), t) - U^f(i_k^f, t) - t \left[M_k^f(t) - M_k^d(t) \right] \geq 0. \quad (29)$$

The right-hand sides of (29) and (26) are both zero, but the left-hand side of (29) is smaller than the left-hand side of (26), since imports are obviously higher when B sources specialized inputs from the foreign supplier. Hence, if condition (29) 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

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

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

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