Preferential Trade Agreements and Global Sourcing∗

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Abstract

We study how a preferential trade agreement (PTA) affects sourcing decisions under incomplete contracting in an international context. The model features dual sourcing and search costs. Contract incompleteness implies underinvestment by the parties in a transaction. We show that this inefficiency is mitigated by a PTA, because it allows the parties to internalize a larger fraction of their bargaining surplus. On the other hand, the PTA also yields sourcing diversion. A more efficient supplier tilts the tradeoff toward the beneficial investment effect; a higher external tariff tips it toward sourcing diversion. In a dynamic version of the model with search and matching, a PTA also has the benefit of inducing more search—which otherwise would be inefficiently low—and of prompting firms with mediocre matches outside the PTA to re-match with suppliers inside the bloc. On the whole, we offer a new framework to study the benefits and costs from preferential liberalization in the context of global sourcing.

Keywords: Regionalism; hold-up problem; sourcing; trade diversion; incomplete contracts.

JEL classification: F13, F15, D23, D83, L22

[Preliminary and incomplete]

1 Introduction

The past few decades have seen an explosion in the number of Preferential Trade Agreements (PTAs). The World Trade Organization (WTO) reports almost 300 reciprocal PTAs in force in

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2015, including virtually all WTO members, compared with just a few dozen in the early 1990s. There are also numerous schemes of unilateral trade preferences.\(^1\) A parallel trend has been the growth of trade in parts and components. As Johnson and Noguera (2014) document, the ratio of trade in value added to gross exports (which they call ‘the VAX ratio’) has declined steadily in the last 40 years. Increasingly, researchers are arguing that those two trends are related to each other (see for example Baldwin, 2011). Indeed, Johnson and Noguera (2014) find a strong link between reductions in the VAX ratio and the formation of PTAs. What we still miss is a basic framework that allows us to assess the desirability of PTAs in that context. This is what we aim to provide in this paper.

Conventional welfare analyses of preferential liberalization typically point to two opposing effects of preferential tariffs, trade creation and trade diversion (Viner, 1950). Trade creation occurs when firms from foreign partner countries produce more due to the PTA, at the expense of inefficient domestic firms. This increases overall welfare. Trade diversion occurs when member-country firms produce more due to the PTA, but at the expense of efficient nonmember firms. This lowers overall welfare. Those effects are based upon classical trade models, which rely on market-clearing for price formation and neglect the nuances of real-world trade in intermediate goods. This is why some authors, like Baldwin (2011), have argued that 21\(^{st}\) century regionalism is no longer about preferential market access and the resulting trade creation/diversion, but mostly about the disciplines that underpin production fragmentation. Antràs and Staiger (2012) make a related point when studying the economics of (nondiscriminatory) trade agreements. A key distinction is that such trade often involves customized components that commit a buyer and a seller to each other. It is well known that such bilateral monopoly can lead to underinvestment in component-specific technology due to ‘hold-up problems’ (e.g., Grossman and Hart, 1986). By renegotiating terms of trade, a buyer of customized components can hold up the seller and force a new bargain where she captures some of the surplus created by sunk investments made by the seller. When contracts are incomplete, the seller anticipates the renegotiation prior to investing and underinvests.

In this paper, we show that PTAs can enhance welfare by (imperfectly) substituting for weak contract enforcement. To make our point as stark as possible, we develop a simple model that shuts

\(^1\)See https://www.wto.org/english/tratop_e/region_e/region_e.htm and for detailed statistics on preferential integration.
down all Vinerian trade creation channels but allows for trade diversion. We design the model to put aside Vinerian trade creation not because we deem it unimportant. Instead, we leave classic trade creation out of the analysis to shed light on a potentially important force that has so far been ignored in the academic literature and in policy circles alike. Still, all the action is driven by preferential market access.

In our setting, in comparison with the case without an agreement, PTA trading partners share a higher surplus on every unit traded, relative to what they could obtain by dealing with alternative producers in nonmember countries. This propels firms to trade more, which in turn induces them to increase their investment in cost-reducing technology. Since the better technology yields fruits (i.e., lower marginal costs) to every unit traded, this relationship-strengthening effect is stronger, the more units the firms initially trade. Since without the PTA there is underinvestment due to a hold-up problem, the PTA-induced investment will generally improve efficiency. This beneficial effect may overcome the negative effect of the tariff discrimination—essentially, trade diversion in the sourcing of components. This sourcing diversion is unaffected by the number of units that the firms initially trade with each other. Therefore, the relationship-strengthening effect is more likely to dominate the sourcing-diversion effect when firms initially trade high volumes. This happens when the firms trading customized components are relatively efficient. Hence, we augment Viner’s classic tradeoff by showing that a PTA is more likely to enhance welfare when it is applied to more efficient industries, which trade large volumes of specialized inputs even without the PTA, in member countries where contract enforcement is fundamentally weak.²

Now, as the external tariff rises, the initially positive relationship-strengthening effect grows but eventually falls, whereas the negative sourcing-diversion effect increases monotonically in the tariff. Hence, if external tariffs are sufficiently high, PTAs are likely to lower welfare even in industries with highly productive firms. As in the classical case, with sufficiently high external tariffs trade diversion dominates. Yet here the comparison is not with trade creation, but with the investment effect. If the discrimination is too high, it will yield “too much” investment, possibly more than offsetting the benefit of alleviating the original hold-up problem.

²This result is reminiscent of the “natural trading partners” hypothesis, which posits that agreements formed between countries that trade heavily with each other are more likely to enhance welfare. The natural trading partners hypothesis is often relied upon in policy circles and has empirical support (e.g., Baier and Bergstrand, 2004), but lacks solid theoretical foundations (e.g., Bhagwati and Panagariya, 1996). Our result provides a possible rationale for it.
Our analysis also provides a basic criterion for selecting industries for exclusion from PTAs. Industry exclusion is a staple of PTAs. Although Article XXIV of the GATT requires that "substantially all trade" must be included in every preferential agreement, the vagueness of the requirement allows for very flexible interpretations. Furthermore, PTAs that do not include developed economies can be notified to the WTO under the "Enabling Clause," which imposes even weaker constraints. As a result, in observed PTAs exclusions vary from a few products to several entire sectors. Surprisingly, there are very few theoretical analyses of sector exclusions in PTAs. The most notable exception is Grossman and Helpman (1995). According to their political-economy analysis, the welfare-enhancing sectors where trade creation would dominate are the ones which tend to be excluded, because those sectors do not receive support from organized lobbies. This tends to make actual (that is, politically viable) PTAs likely to be welfare-decreasing. Here, we find that the low-productivity industries are the ones that should be excluded, because in those sectors the mitigation of hold-up problems is less valuable. In that case, a PTA can be welfare-improving even if we shut down classic trade creation, provided that investment incentives are considered.

The introduction of search and matching brings a new dimension to the analysis, which allows us to study how PTAs affect the location of customized sourcing. In the absence of PTAs, there is too little search. Intuitively, this occurs for the same reason investments are too low. Welfare includes both buyer and supplier profit, but search is based just upon buyer profit.

A PTA mitigates that inefficiency by inducing a higher search intensity. It also induces firms initially sourcing elsewhere to seek new suppliers in the PTA members. This helps to rationalize the finding of Johnson and Noguera (2014) that PTAs explain the observed pattern of international sourcing. It also indicates a new channel through which PTAs promote efficiency.

Our paper illustrates how taking Viner’s (1950) distinction further can change the normative implications of PTAs, sometimes entirely reversing Viner’s original idea. In this sense it relates to Ornelas (2005b), who shows that purely trade-creating PTAs can be harmful, when one considers their implications for multilateral liberalization. Here, in contrast, we show that purely trade-diverting PTAs can be helpful, when one considers how they can mitigate hold-up problems created by incomplete contracts. The central point is that, when it comes to the trade of specialized inputs,
tariff preferences are not just policy devices that directly affect prices; they also affect production costs, through changes in investment incentives.

Moreover, our analysis complements research using detailed models of intermediate input trade and bargaining (Antràs and Helpman 2004, 2008; Ornelas and Turner 2008, 2012; Antràs and Staiger, 2012).

Our paper also relates to the literature that seeks to link trade liberalization to more investment and more innovation. That line of research is best exemplified by Bustos (2011) and Lileeva and Trefler (2010), who provide compelling theoretical analyses combined with empirical support for their model predictions. In both papers, the empirical analysis relies on the reduction of preferential tariffs (Argentinean firms facing lower tariffs in Brazil under Mercosur in one case, Canadian firms facing lower tariffs in the U.S. under CUSTA in the other), although their models pay no heed to the preferential nature of the liberalization. In contrast, we focus on the discriminatory aspect of tariff changes. Furthermore, we are interested in how they affect investment related to international sourcing decisions, not a special concern in the analyses of Bustos (2011) and Lileeva and Trefler (2010).

The paper is organized as follows. We setup the basic model in section 2, and study the equilibrium without a trade agreement in section 3. In section 4 we analyze the equilibrium with a PTA in place and describe the impact of the agreement on firms' choices. We then study the welfare impact of the PTA (section 5). We introduce search costs and study how a PTA affects the location of sourcing in section 6. We conclude in section 7.

2 Model

There is a continuum of final goods available for consumption in the world economy. There is also a numéraire good that enters a consumer’s utility function linearly. For each final good, production is carried out by a Buyer (B) firm located in the country Home. These firms act as aggregators, transforming intermediate inputs into marketable goods. Final good producers in each industry obtain revenue $V(Q)$ from purchasing a total of $Q$ intermediate inputs, where $V' > 0$ and $V'' < 0$.

There is another country called Foreign, as well as the rest of the world (ROW). In sourcing,
Each B firm may purchase generic inputs available in the world market, g, and/or customized inputs q from a specialized supplier (S), indexed by $\omega$ and located in either Foreign or ROW. Generic inputs are produced by a competitive fringe, and sell for price $p_w$, inclusive of compatibility costs. The buyer faces a per-unit tariff $t$ on intermediate goods imported from both Foreign and from ROW.

To produce, each buyer must match with a supplier. To find a supplier with whom to match, a buyer must incur costly search in either Foreign or ROW. Upon finding a satisfactory match, B and S specialize their technologies toward each other. This specialization costs nothing, but implies that at any point in time a buyer purchases specialized inputs from only one supplier. We postpone the search and match analysis until section 6. Until there, we carry out the analysis for a given match.

Each particular supplier firm is identified by $\omega$, a heterogeneity parameter that enters the supplier’s cost function. The specialized inputs are not traded on an open market, and therefore have no value outside the B and S relationship. Conditional on investment choice $i$ and output choice $q$, the supplier faces cost function

$$C(q, i, \omega) = (A + \omega - bi)q + \frac{c}{2}q^2.$$  

Note that parameter $\omega$ shifts the firm’s marginal cost at rate 1. The lower is $\omega$, the more efficient the firm is. In turn, parameter $c$ determines the slope of the form’s marginal cost. Finally, parameter $b$ denotes the effectiveness of investment in reducing production costs. S chooses its relationship-specific investment to lower its marginal cost curve prior to trade with B.

The investment is observed by both B-S, but is not verifiable in a court of law. The investment cost is

$$I(i) = i^2.$$  

Investment is bounded by $i \in [0, i^{max}]$. We assume that $2c > b^2.$

We focus on the case where B engages in dual sourcing. To guarantee that S produces some inputs, we need $C_q(0, 0, \omega) < p_w$ for all $\omega$. Now define $Q^*$ as the level of total inputs sourced. This satisfies $V''(Q^*) = p_w + t$. To ensure that S does not produce all inputs, we assume $C_q(Q^*, i^{max}, 0) >$  

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4This ensures that the effect of investment on marginal cost is not too large relative to the elasticity of the cost function. If $b$ were too large, the supplier would want to make $i \to \infty$. 

6
so that even under the maximum investment (and under free trade) the marginal cost for the most productive firm (ω = 0) is still sufficiently high that B prefers to purchase some generic inputs. To ensure production of the final good, the initial level of marginal revenue for B needs to be sufficiently high: V'(0) > p_w + t.

The timing of events is as follows. First, S chooses its investment and pays entirely for it. The investment is non-contractible. Second, the firms bargain over terms of trade for inputs. If bargaining breaks down, then S produces nothing and B has no choice but to purchase only generic inputs. Third, final production occurs and payoffs are realized.

3 No Trade Agreement

Initially, there is no trade agreement between Home and Foreign, and all inputs imported into Home are subject to the tariff. Conditional on investment i, efficient sourcing of customized and generic inputs, respectively q_N and g_N, satisfies the following two conditions

\[ Q^* = q_N + g_N, \]
\[ C(q_N, i, \omega) = p_w. \]

The latter condition implies

\[ q_N = \frac{p_w - A - \omega + bi}{c}. \]

After S chooses his investment, B and S determine the price of the specialized intermediate inputs, p_s, by Generalized Nash bargaining over the surplus due to trading customized instead of generic inputs.

Specifically, let the supplier have bargaining power α ∈ (0, 1). Under Generalized Nash bargaining, the two firms maximize the following expression with respect to p_s, the price of the inputs they bargain over:

\[ (U^T_B - U^N_B)^{(1-\alpha)}(U^T_S - U^N_S)^{\alpha}, \]

where U^J_k is the verifiable profit that firm k (either B or S) would receive under scenario J. The two possible scenarios are bargaining and trading (T) or not reaching an agreement and thus
not trading \((N)\). Those values are laid out as follows: \(U^T_B = V(Q^*) - (p_w + t)q_N - (p_s + t)q_N;\)
\(U^0_B = V(Q^*) - (p_w + t)Q^*;\)
\(U^T_S = p_s q_N - C(q_N, i, \omega);\)
\(U^0_S = 0.\)

Defining \(\Omega \equiv (U^T_b - U^0_b) + (U^T_s - U^0_s)\) as the bargaining surplus, the outcome of bargaining sees
the two firms split the proceeds, with \(S\) receiving \(\alpha\Omega\) and \(B\) receiving \((1 - \alpha)\Omega\). With no trade
agreement,
\[
\Omega_N = p_w q_N - C(q_N, i_N, \omega). \tag{4}
\]

\(S\)'s investment decision is the solution of
\[
\max_{i_N} \alpha\Omega_N - I(i_N).
\]

Thus, equilibrium investment, \(i^*_N\), satisfies
\[
I'(i^*_N) = -\alpha C_i(\cdot), \text{ or equivalently,}
\]
\[
i^*_N = \left( \frac{ab}{2c - ab^2} \right) (p_w - A - \omega). \tag{5}
\]

Note that as either the seller’s bargaining power \((\alpha)\) or the effectiveness of investment \((b)\) rises,
investment increases. Conversely, a steeper marginal cost curve \((a\ higher\ c)\) brings investment incentives down.

Substituting (5) back in (3) and manipulating, we find
\[
q^*_N = \left( \frac{2}{\alpha b} \right) \left( \frac{ab}{2c - ab^2} \right) (p_w - A - \omega)
\]
\[
= \left( \frac{2}{\alpha b} \right) i^*_N.
\]

Hence, the equilibrium investment and output are proportional. Thus, more productive firms
produce more output for a given investment, and they also invest more. This reinforces their
original advantages. When \(\alpha\) is very small, the investment is very low, and drops to zero when
\(\alpha = 0\), when \(S\) does not appropriate any of the benefits of his investment. Observe also that neither
investment nor production is affected by the tariff, which in this setting distorts the total volume
of inputs, \(Q^*\), but does not interfere with the sourcing of \(q\).

It is useful to compare \(S\)'s investment choice with the efficient level of investment, given the
tariff. Under efficient sourcing, social welfare can be defined as

\[ \Psi = V(Q^*) - p_w Q^* + p_w q_N - C(q_N, i, \omega) - I(i). \]

The *efficient* level of investment \( (i^e) \) maximizes \( \Psi \). Observe that, given dual sourcing, the first two terms of \( \Psi \) are unaffected by the level of investment. Thus, using (2), it follows that efficiency requires

\[ I'(i^e) = -C;(.). \] (6)

This yields

\[ i^e = \left( \frac{b}{2c - b^2} \right) (p_w - A - \omega). \]

Observe that, as \( b \) approaches \( \sqrt{2c} \), the level of the efficient investment blows up.\(^5\) Comparing \( i_N^* \) with \( i^e \), it is immediate that \( \alpha < 1 \) yields \( i_N^* < i^e \). Moreover, the difference \( (i^e - i_N^*) \) increases if \( S \) were more productive (i.e., if \( \omega \) were lower). Thus, it is precisely the relationships with the best suppliers that are more negatively affected by contract incompleteness.

4 **A Preferential Trade Agreement**

Under a PTA, the tariff for goods traded between *Home* and *Foreign* is eliminated. Imports from *ROW* still face the tariff, assumed unchanged. Hence, the specialized supplier’s price drops to \( p_s \), as opposed to \( p_s + t \) without the agreement.\(^6\) For expositional simplicity, we assume that *Foreign* does not produce generic inputs.\(^7\) Accordingly, generic inputs \( g \) still cost \( p_w + t \) for *Home*’s buyers.

The total volume of inputs purchased by \( B \) is still \( Q^* \), as pinned down by \( V'(Q^*) = p_w + t \), but now the composition of the sourcing decision changes to reflect the new relative prices. This is summarized by the condition

\[ C_q(qp, ip, \omega) = p_w + t, \] (7)

\(^5\)In this case, \( i_{\text{max}} \) would obtain as a corner solution.
\(^6\)Naturally, the negotiating price \( p_s \) also changes endogenously with the PTA.
\(^7\)Alternatively, we could assume that *Foreign* has an industry of generics but the industry is unable to supply enough \( g \) to fulfill *Home*’s demand, so *Home* still imports \( g \) from *ROW* under the PTA. This would leave all of our main results essentially unchanged.
which in equilibrium yields
\[ q_P = \frac{p_w + t - A - \omega + bi}{c}. \] (8)

Only one of the potential \( U^J_k \) terms, \( U^T_B \), structurally changes, becoming
\[ U^T_B = V(Q^*) - (p_w + t)q_P - p_sq_P. \]

The bargaining surplus under a trade agreement, \( \Omega_P \), is defined in the same manner as above, but now reflects the change in buyer profit with trade due to tariff savings when \( B \) sources from \( S \):
\[ \Omega_P = (p_w + t)q_P - C(q_P, i_P, \omega). \]

Due to generalized Nash bargaining, \( B \) and \( S \) retain the same shares of \( \Omega_P \) as they do without a trade agreement, so the investment decision is the solution of
\[ \max_{i} \alpha \Omega_P - I(i_P). \]

The optimal investment under the PTA thus satisfies
\[ i^*_P = \left( \frac{\alpha b}{2c - \alpha b^2} \right) (p_w + t - A - \omega). \] (9)

Clearly, the preferential trade agreement induces an increase in relationship-specific investments.

The resulting equilibrium level of customized inputs,
\[ q^*_P = \left( \frac{2}{\alpha b} \right) i^*_P, \] (10)
remains proportional to investment. Hence, the increases in both investment \( \Delta i \) and in customized inputs \( \Delta q \) are proportional to the size of the external tariff:
\[ \Delta i \equiv i^*_P - i^*_N = \left( \frac{\alpha b}{2c - \alpha b^2} \right) t, \]
\[ \Delta q \equiv q^*_P - q^*_N = \left( \frac{2}{2c - \alpha b^2} \right) t. \]
They each increase with the seller’s bargaining power $\alpha$ and with the responsiveness of marginal cost to investment $b$, and fall with the slope of the marginal cost curve $c$.

Part of the increase in the quantity, $\frac{t}{c}$, is due entirely to $S$‘s cost advantage from not facing the tariff. This effect takes place even if there were no additional investment. In particular, observe that even if the supplier had no bargaining power ($\alpha = 0$) and therefore did not invest, $\Delta q(\alpha = 0) = \frac{t}{c} > 0$.

Under the PTA, $S$‘s investment enhances the bargaining surplus that $B$ and $S$ share by more than it does without a trade agreement. Since $\alpha > 0$, $S$ keeps some of those gains and has an incentive to increase his investment. When investment is higher, $S$‘s entire marginal cost curve is lower. There are then more units that, from an efficiency standpoint, should be produced by $S$. Such level, $q_1^*$, satisfies $C_q(q_1^*, i_P, \omega) = p_w$. Developing this expression and using (3), we obtain

$$q_1^* = q_N^* + \left(\frac{\alpha b^2}{2c - \alpha b^2}\right) \frac{t}{c} = q_N^* + \frac{b}{c} \Delta i.$$ 

It is also easy to see from (8) that $q_P^* = q_1^* + \frac{t}{c}$.

That is, under the PTA $S$ produces $\frac{t}{c}$ more units than it should, from an efficiency standpoint.

Figure 1 highlights the effects of the PTA. Units $q \in (0, q_N)$ are sold regardless of whether there is a PTA. But due to the higher investment, there is extra bargaining surplus for each of those units, because $S$‘s marginal cost is lower. This extra surplus is shown by area $C$. Units $q \in (q_N, q_1)$ are produced by $S$ under the PTA, but not otherwise, because $S$‘s marginal cost is lower than $p_w$. They represent trade diversion-induced productivity growth. The additional surplus from those units is shown by area $D$. The $\frac{t}{c}$ units produced by $S$ under the PTA at a marginal cost higher than $p_w$ are those between $q_1$ and $q_P$. They reflect classic trade diversion. That extra production leads to the deadweight loss shown by area $E$. Furthermore, under a PTA there is also an additional investment cost (not shown in the figure), which reduces the overall welfare gain.

Interestingly, the PTA can lead to too much investment relative to the efficient level. Recall that without the agreement $i_N^* < i^e$ for any $\alpha \in [0, 1)$. Such an unambiguous ordering does not
exist under the PTA. Comparing $i_P$ with $i^e$, one finds that

$$i_P^* > i^e \iff (2c - b^2)\alpha t > 2c(1 - \alpha)(p_w - A - \omega).$$

It follows that $i_P^* > i^e$ when $\alpha$ is sufficiently close to one (in which case the hold-up problem is relatively unimportant, so the investment boost due to the PTA is mostly distortionary) and/or when $t$ is sufficiently high (in which case the PTA is very effective in encouraging investment).

Overall, this analysis highlights a "within relationship" tradeoff between classic Vinerian trade diversion and an entirely novel effect. Due to the PTA, the firms create additional surplus for all units of customized inputs that would be produced without the PTA, plus some surplus for additional units traded. This surplus—areas $C$ and $D$ in Figure 1—increases welfare, possibly by more than the extra costs due to excessive production (area $E$) and investment.

It is important to stress at this point that, while our model displays Vinerian trade diversion, *Vinerian trade creation is shut down*. Classic trade creation would be observed if the PTA led to more total units traded, but $Q^*$ is fixed by construction (for given $t$). Thus, if one consider-
erred only traditional forces, one would deem the model designed to highlight the negative welfare consequences of PTAs. However, we also uncover a novel channel through which PTAs can raise economic efficiency.

5 Welfare Effects of a PTA

Consumer welfare from the final good remains constant, because the total level of inputs purchased, \( Q^* \), does not change. But the PTA induces an increase in the sourcing of specialized inputs, coupled with changes in the cost of producing them and an increase in the cost of investment incurred by \( S \).

We split the welfare impact of the PTA (\( \Delta \Psi \)) into the two effects, relationship strengthening (\( \Delta \Psi_R \)) and sourcing diversion (\( \Delta \Psi_S \)), so that \( \Delta \Psi = \Delta \Psi_R + \Delta \Psi_S \). The relationship-strengthening effect is the additional surplus created by \( S \)'s extra investment on the production of \( q_1^* \)—i.e., the reduction in specialized input cost relative to the analogous cost from using generic inputs—net of the increased investment cost. Specifically,

\[
\Delta \Psi_R = p_w(q_1^* - q_N^*) + [C(q_N^*, i_N^*) - C(q_1^*, i_P^*)] - [I(i_P^*) - I(i_N^*)].
\]

This expression can be rewritten as

\[
\Delta \Psi_R = \frac{ab}{2c - \alpha b^2} \Delta i \left[ (1 - \alpha) b q_N^* + \left( \frac{b^2}{2c} - 1 \right) \Delta i \right].
\]

The first term inside the brackets is positive and proportional to initial output. It reflects the welfare gains from moving the supplier’s output toward the first-best level, and is smaller when the supplier has more bargaining power. The second term is negative and proportional to the external tariff.

The sourcing-diversion effect corresponds to the deadweight loss from using customized inputs that are too expensive. This is the direct result of the protection the tariff preference effectively
affords $S$ by skewing the sourcing decision away from the initial equilibrium. Explicitly,

$$
\Delta \Psi_S = C(q_1, i_P) - C(q_P, i_P) + p_w(q_P - q_1)
= -\frac{t^2}{2c}.
$$

(13)

This is (the negative of) area $E$ from Figure 1—a triangle with base $q_P - q_1 = \frac{t}{c}$ and height $t$.

Looking first at the relationship-strengthening effect, we take the partial derivative of (12) with respect to the heterogeneity parameter $\omega$, and find

$$
\frac{\partial \Delta \Psi_R}{\partial \omega} = (1 - \alpha) b \Delta i \frac{\partial q_N^*}{\partial \omega} < 0.
$$

(14)

This expression is negative because $q_N^*$ is decreasing in $\omega$. It implies that the cost saving aspect of a PTA is unambiguously more important for more productive firms (which have a lower $\omega$). The key force behind this result is that more productive firms produce more (for given investment), and therefore the beneficial effect of the extra investment due to the PTA applies to more units than it would, were the supplier less productive.\footnote{A similar result can be obtained if we look at other parameters that could index productivity in our model, such as $c$ (the slope of the marginal cost curve) or $b$ (the effectiveness of investment in lowering marginal costs).}

In terms of Figure 1, this means that areas $C$ and $D$ expand as $\omega$ falls. Observe that the size of the vertical shift of the marginal curve is independent of $\omega$, since $\Delta i$ is unaffected by $\omega$. Similarly, the horizontal shift, given by $q_1 - q_N^*$, is also independent of $\omega$. It follows that the combined area $C + D$ is affected by $\omega$ only because it is proportional to $q_N^*$. Intuitively, a more productive supplier produces a larger number of units in equilibrium, with or without the PTA. Thus, when cost-reducing investment rises with the PTA, the corresponding cost savings apply to more units when $\omega$ is relatively low.

On the other hand, the sourcing-diversion effect does not change with $\omega$. Since neither the level of productivity nor investment affects the slope of the marginal cost curve, the implied deadweight loss is a constant function of both. The implication is that the downside of an agreement remains the same, while the upside rises with the productivity of the supplier.

Lemma 1 As $S$’s productivity rises, the cost savings from a Preferential Trade Agreement unambiguously increase, but its sourcing diversion remains unchanged.
One implication of Lemma 1 is that the desirability of the inclusion of specific industries in the PTA is not all the same. We find that \( \Delta \Psi_R + \Delta \Psi_S \geq 0 \) if

\[
\omega \leq (p_w - A) - \left( \frac{2c - 2o b^2 + \alpha^2 b^2}{2\alpha(1 - \alpha)b^2} \right) t \equiv \hat{\omega}
\]

(15)

Obviously, \( \hat{\omega} \) may be negative, in which case there are no suppliers in our model such that the PTA enhances welfare.

**Proposition 1** *The PTA enhances welfare only if* \( S \) *is sufficiently productive:* \( \omega < \hat{\omega} \).

The level of the external tariff also affects the productivity threshold defined in Proposition 1. The effect is unambiguous: a higher \( t \) yields a lower \( \hat{\omega} \). In words: the more discriminatory is the PTA, the stricter is the supplier’s productivity requirement to make the agreement welfare improving. See the Appendix for the proof.

**Proposition 2** *As the external tariff rises, the threshold level of productivity \( \hat{\omega} \) unambiguously decreases, implying that more productive suppliers of customized inputs are required to ensure that the PTA will yield a net positive welfare effect.*

At \( \omega = \hat{\omega} \), the relationship-strengthening effect exactly balances the sourcing-diversion effect. At that point, an increase in \( t \) does not improve the former as much as it worsens the latter. As a result, a decrease in \( \hat{\omega} \) is required to offset that difference. The key element behind this result is that the welfare impact of the PTA increases with supplier productivity (i.e., falls with \( \omega \)). Net of investment costs, the impact of the PTA on the firms’ joint payoff becomes simply \( \Delta \Psi(\omega) + tq^*_p \), and the second part of the proposition follows.

It is interesting to observe that in our setting, when it comes to evaluate what types of producers would benefit more with the PTA, society’s and producers’ views are aligned. Specifically, just as with the two countries’ joint welfare, \( \Psi(\omega) \), a PTA increases the payoff of the producers by more, the lower is \( \omega \).

**Proposition 3** *The PTA enhances the firms’ bargaining surplus by more, the higher the productivity of the supplier (i.e., the lower is \( \omega \)). The same is true for the firms’ bargaining surplus net of investment costs.*

15
Proof. The bargaining surplus of a pair \( B-S \) changes with the PTA according to

\[
\Delta \Omega(\omega) = p_w(q_p^* - q_N^*) + tq_p^* + [C(q_N^*, i_N^*) - C(q_p^*, i_P^*)].
\]

Using (11), (13) and the definition of \( I(i) \), this expression can be rewritten as

\[
\Delta \Omega(\omega) = \Delta \Psi(\omega) + tq_P^* + \Delta i (i_P^* + i_N^*).\]

From the discussion leading to Proposition 1, we know that \( \partial \Delta \Psi(\omega)/\partial \omega < 0 \). We know from (9) and (10) that \( \partial \Delta q_p^*/\partial \omega < 0 \). And we know from (5) and from (9) that \( \partial (i_P^* + i_N^*)/\partial \omega < 0 \) as well. Hence, \( \partial \Delta \Omega(\omega)/\partial \omega < 0 \).

Proposition 1 provides a criterion for industry exclusion in PTAs. Such “exceptions” are pervasive in reality, but there is very little research on the desirability of excluding industries when forming PTAs. An important exception is Grossman and Helpman (1995), but their analysis is positive rather than normative: because of producers’ lobbying pressures, governments tend to leave out precisely the efficiency-enhancing industries, while keeping those that would amplify inefficiencies. Our normative analysis suggests the opposite. This may seem unsurprising, but observe that the key players in our analysis are the producers. Put differently, in our setting the interests of producers and of society are aligned, in the sense that Proposition 3 is analogous to Proposition 1.\(^{10}\) and they call for prioritizing industries with high underlying productivity in the agreement, contrarily to Grossman and Helpman’s conclusion. The key reason for the difference is that here a PTA has the benefit of lowering inefficiencies due to hold-up problems, not the focus of Grossman and Helpman (1995).

\(^{10}\)The alignment is not perfect because the producers do not internalize the effect of the PTA on tariff revenue. However, this additional effect only reinforces the main point of Corollary 1. The reason is that tariff revenue falls with the PTA by more, the lower \( \omega \) is. Therefore, the PTA benefit for the producers decreases even faster with \( \omega \) than the benefit for society. In fact, from the producers’ point of view, there is a strictly positive benefit with the PTA for any \( \omega \).
5.1 The Effect of the Tariff Preference

Rearranging (15), we see that the welfare effect of the PTA is positive if

\[
t \leq \left( \frac{2\alpha(1-\alpha)b^2}{2c-2\alpha b^2 + \alpha^2 b^2} \right) \left( p_w - A - \omega \right) \equiv \tau. \tag{16}
\]

But unlike higher productivity, which has unambiguously positive welfare effects (and which monotonically increases \(\tau\)), an increase in the tariff when \(t \in [0, \tau]\) may enhance or weaken the welfare impact of a PTA. Note first that \(t\) becomes the external tariff under the preferential agreement. Its size affects the relationship-strengthening and the sourcing-diversion effects differently.\(^{\text{11}}\) We have the following result.

**Proposition 4** The welfare effect of the PTA is strictly positive for \(t \in [0, \tau]\) and has an inverted-U shape with respect to the external tariff. It increases with \(t\) for \(t < \frac{\tau}{2}\), is maximized for \(t = \frac{\tau}{2}\), and falls with \(t\) for \(t > \frac{\tau}{2}\).

Sourcing diversion is a very simple function of the tariff—trade diversion monotonically increases with \(t\), and at an increasing rate. On the other hand, the relationship-strengthening effect is more nuanced. If a hold-up problems did not exist (\(\alpha = 1\)), this effect would be negative for any positive \(t\). But given a hold-up problem, the relationship-strengthening effect is positive for sufficiently low \(t\), initially rises, but eventually falls with \(t\). This can be easily seen in equation (12), where the first term inside the brackets is positive and not a function of \(t\), while the second term is negative and proportional to \(t\).

For very low \(t\), the sourcing-diversion effect is second-order small, so the first-order relationship-strengthening effect dominates even for relatively unproductive firms (i.e., \(\omega\) close to \(p_w - A\)). But because the tariff is small, \(\Delta i\) is small, so \(\Delta \Psi_R\) is small and the effects of the PTA on welfare are minor. As \(t\) increases, \(\Delta i\) increases. For low levels of \(t < \frac{\tau}{2}\), where the term in brackets in (12) is positive and big, the welfare gain from a PTA rises with \(t\). For sufficiently high \(t > \frac{\tau}{2}\), however, the increase in \(\Delta \Psi_R\) is more than offset by a fall in \(\Delta \Psi_S\), so the welfare improvement from a PTA falls with \(t\). For \(t > \frac{\tau}{2}\), we have \(\Delta \Psi < 0\).

\(^{\text{11}}\) Naturally, the tariff affects welfare also through the conventional mechanism of inefficiently lowering the total volume of traded inputs, \(Q^*\). However, under dual sourcing with and without the PTA, that effect is unchanged by the agreement.
5.2 Bargaining Power and the Intensity of the Hold-Up Problem

Obviously, the welfare effect of the PTA depends crucially upon bargaining power. The agreement may enhance overall welfare provided that it primarily serves to substitute for incomplete contracts for sufficiently productive firms. When the hold-up problem is very mild ($\alpha$ is near 1), there is no important contractual inefficiency to substitute for. In that case, a PTA distorts sourcing decisions and induces excessive relationship-specific investment. In terms of equation (12), observe that when $\alpha \to 1$, the first term inside the brackets approaches zero and the relationship-strengthening effect is negative for any tariff and any $\omega$. Thus, when $\alpha \to 1$ the tariff discrimination under the PTA only has negative welfare effects.

Conversely, when the hold-up problem approaches its most serious level ($\alpha$ is near 0), the PTA is a poor substitute for incomplete contracts because the investment response to the PTA is too weak. In that case, a PTA merely distorts sourcing decisions. This is clear from (12), since $\lim_{\alpha \to 0} \Delta i = 0$. Thus, also when $\alpha \to 0$, the tariff discrimination under the PTA only brings undesirable effects.\(^{12}\)

It is when the supplier’s bargaining power is neither too low nor too high that PTAs can be effective. In that case, there is underinvestment but investment is responsive to the tariff discrimination engendered by a PTA. Thus, if the supplier is sufficiently productive (Proposition 1) and the hold-up problem is "moderate," a PTA can enhance social welfare even in a setting where classic trade creation is absent.

Not surprisingly, there is a level of bargaining power that maximizes $\Delta \Psi$:

$$\alpha^O = \frac{(p_w - A - \omega) 2c}{(p_w - A - \omega)(4c - b^2) + t(2c - b^2)}.$$  

As $t \to 0$, the value of $\alpha$ that maximizes $\Delta \Psi$ becomes

$$\alpha^O = \frac{2c}{4c - b^2} \equiv \alpha^{Max},$$

which is always bigger than 0.5. As the tariff rises, $\alpha^O$ falls and may be below 0.5. Intuitively, a higher tariff implies a higher $\Delta i$ and a higher negative second term from (12). By dampening $\Delta i$, a lower $\alpha$ lessens the negative effect of this term.

\(^{12}\)It is easy to check that $\lim_{\alpha \to 1} \Delta \Psi(\alpha) < \lim_{\alpha \to 0} \Delta \Psi(\alpha) < 0.$
Note that the value of $\alpha$ that maximizes $\Delta \Psi$ as $t \to 0$ is also the value of $\alpha$ that maximizes $\bar{t}$, so we will call it $\alpha^{Max}$. It is easy to see that $\alpha^{Max} \in (\frac{5}{3}, 1)$ for any positive values of $b$ and $c$ such that $2c > b^2$. Hence, the welfare-optimizing external tariff is itself maximized when the supplier has more bargaining power than the buyer. We can plug this expression into (16) to identify $t^{Max}$, which permits the following summarizing proposition.

**Proposition 5** For a sufficiently high tariff level $t > \frac{2b^2}{8c-3b} (p_w - A) \equiv t^{Max}$, welfare falls with the PTA regardless of bargaining power. If $0 < t \leq \frac{2b^2}{8c-3b} (p_w - A - \omega)$, there is a minimum level of supplier bargaining power, $\alpha_{min}$, such that welfare necessarily falls with the PTA if $\alpha < \alpha_{min}$. There is also a maximum level of supplier bargaining power, $\alpha_{max} = 1 - \alpha_{min}$, such that welfare necessarily falls with the PTA if $\alpha > \alpha_{max}$. As $t \to 0$, welfare rises with the PTA for any level of bargaining power and for any $\omega \in [0, p_w - A]$.

JLT: We still do not have great intuition for the terms in (12), especially the second.

### 6 Search and Matching

Consider now the search and matching problem. Let there exist a unit mass of buyers, but let the number of buyers be small relative to the number of suppliers. Specifically, if some measure of buyers is already matched, the distribution of remaining suppliers remains unchanged for the other buyers looking to match. Let the distribution of suppliers vary according to productivity $\omega$ on $[0, \bar{\omega}]$ according to distribution $G(\omega)$.

The search framework follows a standard "no recall" setup. The buyer’s goal is to find a supplier with high enough productivity. It costs $K > 0$ to attempt a single search, which yields one match. If a buyer likes its first match, then he and the supplier specialize towards each other and pursue investment and production according to our basic model. If a buyer does not like his first match, he may pay another $K$ and search again. Indeed, he may search as many times as he likes. Because a failed search leaves the buyer with $K$ in sunk costs but otherwise right where he started, the choice to initiate an additional search does not depend on the number of previous searches.
Without a PTA, a buyer matched with a supplier with productivity $\omega$ obtains a payoff of

$$U^N_B(\omega) = [V(Q^*) - (p_w + t)Q^*] + (1 - \alpha)\Omega^N_*(\omega),$$

where $\Omega^N_*(\omega)$ is the buyer’s surplus without a PTA (as defined in equation (4)) evaluated at the equilibrium. Clearly, $\partial \Omega^N_*(\omega)/\partial \omega < 0$. On the other hand, the term in brackets is independent of $\omega$ and is unaffected by $\omega$.

Now, denote the payoff of a buyer who has found a supplier with productivity $\omega'$ by $V^N_B(\omega')$. We have that

$$V^N_B(\omega') = \max \left\{ U^N_B(\omega'), \int_0^{\tilde{\omega}} V^N_B(\omega)dG(\omega) - K \right\}. \quad (17)$$

In words, B’s payoff is the highest between what he would obtain by keeping the match, $U^N_B(\omega')$, and what he would obtain by searching again (net of search costs), $\int_0^{\tilde{\omega}} V^N_B(\omega)d\omega - K$.

The search equilibrium is characterized by a cutoff rule, where all buyers search until they match with a supplier with sufficiently high productivity $\omega \leq \tilde{\omega}_N$. The cutoff value $\tilde{\omega}_N$ is determined by the following condition:

$$U^N_B(\tilde{\omega}_N) = \int_0^{\tilde{\omega}} V^N_B(\omega)dG(\omega) - K. \quad (18)$$

Under this cutoff rule, if $\omega > \tilde{\omega}_N$, B searches again. In that case, using (18), we have that $V^N_B(\omega) = \int_0^{\tilde{\omega}} V^N_B(\omega)dG(\omega) - K = U^N_B(\tilde{\omega}_N)$. If instead $\omega \leq \tilde{\omega}_N$, B stops searching, so $V^N_B(\omega) = U^N_B(\omega)$. Substituting those expressions back into (18) and rearranging, we obtain

$$U^N_B(\tilde{\omega}_N) = \int_0^{\tilde{\omega}_N} U^N_B(\omega)dG(\omega) + [1 - G(\tilde{\omega})]U^N_B(\tilde{\omega}_N) - K.$$

The left-hand side is the buyer’s payoff conditional on matching with a supplier with productivity $\tilde{\omega}$. The right-hand side is the expected payoff of the buyer when he searches, minus the search cost. Note that with probability $1 - G(\tilde{\omega})$ the buyer’s search fails and his expected future payoff (net of sunk costs) is $U^N_B(\tilde{\omega}_N)$. Solving this, we find

$$U^N_B(\tilde{\omega}_N) = E[U^N_B(\omega| \omega < \tilde{\omega}_N)] - \frac{K}{G(\tilde{\omega}_N)}, \quad (19)$$

where the right-hand side is now the expected gross payoff of a buyer who finds a successful match.
minus the total expected future cost of searching again.

The introduction of a PTA with Foreign affects the search equilibrium. The effect will depend on whether we consider a buyer matched in Foreign or ROW. Let us start by considering a buyer who was matched in Foreign before the PTA.

6.1 The Effect of a PTA on Matches in Foreign

When a PTA is implemented between Home and Foreign, trade of specialized inputs between them no longer incur a tariff. As discussed earlier, by itself this raises the bargaining surplus between buyers and suppliers in the two countries. In turn, the prospect of greater surplus induces suppliers to increase their relationship-specific investment. For both reasons, the payoff of buyers and suppliers in any given match increases with the PTA.

Furthermore, as it follows from Proposition 3, the firms’ payoffs increase with PTA by more, the more productive is the supplier. An implication is that the buyers’ incentives to search for suppliers in Foreign change with PTA. Since search costs are unaltered but the returns to a match increase disproportionally with more productive suppliers, buyers will be more demanding in their search under the PTA. In other words, the cutoff level of $\omega$ under the PTA, $\tilde{\omega}_P$, is lower than $\tilde{\omega}_N$.

**Proposition 6** Under the PTA, the search cutoff in Foreign drops to $\tilde{\omega}_P$, $\tilde{\omega}_P < \tilde{\omega}_N$. Therefore, buyers matched with suppliers in Foreign with productivity $\omega \in (\tilde{\omega}_P, \tilde{\omega}_N]$ will dissolve their original partnerships and search again until they find a supplier with $\omega \leq \tilde{\omega}_P$.

**Proof.** In the absence of a PTA, the net gain from keeping searching when $B$ has found a supplier with productivity $\tilde{\omega}_N$ is $\int_{\tilde{\omega}_N}^{\tilde{\omega}_P} U_B^N(\omega) dG(\omega) - K - G(\tilde{\omega}_N)U_B^N(\tilde{\omega}_N)$, which equals zero by construction. With the PTA, the net gain from keeping searching in that case is instead $\int_{\tilde{\omega}_N}^{\tilde{\omega}_P} U_B^P(\omega) dG(\omega) - K - G(\tilde{\omega}_P)U_B^P(\tilde{\omega}_N)$. The threshold characterizing optimal search under the PTA, $\tilde{\omega}_P$, is lower than $\tilde{\omega}_N$ if the gain from keeping searching with a match $\tilde{\omega}_N$ increases with the agreement. This happens if

$$\int_{\tilde{\omega}_N}^{\tilde{\omega}_P} [U_B^P(\omega) - U_B^N(\omega)] dG(\omega) - \int_{\tilde{\omega}_N}^{\tilde{\omega}_P} [U_B^P(\tilde{\omega}_N) - U_B^N(\tilde{\omega}_N)] dG(\omega) > 0,$$

or equivalently, if

$$\int_{\tilde{\omega}_N}^{\tilde{\omega}_P} [\Delta \Omega(\omega) - \Delta \Omega(\tilde{\omega}_N)] dG(\omega) > 0.$$
But from Proposition 3 we know that $\partial \Delta \Omega(\omega)/\partial \omega < 0$. Thus, the term in brackets is strictly positive for all $\omega < \tilde{\omega}_N$, confirming the inequality above holds. ■

6.2 The Effect of a PTA on Matches in ROW

In the absence of a PTA, buyers from Home use the same cutoff rule when searching in Foreign and ROW. After Home forms the PTA with Foreign, however, a buyer with a match in ROW may have two types of incentives to search again. First, even if $B$ were already matched in Foreign, he would want to re-match there if his initial supplier had $\omega \in (\tilde{\omega}_P, \tilde{\omega}_N]$, as the Proposition 6 shows. Furthermore, even if $B$’s original partner in ROW had productivity $\tilde{\omega}_P$ (the level where he would stop searching if the supplier were in Foreign), $B$ would still want to re-match, in Foreign, so that he would enjoy the direct (no tariff on specialized inputs) and indirect (higher supplier investment) benefits from the PTA.

As a result, there will be a new cutoff level $\tilde{\omega}_{ROW}$, such that $\tilde{\omega}_{ROW} < \tilde{\omega}_P$, describing the search equilibrium in ROW. All buyers initially matched with less productive suppliers in ROW before the PTA will seek new partners in Foreign after the PTA, according to the cutoff level $\tilde{\omega}_P$.

Proposition 7 Under the PTA, the search cutoff in ROW drops to $\tilde{\omega}_{ROW}$, $\tilde{\omega}_{ROW} < \tilde{\omega}_P$. Buyers matched with suppliers in ROW with productivity $\omega \in (\tilde{\omega}_{ROW}, \tilde{\omega}_N]$ will dissolve their original partnerships and search again until they find a supplier with $\omega \leq \tilde{\omega}_P$ in Foreign. The cutoff $\tilde{\omega}_{ROW}$ may be below zero, in which case all buyers leave ROW to Foreign with the PTA.

Proof. We know that a buyer with a match $\tilde{\omega}_P$ in ROW does not have an incentive to search there again, since $\tilde{\omega}_P < \tilde{\omega}_N$. Now, if a buyer with match $\omega'$ wants to leave ROW to search in Foreign, then it is clear that all buyers with matches $\omega'' > \omega'$ want to do the same. It then suffices to show that a buyer with a match $\tilde{\omega}_P$ in ROW has an incentive to search in Foreign.

In ROW, a buyer with a match $\tilde{\omega}_P$ has payoff $U_B^N(\tilde{\omega}_P)$. If $B$ searches in Foreign, he obtains the expected value from searching there under the PTA, which by definition of the cutoff is equal to $U_B^P(\tilde{\omega}_P)$. But we know that $U_B^P(\tilde{\omega}_P) > U_B^N(\tilde{\omega}_P)$. Thus, a buyer with a match $\tilde{\omega}_P$ in ROW does have an incentive to search in Foreign. There will be a lower cutoff $\tilde{\omega}_{ROW}$ such that $U_B^P(\tilde{\omega}_P) = U_B^N(\tilde{\omega}_{ROW})$. For matches with suppliers with $\omega \leq \tilde{\omega}_{ROW}$, $B$ will keep his match in ROW. Nothing guarantees, however, that $\tilde{\omega}_{ROW} > 0$. ■
6.3 Parts from previous versions

- We need now the welfare analysis. The proposition below is a start, but needs adjustment in terms of notation. And then we need the rest of the welfare analysis.

The first-best level of search, on the other hand, is implied by

\[ \Psi(t, \tilde{\omega}) = E[\Psi(t, \omega | \omega < \tilde{\omega})] = \frac{K}{G(\tilde{\omega})}. \]

Note that \( \Psi \) includes the sum of supplier and buyer profit, as well as a (negative) sourcing diversion term that does not change with \( \omega \) or \( t \). The following result is then straightforward.

**Proposition 8** For the quadratic cost specification, buyer firms search for suppliers too infrequently in equilibrium, i.e., \( \tilde{\omega} > \tilde{\omega}_{FB} \).

**Proof.** We rewrite conditions for \( \tilde{\omega} \) and \( \tilde{\omega}_{FB} \) in the following way:

\[
\left\{ E[\pi_B(t, \omega | \omega < \tilde{\omega})] - \pi_B(t, \tilde{\omega}) \right\} G(\tilde{\omega}) = K
\]

\[
\left\{ E[\Psi(t, \omega | \omega < \tilde{\omega}_{FB})] - \Psi(t, \tilde{\omega}_{FB}) \right\} G(\tilde{\omega}) = K.
\]

Note that \( \Psi \) includes both \( \pi_B \) and \( \pi_S \). Note also that because the sourcing diversion effect is independent of \( \omega \), it follows immediately that

\[ E[\Psi(t, \omega | \omega < \tilde{\omega})] - \Psi(t, \tilde{\omega}) = E[\pi_B(t, \omega | \omega < \tilde{\omega})] - \pi_B(t, \tilde{\omega}) + E[\pi_S(t, \omega | \omega < \tilde{\omega})] - \pi_S(t, \tilde{\omega}) > E[\pi_B(t, \omega | \omega < \tilde{\omega})] - \pi_B(t, \tilde{\omega}) \)

for every \( \tilde{\omega} \). Then, it must be the case that

\[ \left\{ E[\Psi(t, \omega | \omega < \tilde{\omega})] - \Psi(t, \tilde{\omega}) \right\} G(\tilde{\omega}) \) exceeds \( K \) for a lower \( \tilde{\omega} \) than \( \left\{ E[\pi_B(t, \omega | \omega < \tilde{\omega})] - \pi_B(t, \tilde{\omega}) \right\} G(\tilde{\omega}) \).

Hence \( \tilde{\omega}_{FB} < \tilde{\omega} \). 

The intuition is straightforward. The buyer does not capture all of the additional surplus resulting from a higher level of productivity, so it has insufficiently strong incentives to search. Moreover, any inefficiency that results from sourcing diversion is unchanged by search, so it nets out of \( E[\Psi(t, \omega | \omega < \tilde{\omega}_{FB})] - \Psi(t, \tilde{\omega}_{FB}) \).

- This is the proposition showing that the cutoff falls with the PTA, but only indirectly by looking at the size of the preference. I think I have proved this above without needing to rely on \( t \). But I’m not 100% sure that is the best approach.
Proposition 9 If the buyer’s profit satisfies decreasing differences in $t$ and $\omega$, then the equilibrium cutoff level of productivity $\tilde{\omega}$ is decreasing in the tariff gap $t$.

Proof. The condition implied by (19) may be rearranged to yield

$$\int_0^{\tilde{\omega}} \pi_B(t,\omega)g(\omega)d\omega - \pi_B(t,\tilde{\omega})G(\tilde{\omega}) = K.$$  

This is an implicit function in $t$ and $\tilde{\omega}$. Hence, we can write

$$\frac{d\tilde{\omega}}{dt} = -\frac{\int_0^{\tilde{\omega}} \frac{d\pi_B(t,\omega)}{dt}g(\omega)d\omega - \frac{d\pi_B(t,\tilde{\omega})}{dt}G(\tilde{\omega})}{\pi_B(t,\tilde{\omega})g(\tilde{\omega})}.$$

If the profit function satisfies decreasing differences in $t$ and $\omega$, then the term in brackets (inside the integral) in the right-hand side is positive for all $\omega < \tilde{\omega}$. Because $\frac{d\pi_B(t,\tilde{\omega})}{d\tilde{\omega}} < 0$, we can conclude that the entire expression is negative. 

Intuitively, if the external tariff raises the buyer’s profit comparatively more when it is matched with a high-productivity supplier, then the buyer will search more under the PTA. Note also that the level of search does not change the sourcing diversion effect. Hence, search adds a pure welfare increase. It follows immediately that if it is optimal to execute a PTA with a fixed set of suppliers, then it is optimal when search and matching also occur.

[incomplete]

6.4 Example With Uniform Draws

Suppose that $\omega$ is distributed uniformly on $[0,1]$, and suppose further that $p_w - A > 1$, so that production is profitable for all suppliers. With no PTA, we have the following buyer payoff:

$$\pi_B(0,\tilde{\omega}) = \frac{2c(1-\alpha)}{(2c-\alpha b^2)^2} [p_w - A - \tilde{\omega}]^2.$$

For uniform draws of $\omega$, we have

$$E[u_B(0,\omega|\omega < \tilde{\omega})] = \frac{1}{\tilde{\omega}} \frac{2c(1-\alpha)}{(2c-\alpha b^2)^2} \left[ (p_w - A)^2 \tilde{\omega} - (p_w - A) \tilde{\omega}^2 + \frac{\tilde{\omega}^3}{3} \right].$$
Plugging into \( \) and solving, we then have
\[
\omega_N^2 (p_w - A) - \frac{2\omega_N^3}{3} = \frac{(2c - \alpha b^2)^2 K}{2c(1 - \alpha)}.
\]

With a PTA, the expressions change only slightly, so that the equilibrium condition is
\[
\tilde{\omega}_P^2 (p_w + t - A) - \frac{2\tilde{\omega}_P^3}{3} = \frac{(2c - \alpha b^2)^2 K}{2c(1 - \alpha)}.
\]

Since the left-hand side increases more quickly in the cutoff productivity when \( t > 0 \), the equilibrium cutoff is lower with the PTA: \( \tilde{\omega}_P < \tilde{\omega}_N \). Under the PTA, the payoff to an improved supplier match is higher. Hence, firms search more.

Now consider searching for matches in the rest of the world (\( \text{ROW} \)). Under no PTA, the payoffs are the same in \( \text{ROW} \) as in \( F \). Hence, the cutoff level of productivity is the same. So without a PTA, we should see similar levels of productivity among suppliers in \( F \) and \( \text{ROW} \).

Under a PTA, the payoffs for searching in \( F \) are higher than for searching in \( \text{ROW} \). Hence, any firm that searches will do so in \( F \). If firms are already matched in \( \text{ROW} \) and have extremely favorable matches, however, then they may prefer to keep those matches rather than search again. If they search in \( F \), then they will continue the search until they find a \( \omega \leq \tilde{\omega}_P \). Hence, the condition determining the cutoff \( \tilde{\omega}_R \) is
\[
\pi_B(\tilde{\omega}_R) = E[u_B(\omega | \omega < \tilde{\omega}_P; t > 0)] - \frac{K}{G(\tilde{\omega}_P)}.
\]

For uniform draws, this solution is defined implicitly by
\[
\frac{K}{\tilde{\omega}_P} = \frac{(2c - \alpha b^2)^2}{2c(1 - \alpha)} \left[ t(1 - \tilde{\omega}_P) + (p_w - A)(2\tilde{\omega}_R - \tilde{\omega}_P) + \frac{\tilde{\omega}_P^2}{3} - \tilde{\omega}_R^2 \right].
\]

It is clear that \( \tilde{\omega}_R \leq \tilde{\omega}_P \) for any \( t > 0 \).

### 6.5 Notes for Further Work

It is not possible to work out these cutoffs analytically. Key to the results is that \( E[u_B(\omega | \omega < \tilde{\omega})] \) increases more rapidly with the tariff than \( \pi_B(\tilde{\omega}) \).
7 Conclusion

In this paper, we offer novel insights on the welfare effects of PTAs in the context of traded customized intermediate inputs in the presence of incomplete contracts. In that context, we show that a PTA stimulates cost-reducing investments that may generate enough additional surplus to overwhelm traditional Vinerian trade diversion effects. This will tend to occur in industries where the most units are traded, because it is for such firms that investments create the most surplus. A PTA also induces firms to search more intensively for better partners, and to do so inside the PTA, rather than in non-members.

We demonstrate this possibility result for the simple case of linear demand. This specification has numerous useful characteristics. Primarily, it sharply highlights the key first-order effect of the pre-PTA level of inputs on whether a PTA is likely to enhance welfare. The model permits closed-form solutions for welfare and shows that the only positive force for welfare is proportional to the initial level of inputs. Alternative specifications—e.g., non-linear marginal costs—would introduce second-order effects that would blur this connection but not diminish the first-order importance of the initial level of inputs. This specification also restricts attention to cases where a tariff causes the same trade diversion effect for all firms that produce customized inputs. This helps to fix ideas and sacrifices little generality. This effect is the product of the size of the tariff (which is the same for all firms by construction) and the number of units that are diverted. This latter figure could differ across firms. It would differ if the marginal cost curve were non-linear, but again, differences across firms would be of second-order importance.

We impose dual sourcing to shut down classic trade creation in the analysis. This permits us to emphasize the trade-off between the costs from trade diversion and the benefits from efficiency-enhancing higher investment due to a PTA. But observe that, if the investment effect were sufficiently high, dual would become single sourcing, and the PTA would also generate Vinerian trade creation. This would tilt the trade-off toward higher net gains.

At a more general level, an increasingly important theme for policymakers and academics alike is the expansion of global value chains (GVCs). Our setting is rather simple, with a GVC containing
only two firms and with inputs crossing only one national border, whereas a typical characteristic of a GVC includes several producers and parts crossing several national borders. But as Yi (2003) points out, tariffs are typically applied on gross exports. This suggests that the mechanisms we develop are likely to be even more important for ‘true’ GVCs.

Baldwin (2011) and several others have argued that regionalism nowadays is about the rules that underpin fragmentation of production, not about preferential market access. As such, Baldwin (2011) claims that the traditional Vinerian approach is outdated and that we need “a new framework that is as simple and compelling as the old one, but relevant to 21st century regionalism” (p. 23). Here we show that preferential market access is critical for the international fragmentation of production, probably more than it has ever been for the trade of final goods. Hence, we provide a step in the direction of providing a framework that incorporates the Vinerian view into the “new regionalism.” Much more is needed, though.

Appendix

**Efficient investment levels**  Without an agreement, the efficient investment level solves

\[
\max_i p_w q_N - C(q_N, i, \omega) - I(i). \tag{20}
\]

The first-order necessary condition is

\[
p_w \frac{dq_N}{dt} - C_q(q_N, i, \omega) \frac{dq_N}{dt} - C_i(q_N, i, \omega) = I'(i).
\]

Using (2), this expression simplifies to \(-C_i(q_N, i, \omega) = I'(i^e)\), as indicated in (6).

With a PTA, the efficient investment level also solves (20), after replacing \(q_N\) with \(q_P\). The first-order necessary condition is analogous to the one above, but using (7) it simplifies to

\[-t \frac{dq_P}{dt} - C_i(q_P, i, \omega) = I'(i).
\]

This expression may appear to yield a level of investment different from \(i^e\). However, developing it
further we obtain

\[-t \frac{b}{c} + b \left( \frac{p_w + t - A - \omega + bi}{c} \right) = 2i,\]

which is satisfied exactly when \(i = i^c\).

**Proof of Proposition 2**  The productivity threshold \(\hat{\omega}\) is defined as the level of \(\omega\) that makes the PTA welfare-neutral. That is, \(\Delta \Psi(\hat{\omega}, t) \equiv 0\). Using (12) and (13), this expression can be rewritten as

\[
\Delta i \left[ (1 - \alpha) bq^*_N(\hat{\omega}) + \left( \frac{b^2}{2c} - 1 \right) \Delta i \right] - \frac{t^2}{2c} = 0,
\]

or equivalently,

\[
\left[ (1 - \alpha) bq^*_N(\hat{\omega}) + \left( \frac{b^2}{2c} - 1 \right) \Delta i \right] = \frac{t^2}{2c \Delta i}.
\]  

(21)

The effect of the tariff on \(\hat{\omega}\) is given by

\[
\frac{d \hat{\omega}}{dt} = -\frac{\partial \Delta \Psi(\hat{\omega}, t) / \partial t}{\partial \Delta \Psi(\hat{\omega}, t) / \partial \omega}.
\]

We know from (14) that the denominator of this expression is strictly negative. It follows that \(\text{sgn}(d \hat{\omega}/dt) = \text{sgn}(\partial \Delta \Psi(\hat{\omega}, t) / \partial t)\).

To determine \(\text{sgn}(\partial \Delta \Psi(\hat{\omega}, t) / \partial t)\), use (21) and recall that \(dq^*_N / dt = 0\) to obtain

\[
\frac{\partial \Delta \Psi(\hat{\omega}, t)}{\partial t} = \frac{\partial \Delta i}{\partial t} \left[ \frac{t^2}{2c \Delta i} - \Delta i \left( \frac{2c - b^2}{2c} \right) \right] - \frac{t}{c}.
\]

Now notice that, as \(\Delta i\) is a linear function of \(t\), \(\frac{\partial \Delta i}{\partial t} = 1\). Thus,

\[
\frac{\partial \Delta \Psi(\hat{\omega}, t)}{\partial t} = -\frac{t}{2c} - \Delta i \left( \frac{2c - b^2}{2c} \right) \frac{\partial \Delta i}{\partial t} < 0.
\]

**References**


Freund, Caroline and Emanuel Ornelas (2010). "Regional Trade Agreements." Annual Review of Economics 2, 139-166.


