Optimal Tariffs, Tariff Jumping, and Heterogeneous Firms∗

Matthew T. Cole†

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Abstract
The majority of research to date investigating optimal tariffs in the presence of multinationals finds a knife-edge result where, in equilibrium, all foreign firms are either multinationals or exporters. By utilizing a model of heterogeneous firms, I am able to dull the knife edge, resulting in equilibria in which both pure exporters and multinationals coexist. I utilize this model to study the case of endogenously chosen tariffs (which, in some cases results in a subsidy). I find that, if multinationals are present in equilibrium, the optimal tariff is lower than in the case where multinationals are excluded as a choice of firm structure. Moreover, I show that the socially optimal tariff is a subsidy, contrary to the standard optimum of free trade. This results in no multinationals in the socially efficient outcome. Finally, I find the typical result that tariff competition results in inefficiently high tariffs (or inefficiently low subsidies).

1 Introduction
The optimal tariff literature stems as far back as Bickerdike (1906), which links a country’s ability to increase welfare through a tariff to the elasticity of the foreign export supply. With the rise of foreign direct investment (FDI), recent literature has begun to examine the interaction between FDI and tariffs. One such interaction is through what has been coined “tariff-jumping”, which refers to a foreign firm investing (either through greenfield

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†Department of Economics, 520 PLC Building, 1285 University of Oregon, Eugene, OR 97403. Fax: +1(541)346-1243. Email: mcole@uoregon.edu.
FDI or firm acquisition) in the host country to avoid protectionist barriers. There are two primary hypotheses for the motivation behind tariff-jumping; one anticipatory and the other reactional. The former is where a firm uses FDI as a *quid pro quo* for a lower future threat of protection and was formally introduced by Bhagwati (1987)\(^1\). The latter, and what will be focused on here, is where a firm finds it more profitable to operate a foreign subsidiary in a host country in response to erected trade barriers by the importing country. In this paper I offer the first model of endogenously chosen tariffs where heterogeneous firms can choose between exporting and FDI as a foreign market entry mode using a simple formulation of the Helpman, Melitz, and Yeaple (2004) model.

Ellingsen and Wärneryd (1999) (EW) are the first to analyze the preferred level of protection in the presence of (or threat of) tariff-jumping. They find that domestic firms would prefer a tariff just high enough to keep multinationals out of a host country. On the one hand, this result is useful in that it illustrates how domestic firms, contrary to intuition, do *not* want full protection. On the other hand, it provides a knife-edge result in which there is no FDI in equilibrium; i.e. there is no occurrence of tariff-jumping\(^2\). This does not coincide with what is seen in the real world, where in many industries, there are both multinational and exporting firms (see Halland and Wooton (1998), Blonigen and Ohno (1998), and Blonigen (2002)). This knife-edge result is a side-effect of assuming firms are homogeneous – an assumption absent from my model\(^3\).

\(^1\) Blonigen and Feenstra (1997) find that the threat of protection had a substantial positive effect on greenfield FDI in the U.S. in the 1980s, but the protection variable used is a dummy variable taking on only values of zero and one. Similarly, Blonigen and Figlio (1998) investigate the effect of FDI on U.S. legislators’ votes on protectionist policies between 1985 and 1994 and finds that *quid pro quo* FDI has an effect, but not in a systematic way. For instance, legislators who were initially more protectionist in nature tended to increase trade restrictions, where legislators who took more of free trade stance were inclined to lower trade restrictions.

\(^2\) EW does characterize an equilibrium with FDI under uncertainty.

\(^3\) Another departure from EW is the social welfare function I use. EW cite the literature on the political economy of protection, such as Hillman (1989) and Rodrik (1995), and utilize a welfare function that reflects the preferences of small, but strong, interest groups – hence they maximize domestic profits. Blonigen, Tomlin, and Wilson (2004) empirically investigate the effect of U.S. antidumping decisions on domestic firm profits and find that when tariff-jumping FDI occurs, the profit gains from the trade barrier are at least partially mitigated. Though domestic firm profits are an important welfare consideration (particularly in a political economy framework), I take a more classical approach and maximize the indirect utility of a representative consumer.
An alternative approach to that of EW is taken by Blanchard (2006, 2007) which assumes exogenous levels of FDI, eliminating the knife-edge. However, Blanchard (2006, 2007) eliminates the endogenous choice of FDI and, thus, the tariff-jumping consideration is absent. The cost of this assumption is not minor, as it ignores a major focus of the recent trade literature, a focus often continued with the work on heterogeneous firms. In contrast, my modeling of firm heterogeneity dulls the knife-edge result of EW, while still allowing for endogenous firm entry.

Since Melitz (2003) and Jean (2002), a great deal of attention has been given to introducing firms that differ in terms of productivity into trade models. Typically in these models, trade restrictions are exogenously given symmetric ice-berg transport costs and little is done with regards to optimal trade policy. To my knowledge, no one has studied optimal tariffs in the presence of both heterogeneous firms and the endogenous choice to become a multinational. While Helpman, Melitz and Yeaple (2004) provide a model with heterogeneous firms and the option to become multinationals, their focus is not on optimal trade policy. Instead they focus on industry composition and productivity as a result of symmetric trade restrictions (modeled by iceberg transport costs). Jørgensen and Schröder (2006) investigate the welfare effects of a tariff in a Melitz (2003) type model. However in their model, tariffs are symmetric and exogenous. Though their model describes some interesting welfare effects, it does not characterize the unilateral strategy of a particular country. Demidova and Rodríguez-Clare (2007) similarly analyze trade policy in a Melitz-type model and show the first best outcome can be achieved through either a consumption subsidy, export tax, or an import tariff. Nevertheless, they do so in a small economy which alleviates the need for symmetric tariff setting. Further, neither Jørgensen and Schröder (2006) nor Demidova and Rodríguez-Clare (2007) allow for the possibility of FDI.

It is interesting that there is such limited theoretical work on optimal trade policy in

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4 Technically, FDI in Blanchard (2006) is modeled as passive claims on foreign output and not majority ownership of a firm. However, given the perfect competition assumption of her model, the two definitions can be interpreted identically.
which both exporters and multinationals are present in equilibrium, given the empirical evidence of its existence. Exceptions to this include Blonigen and Ohno (1998), who provide a partial equilibrium Cournot model where firms have differing (expected) costs of FDI. In this model, foreign firms who establish a significant production presence try to increase trade barriers in the home country. The authors provide case studies of U.S. antidumping cases in tapered roller bearings and color picture tubes and the escape clause investigation of Japanese autos for empirical evidence. Nevertheless, filling this gap in the theory is critical as it lays the necessary foundation for studying noncooperative trade policy, the formulation of trade agreements, and the many impacts of international trade policy.

This paper contributes to the literature in several ways. First, I find that under certain parameters, a country’s noncooperative Nash tariff is a subsidy. This result is not driven by the option for firms to tariff-jump since, under this parameterization, there will be no multinationals in equilibrium and the threat of tariff-jumping is not binding. When varieties are less substitutable, there is a high price markup resulting in many firms selling a small amount of output. In this case, it is more beneficial to induce foreign firms to produce more than to protect the domestic sector. Second, I solve for the Nash tariff in the presence of multinationals. I provide a model where both multinationals and exporters are present in equilibrium which is an important step in bringing the theory closer to empirical results. Furthermore, I show that tariff-jumping lowers the Nash tariff, providing an important implication for strategic trade policy and trade negotiations. Finally, I solve for the social planner’s optimal tariff and show that it is a subsidy and not free trade; in this model, the presence of multinationals is not optimal.

The paper proceeds as follows. Section 2 develops the model and characterizes the equilibrium. Section 3 characterizes the noncooperative Nash tariff set by a country both with and without multinationals and compares the two. Section 4 solves the social planner’s problem and compares it to the Nash Equilibrium. Section 5 concludes.
2 The Model

There are two countries labeled $k$ and $j$. Each country is endowed with $\bar{L}$ units of labor which is the sole factor of production. Without loss of generality, let $\bar{L}_k \geq \bar{L}_j$. There are two sectors. Sector 1 is the numeraire and consists of a homogeneous good ($y$) that is produced under constant returns to scale, is freely traded, and is sold in a perfectly competitive market. Sector 2 consists of a continuum of heterogeneous goods, each variety of which is indexed by $i$. As is standard in the Melitz model, this is produced under increasing returns to scale in a monopolistically competitive market with free entry. Unlike sector 1, this market may face tariff barriers. With the exception of the differing labor endowments and (potentially) tariff rates, countries are identical. Therefore, analyzing the situation for country $k$ informs us of the analogous situation for country $j$, and I will define country $k$ to be the domestic country, without loss of generality, to ease discussion.

The timing of the model is as follows. In period 1, tariffs are simultaneously set; in period 2, firms choose whether or not to enter and which market to serve (if the firm chooses to enter); and in period 3, production takes place, trading commences, and payoffs are realized. The equilibrium characterized will be subgame perfect.

2.1 Sector 1

The price of $y$ is normalized to 1 in each market. Assuming that one unit of labor is needed for production, this will normalize the wage in each country to unity. Finally, I assume that in equilibrium a positive amount of $y$ is produced in each country.

2.2 Consumers

The representative consumer in country $k$ has quasi-linear preferences embedded with a Dixit-Stiglitz utility function which displays love for variety over the heterogeneous good;
\[ U_k = \mu \ln(C_{xk}) + C_{yk}, \quad C_{xk} = \left( \int_0^{N_k} x_k(i) \alpha \, di \right)^{\frac{1}{\alpha}}, \quad \mu > 0 \]  

where \( \varepsilon = 1/(1 - \alpha) > 1 \) is the elasticity of substitution, \( N_k \) is the total mass of varieties in country \( k \), and \( C_{yk} \) denotes aggregate consumption of the numeraire. Note that although it is tempting to interpret \( C_{xk} \) as aggregate consumption of the heterogeneous good, it is not due to the exponents. Consumers maximize utility subject to their budget constraint:

\[ \int_0^{N_k} p_k(i) x_k(i) \, di + C_{yk} \leq I_k \]

where \( p_k(i) \) is the price of variety \( i \) and \( I_k \) is aggregate income in country \( k \). I assume that income in each country is sufficiently large that both goods are consumed. The solution to this problem yields a demand function for the heterogeneous good of variety \( i \) in country \( k \):

\[ x_k(i) = \frac{p_k(i)\varepsilon \mu}{\int_0^{N_k} p_k(i)^{1-\varepsilon} \, di}. \]

Since preferences are identical across both countries, it follows that the total expenditure on the heterogeneous good is equal to \( \mu \) in both foreign and domestic markets.

### 2.3 Heterogeneous Firms

There is a continuum of entrepreneurs. At time zero, every entrepreneur is given a unique draw that indexes its variety and productivity type. Once the entrepreneur is aware of her type, she decides two things; whether to create a firm and where to sell. If a firm is created, it must incur a fixed cost measured in units of labor. This cost is referred to as a ‘beachhead’ cost and can be interpreted as forming a distribution and servicing network.\(^5\)

The fixed cost is indexed by \( i \), and will be dependent on the market(s) being served by the firm. The indexing of this cost function illustrates that the magnitude of a firm’s fixed costs

\(^5\)The term ‘beachhead’ costs was coined by Baldwin (1988).
is dependent on an entrepreneur’s endowed ability. Subsequent production exhibits constant returns to scale with labor as the only factor of production. The unit-labor requirement for a firm is normalized to one.

There are two available markets for a potential firm, each with a corresponding fixed cost. A firm can choose to serve only the domestic market and pay \( f(i) \) or it can choose to additionally serve the foreign market. If a firm chooses to serve the foreign market, it can do so through exports and pay an extra \( \gamma f(i) \) or become a multinational and pay an extra \( \Gamma f(i) \). I assume that \( \Gamma > \gamma > 1; f'(i) > 0 \) and \( f''(i) \geq 0 \) denote the first and second derivatives respectively. Thus, entrepreneurs with higher ability correspond to a lower index \( i \). These fixed cost differences are the source of firm heterogeneity. For illustrative purposes, I will periodically assume the fixed cost mapping takes the form \( f(i) = \eta i + \lambda \), but will remain general throughout the majority of the text. A firm, therefore, faces the following menu of fixed costs (measured in units of labor).

<table>
<thead>
<tr>
<th>Firm Type</th>
<th>Fixed Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>domestic only</td>
<td>( f(i) )</td>
</tr>
<tr>
<td>domestic and exporter</td>
<td>( (1 + \gamma)f(i) )</td>
</tr>
<tr>
<td>domestic and multinational</td>
<td>( (1 + \Gamma)f(i) )</td>
</tr>
</tbody>
</table>

Goods that are exported from country \( k \) to country \( j \) are subject to an ad valorem tariff \( \tau_j \), where I define \( t_j \equiv 1 + \tau_j \). I assume that a government is unable to distinguish a particular firm’s type, so any tariff is an across-the-board tariff applied to all foreign exporters. Intuitively, this is akin to a country charging the same tariff on all imported automobiles and not different tariffs on specific makes and models.

The decision to become a firm and which market to service depends on the associated profit for each type. Recall that the numeraire yields wages equal to one in both countries,

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6 Constant expenditure in each country (equal to \( \mu \)), along with identical technologies and entrepreneurs implies that the condition \( \Gamma > \gamma > 1 \) is sufficient to insure a firm that serves the foreign market (either through exports or FDI) will also serve the domestic market.
thus the operating profits from serving the domestic market are

\[ \pi^k_D(i) = p_k(i)q_k(i) - q_k(i) - f(i), \] (4)

Given the nature of monopolistic competition, the price will be a constant mark-up over marginal cost and be equal to \( \frac{1}{\alpha} \). From market clearing, set \( q_k(i) = x_k(i) \), and the firm has the following profit function for supplying to the domestic market only:

\[ \pi^k_D(i) = B_k - f(i) \] (5)

where

\[ B_k = \left( \frac{1}{\varepsilon \alpha^{1-\varepsilon}} \right) \frac{\mu}{\bar{P}^{1-\varepsilon}} \]

and

\[ \bar{P} = \bar{P}^{1-\varepsilon} = \left( \int_0^{N_k} p_k(i)^{1-\varepsilon} di \right)^{\frac{1}{1-\varepsilon}} \]

is the aggregate price index of the heterogeneous good. Recall that \( N_k \) is the total mass of all varieties in country \( k \), domestic and foreign; with the latter including imported varieties and locally produced varieties through FDI. Thus, the decision for foreign firms to enter the market (either through exports or FDI) affects the aggregate price index which, in turn, affects a domestic firm’s variable profit (represented by \( B_k \)). This price index effect can be more readily seen by fully writing out \( P_k \):

\[ P_k = \int_0^{N_k} p_k(i)^{1-\varepsilon} di = \int_0^{i_{kD}} p_k(i)^{1-\varepsilon} di + \int_{i_{kD}}^{i_{jM}} p^j_k(i)^{1-\varepsilon} di + \int_{i_{jM}}^{i_{jX}} [t_k p_k^j(i)]^{1-\varepsilon} di \]

\[ = \left[ \frac{1}{\alpha^{1-\varepsilon}} \right] [i_{kD} + i_{jM} + t_k^{1-\varepsilon} (i_{jX} - i_{jM})] \]

where \( i_{kD}, \ i_{jM}, \) and \( i_{jX} \) are the mass of domestic firms, foreign multinationals, and foreign exporters respectively. These terms will be discussed in greater detail in the following section.

The decision to serve the foreign market has two options; through exports or FDI. The
additional profit from becoming an exporter or multinational, respectively are:

\[ \pi^k_X(i) = \frac{B_j}{t_j^i} - \gamma f(i) \]  \hspace{1cm} (6)
\[ \pi^k_M(i) = B_j - \Gamma f(i). \]  \hspace{1cm} (7)

Note that the variable profit of a multinational is identical to that of a domestic firm in country \( j \). The variable profit of an exporter is lower (as long as there exists a positive tariff), but the fixed cost is also lower. The difference in variable profits between the two types of firms is the driving force behind the decision to become a multinational. As the tariff rate increases, the variable profit of an exporter decreases while the differences in fixed cost remain the same. When the tariff rate is sufficiently high, the gain from higher variable profit is greater than the higher fixed cost of becoming a multinational, and a firm chooses FDI over exporting. This is then, an example of the well known proximity-concentration tradeoff where multinationals decide between proximity to customers and concentrating production to achieve scale economies, evidence of which is shown by Brainard (1997) among others.\(^7\)

### 2.4 Equilibrium for given tariffs

Firms will enter each market as long as the associated profits are greater than the opportunity cost, that is, as long as the expressions in (5) and (6) are greater than zero. Furthermore, a firm will choose to be a multinational as long as the profit in equation (7) is greater than that in equation (6). I define the cutoff firms as the firms that draw the index, \( i \), that solves

\(^7\)It is worth noting that the model in Brainard suffers from precisely the knife-edge problem that my approach resolves.
the following conditions:

\[ B_h = f(i_{hD}) \]  
(8)

\[ \frac{B_h}{t^\varepsilon\gamma} = f(i_{gX}) \]  
(9)

\[ \left( \frac{t^\varepsilon_h - 1}{(\Gamma - \gamma)t^\varepsilon_h} \right) B_h \leq f(i_{gM}) (= \text{if } i_{gM} > 0) \]  
(10)

for \( h = j, k \) and \( g \neq h \). The index \( i_{hD} \) represents the firm that is indifferent between producing the heterogeneous good and not producing at all (i.e. the least efficient domestic producer). The least efficient exporting firm is denoted by \( i_{gX} \), and \( i_{gM} \) is the firm that is indifferent between serving the foreign market through exports or FDI. Figure 1 illustrates an example of this by plotting the firm’s profit as a function of its index.

![Figure 1: Firm profit as a function of the index \( i \)](image)

It can be seen intuitively from the equilibrium conditions, that as trade restrictions increase, less efficient exporting firms drop out of the foreign market and lower efficient

\[ B_h = \frac{\mu}{\varepsilon \left[ i_{hD} + i_{gM} + t^\varepsilon_h \left( i_{gX} - i_{gM} \right) \right]} \]
domestic firms enter the domestic market. Moreover, if the trade restriction is sufficiently high, the most efficient exporters will switch over to become multinationals. These results are qualitatively identical to those of other similar models in the heterogeneous firm literature, such as Melitz (2003) and Helpman, Melitz, and Yeaple (2004). Where this paper differs and makes its main contribution is by characterizing a country’s noncooperative Nash tariff. This is the goal of the next section.

There is nothing in this model that ensures there will always be a positive mass of multinationals. The presence of multinationals depends on both the tariff level and the fixed cost mapping. Recall from the illustrative example, \( f(i) = \eta i + \lambda \), that the most efficient firm would have a fixed cost \( f(0) = \lambda \). It follows, then, that there will be no multinationals in equilibrium if

\[
\left( \frac{\epsilon_{ih} - 1}{(\Gamma - \gamma)\epsilon_{ih}} \right) B_h < \lambda.
\]  (11)

In Figure 2, I denote by \( FF \) the line comprising the ordered pairs, \((\lambda, \tau_k)\), in which the most efficient exporting firm is indifferent between becoming a multinational and staying an exporter (or when condition (11) is an equality).

3 Nash Tariff

In this section, I derive a country’s noncooperative Nash tariff. The indirect utility of the representative consumer is

\[
V_k = \mu \ln (C_{xk}) + I_k - \mu.
\]  (12)

Income is equal to labor income plus profits from domestically owned firms and tariff revenue.\(^{10}\)

\[
I_k = L_k + \int_{i_{k,M}}^{i_{k,X}} \pi^k_X(i)di + \int_{0}^{i_{k,M}} \pi^k_M(i)di + \int_{0}^{i_{k,D}} \pi^k_D(i)di + \frac{\tau_k}{\alpha}C_X.
\]

\(^9\)This is shown in more detail in Cole (2008).

\(^{10}\)Note that profits for multinationals can equal zero, thus maintaining generality.
Figure 2: Minimum Tariff Needed to Induce FDI

The term $C_X$ represents aggregate consumption of the imported heterogeneous good in the domestic country (country $k$).

When country $k$ charges a tariff, there are two standard income effects. The first is an increase in tariff revenue, the second is increased domestic profit from reduced competition. However, there is no terms of trade benefit. This is for two reasons. First, since higher tariff prices are a fixed markup over a constant wage, pre-tariff import prices do not change. Second, quasi-linear utility pushes domestic and overseas income changes onto the numeraire. This leaves consumption of the heterogeneous good, and thus profits from domestically owned exporters or multinationals, unaffected. Note that this means any tariff set by country $j$ will not affect the tariff setting decision of country $k$, resulting in dominant strategies.

Differentiating the indirect utility function (12), the first order condition can be written as:

$$\frac{\partial V_k}{\partial \tau_k} = \frac{\mu}{C_{xk}} \frac{\partial C_{xk}}{\partial \tau_k} + \frac{1}{\epsilon \alpha} \frac{\partial C_D}{\partial \tau_k} - B_k \frac{\partial i_{kD}}{\partial \tau_k} + \frac{C_X}{\alpha} + \frac{\tau_k}{\alpha} \frac{\partial C_X}{\partial \tau_k} = 0 \quad (13)$$

where $C_D$ is aggregate demand of the domestically produced (by a domestic firm) heteroge-
The first underbrace represents the effect of a tariff on consumers by affecting the total amount of the heterogeneous good they consume. The latter two underbraces represent income changes. More specifically, the second underbrace is the effect of a tariff on the profits of domestic firms producing the heterogeneous good. Finally, the third underbrace is the effect of a tariff on government tariff revenue. The first order condition (13) simplifies to

$$\frac{\partial V_k}{\partial \tau_k} = \mu - C_D \left( \frac{\partial P_k}{\partial \tau_k} \right) + C_X + \tau_k \frac{\partial C_X^k}{\partial \tau_k} = 0.$$  (14)

Therefore country k’s Nash tariff solves the following

$$\tau_k^* = \left[ \frac{\partial C_X}{\partial \tau_k} \right]^{-1} \left[ \frac{C_D + \mu}{\varepsilon P_k} \left( \frac{\partial P_k}{\partial \tau_k} \right) - C_X \right].$$  (15)

The first thing to notice here is that the optimal tariff is not unambiguously positive. This is an interesting result and needs some attention. First, recall that for sufficiently low tariff levels, there will be no firms choosing to become multinationals. Thus, for the moment, consider the case without FDI; evaluating (14) at $\tau_k = 0$ yields the following:

$$\left. \frac{\partial V_k}{\partial \tau_k} \right|_{\tau_k=0} = \frac{\mu}{\varepsilon N_k} \left[ (1 - \alpha) i_{kD} + i_{jX} \left( \frac{\partial N_k}{\partial \tau_k} \right) \right] + \frac{\mu i_{kD} i_{jX}}{P_k^2}. \quad (?) \quad (+)$$

If $\frac{\partial N_k}{\partial \tau_k} > 0$ (or there is a pro-variety effect), the Nash tariff is positive. However, if there is an anti-variety effect associated with a tariff, the sign of the Nash tariff will depend on the magnitude of this variety effect. As shown in Cole (2008), the effect of a tariff on the total mass of varieties is ambiguous and depends on the elasticity of the fixed cost mapping with

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11 Note that $f(i_{kD}) = B_k$ comes from the equilibrium condition [8].
12 See Appendix A for derivation.
13 Note that $P_k$ is not the aggregate price index, which is $P_k = P_k^{\pi_{2,k}}$.
14 This ambiguity stems from the fact that $\frac{C_X^k}{\varepsilon P_k} \left( \frac{\partial P_k}{\partial \tau_k} \right) > 0$. 


respect to the index, which I define as

\[
\delta(z) = \frac{z}{f(z)f'(z)}.
\]

The effect of \(\delta(z)\) on the sign of the optimal tariff can be better seen by rewriting (15).\(^{\text{15}}\)

\[
\tau_k^* = \left[ \frac{\partial C_X}{\partial \tau_k} \right]^{-1} \left[ \frac{C_X}{\alpha} \right] \left[ \frac{\delta(i_{kD})\mu - \alpha i_{kD} f(i_{kD}) \delta(i_{jX}) [1 + \alpha \delta(i_{kD})]}{f(i_{kD}) \{[\delta(i_{kD}) + 1] i_{kD} \delta(i_{jX}) + [\delta(i_{jX}) + 1] i_k^{-\varepsilon} i_{jX} \delta(i_{kD})\}} \right].
\]

Note that the derivative of aggregate consumption of the imported good is negative and \(\frac{C_X}{\alpha} > 0\). Therefore, the optimal tariff will be positive if and only if the numerator of the underbraced term is negative, or

\[
\delta(i_{kD}) \mu < \varepsilon C_D \delta(i_{jX}) [1 + \alpha \delta(i_{kD})]. \tag{16}
\]

The fact that there exist parameter values in which a nonnegative tariff reduces unilateral welfare is an interesting and new result. Helpman and Krugman (1989) describe a similar model with monopolistic competition and quasi-linear utility and finds a small across-the-board tariff increases welfare\(^{\text{16}}\). In addition, Broda, Limão, and Weinstein (2006) use a similar model and find that this small across-the-board tariff equals the standard inverse of export supply elasticity\(^{\text{17}}\). However, both of these models assume homogeneous firms, therefore the entry decision of firms does not play a crucial role in their analysis. Demidova and Rodríguez-Clare (2007) provide a model with firm-level heterogeneity and find a positive tariff is optimal. Their model differs from what is presented here in that the authors assume a small economy and have a Dixit-Stiglitz type utility function. Since there is no freely traded numeraire in their model, wages are allowed to vary and consequently rise with an increase in the tariff.

\(^{\text{15}}\)See Appendix B for derivation.

\(^{\text{16}}\)This model is a specific example of a more general model described in Flam and Helpman (1987).

\(^{\text{17}}\)Their model is an adaptation of Broda and Weinstein (2008).
For qualitative results, I turn to the illustrative example. It is apparent from (16), that the two main terms of interest here are the elasticity of substitution and $\delta(z)$ (the elasticity of the fixed cost mapping with respect to the index). In Figure 3, I graph a country’s optimal tariff as a function of the elasticity of substitution, $\varepsilon$. It can be seen that for low values of $\varepsilon$, the optimal tariff is a subsidy. As the elasticity of substitution increases, the optimal tariff increases as well up to a point and then decreases but stays positive. When the $\varepsilon$ is small, the firm’s price markup is higher and, ceteris paribus, there are more firms in equilibrium. Though there are more firms in equilibrium, each firm is producing and selling a small amount of output. Thus, firms are producing too little.

When varieties become more substitutable, or as $\varepsilon$ becomes very large, any positive tariff will drive out a large amount of exporters from the market. This will result in very little tariff revenue. Moreover, the benefit to domestic producers is very small as well since for large elasticities of substitution, there is a very small markup over marginal cost. This will result in a low mass of firms in equilibrium, but high output per firm. In the limit, as $\varepsilon \to \infty$, there is no markup and no firm profits (as varieties are perfect substitutes). In this case,
sector 2 will no longer be monopolistically competitive and a different model would need to be employed.

The second term of interest is $\delta(z)$, which is directly affected by the parameter $\lambda$ in my illustrative example; as $\lambda$ increases $\delta(z)$ decreases, or $f(i)$ become less elastic. Figure 4 shows this relationship with the optimal tariff; that is as $\lambda$ increases, $\tau_k^*$ decreases. This is for two reasons, the first being from the increased fixed cost to enter a market $f(i)$. Consequently, the second reason is from the equilibrium firm cutoffs additionally being lower. Moreover, since an exporter has to pay a higher fixed cost (by a multiple of $\gamma$), this increase in $\lambda$ will affect the mass of exporters to a greater extent than domestic producers. This is more apparent by appealing to the equilibrium conditions (8) and (9),

$$f(i_{kD}) = t_k^* \gamma f(i_{jX}).$$

Differentiating (17) with respect to $\lambda$ yields:

$$\eta \frac{\partial i_{kD}}{\partial \lambda} + 1 = t_k^* \gamma \left[ \eta \frac{\partial i_{jX}}{\partial \lambda} + 1 \right].$$

Therefore, when a country increases its tariff, the anti-variety effect will be greater in the presence of a higher $\lambda$. A greater anti-variety effect, on the margin, is associated with lower tariff revenue and gains to domestic surplus, and a greater loss to consumer welfare.

### 3.1 Analyzing the Nash Tariff with FDI

It was just shown that for certain parameter values, a country’s Nash tariff is a subsidy. In this case, there are no multinationals in equilibrium. So the question remains; how does allowing for firms to tariff-jump affect this Nash tariff? For this section I assume parameters are such that there exists a positive mass of multinationals in equilibrium. Recall the Nash

\[18\] Note that the vertical axis begins at 0.066 and not zero; this is for graphical clarity.
Figure 4: Optimal Tariff as a function of $\lambda$ (with $\varepsilon = 3.33$)

tariff is one that solves the following:

$$
\tau_k^* = \left[ \frac{\partial C_X}{\partial \tau_k} \right]^{-1} \left[ \frac{C_D - \mu}{\varepsilon P_k} \left( \frac{\partial P_k}{\partial \tau_k} \right) - C_X \right] > 0
$$

(19)

where

$$
\mu = \frac{1}{\alpha} \left[ C_D + C_M + t_k C_X \right],
$$

$$
\frac{\partial P_k}{\partial \tau_k} = \left[ \frac{1}{\alpha^{1-\varepsilon}} \right] \left[ \frac{\partial i_{kD}}{\partial \tau_k} + (1 - t_k^{1-\varepsilon}) \frac{\partial i_{jM}}{\partial \tau_k} - \alpha \varepsilon t_k^{\varepsilon} (i_{jX} - i_{jM}) + t_k^{1-\varepsilon} \frac{\partial i_{jX}}{\partial \tau_k} \right]
$$

and the strictly positive tariff is required for assuring the existence of FDI in equilibrium. The term $C_M$ refers to aggregate domestic consumption of varieties produced by foreign owned multinationals.

Comparing (15) and (19), it is seen that the Nash tariff takes the same general form regardless of the existence of tariff-jumping firms. However, the individual terms react
differently in the presence of multinationals. In this model, a country gains from a tariff in two ways: (1) tariff revenue (spent on the numeraire) and (2) increased domestic profits. However, in the presence of multinationals both of these gains are dampened. In response to a tariff increase, the least efficient foreign exporters drop out of the market and the most efficient exporters are becoming multinationals. Both actions lower tariff revenue. The latter also lowers the gains to domestic profits from protection. The reason the effect of FDI on the optimal tariff is not straightforward is because at the same time, consumer welfare is not lowered to the extent it would be in the case without multinationals. When a firm tariff-jumps and becomes multinational the variety associated with that firm now carries the same price as a domestic firm resulting in an positive effect on the consumer’s utility. Thus, from the demand side of the market, tariff jumping is beneficial. To get additional insight, I again appeal to my illustrative example. Figure 5 illustrates a country’s optimal tariff for both cases as a function of the elasticity of substitution, $\varepsilon$.

![Figure 5: Optimal Tariff as a function of the elasticity of substitution](image)

Just as in the case without multinationals present, the level of the Nash tariff depends
on the substitutability of varieties. However, what is important to note is that allowing for tariff-jumping lowers the Nash tariff. Blanchard (2006, 2007) have similar findings, however the mode of FDI in these models differ from that presented here. In Blanchard (2007), domestic firms invest in the host country for purposes of exporting back to the home country, which is a story of vertical FDI. I, however, consider horizontal FDI, which according to the evidence of Blonigen, Davies, and Head (2003) and Markusen and Maskus (2002) is the dominant form of FDI. Blanchard (2006) assumes exogenous foreign equity holdings in both the export and import sector. This supply side integration lowers the Nash tariff because a tariff now decreases the return to domestic owners of equity in the foreign export sector. Moreover, there are less gains to domestic producers since a portion is now owned by the foreign country. This latter effect is present in my model, but to a larger extent given that firms are allowed to tariff-jump.

Next, observe the effect the parameter $\lambda$ has on the optimal tariff in the presence of multinationals as shown in Figure 6. Interestingly, a higher fixed cost to enter a market raises the optimal tariff. This should not be surprising by observing the $FF$ line described by Figure 2 (which I have included in this figure as well). Allowing for firms to tariff-jump and become multinationals creates a margin that lowers the gains to a tariff (through revenue and domestic firm profits). If there are less multinationals, the effect is dampened. However, despite the opposite effects, the Nash tariff is still lower when tariff-jumping is allowed. This graph should be interpreted in the following manner; The Nash tariff follows the line with FDI until it intersects the $FF$ line, then following that until it intersects with the line without FDI (following the thickened line). Notice that when the Nash tariff is following the $FF$ line, I have the knife-edge result found by EW; i.e. the optimal tariff is one that is just low enough to not induce tariff-jumping.
4 Social Planner’s Problem

I have shown that the Nash tariff is ambiguous and a positive Nash tariff can be lower in the presence of multinationals than without. In this section, I solve for the Pareto superior tariff and show that allowing for tariff-jumping brings noncooperative tariffs closer to the socially efficient outcome. Noting symmetry, it is sufficient to solve for the socially efficient tariff of one country. I assume equal weight is put on the welfare of each country. The first order condition for the social planner is:

\[
\frac{\partial V_k}{\partial \tau_k} + \frac{\partial V_j}{\partial \tau_k} = \frac{\mu - C_D}{\varepsilon \alpha P_k} \frac{\partial P_k}{\partial \tau} + \frac{C_X}{\alpha} + \frac{\tau_k \partial C_X}{\alpha \partial \tau_k} - \frac{C_M + C_X}{\alpha \varepsilon P_k} \frac{\partial P_k}{\partial \tau_k} - \frac{C_X}{\alpha t_k} = 0,
\]  

(20)
which can be simplified to

$$\frac{\partial V_k}{\partial \tau_k} + \frac{\partial V_j}{\partial \tau_k} = \mu - (C_D + C_M + C_X) \left( \frac{\partial P_k}{\partial \tau} \right) + \frac{\tau_k C_X}{t_k} [1 + \sigma_X] = 0 \quad \text{(III.21)}$$

where $\sigma_X$ is the price elasticity of import demand in country $k$\(^{19}\). Notice, that the only way for this first order condition to be met with a positive tariff (with or without the presence of multinationals) is if the import demand is inelastic. I address this issue here in the following lemmas, first in the absence of multinationals and next with the option to participate in FDI.

**Lemma 1.** In the absence of FDI, the import demand in country $k$ is elastic.

**Proof.** Decomposing $\sigma_X$:

$$\sigma_X = -\frac{\varepsilon i_{kD} + t_k^{1-\varepsilon} i_{jX}}{i_{kD} + t_k^{1-\varepsilon} i_{jX}} + \frac{i_{kD}}{i_{kD} + t_k^{1-\varepsilon} i_{jX}} \left[ \frac{t_k}{i_{jX} \partial \tau_k} \frac{\partial i_{jX}}{\partial \tau_k} - \frac{t_k}{i_{kD} \partial \tau_k} \frac{\partial i_{kD}}{\partial \tau_k} \right] < -1$$

Thus the import demand in country $k$ is elastic with respect to $t_k$. \(\square\)

**Lemma 2.** In the presence of FDI, the import demand in country $k$ is elastic.

**Proof.** Decomposing $\sigma_X$:

$$\sigma_X = \frac{t_k}{i_{kD} + i_{jM} + t_k^{1-\varepsilon}(i_{jX} - i_{jM})} \left[ \frac{i_{kD} + i_{jM} \partial i_{jX}}{i_{jX} \partial \tau_k} - \frac{i_{kD} + i_{jX} \partial i_{jM}}{i_{jX} - i_{jM} \partial \tau_k} - \frac{\partial i_{kD}}{\partial \tau_k} \right]$$

$$\left(\frac{\partial i_{jX}}{\partial \tau_k} < 0, \frac{\partial i_{jM}}{\partial \tau_k} > 0, \frac{\partial i_{kD}}{\partial \tau_k} > 0\right). \quad \text{Thus, the import demand in country $k$ is elastic.} \quad \square$$

\(^{19}\)Note that $\frac{\partial C_X}{\partial \tau_k} = \frac{\partial C_X}{\partial \tau_k}$ and $\sigma_X = \frac{t_k}{C_X \partial \tau_k} \frac{\partial C_X}{\partial \tau_k} = \frac{t_k}{C_X \partial \tau_k} \frac{\partial C_X}{\partial \tau_k}$. 

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Proposition 1. Whether or not multinationals are present, the optimal tariff for the social planner is a subsidy.

Proof. It follows from the first order condition (III.21) that the efficient tariff will be non-negative if the import consumption is inelastic. From Lemmas 1 and 2 I am able to rule out this case.

It is interesting to point out here, that free trade is not the socially optimal outcome as in perfect competition. In a perfectly competitive model, price would equal marginal cost (which in this case is equal to 1) and \( \mu = C_D + C_M + C_X \), resulting in an optimal tariff equal to zero. This is, indeed, an interesting result. In this model, not only are multinationals socially inefficient, but so is free trade – more trade is needed. However, there are some caveats that need to be addressed. In this model, I have omitted any wasteful transport costs. This is a potentially important omission, since even in a world with zero tariffs chosen, there could still be transport costs (which are exogenous to the model) sufficiently high to induce a some firms to become multinationals. Still, in spite of this caveat, noncooperative tariffs are greater than the socially efficient tariff, but the presence of multinationals (or threat thereof) lowers this gap.

In addition, it should be noted that this situation is different than the result where the unilateral tariff is a subsidy. In the unilateral case, the parameters are such that the inefficiency of monopolistic competition and the only policy tool is a tariff/subsidy on imported goods and one might make the case that a domestic policy (either through subsidizing domestic production or consumption) would be optimal. However, for the social planner, global fixed costs are a concern. By subsidizing imports, the social planner is subsidizing the most efficient firms. Thus, it is not clear that another policy in this framework would be more Pareto improving.
5 Conclusion

The idea that a country can increase its welfare by charging a positive tariff has been around since Bickerdike (1906) and the idea of tariff-jumping has been around since Bhagwati (1987). Ellingsen and Wärneryd (1997) was the first to marry these two concepts, but with the unfortunate side-effect of a knife-edge result regarding the amount of multinationals and exporters in equilibrium. I provide a model that dulls this knife-edge through endogenous entry of heterogeneous firms. I take an apolitical approach and maximize the welfare of a representative consumer. I find that a country’s welfare maximizing tariff is qualitatively similar to a model without the presence of multinationals. However, allowing for firms to tariff-jump dampens the effect on the aggregate price index, lowering gains to both domestic firm profits and government revenue. This, in turn, lowers the country’s noncooperative Nash tariff.

Another interesting result of this model is that there exist parameter values (specifically low values of elasticity of substitution across varieties) that correspond to a Nash tariff of a subsidy. This is a new result and depends on the relationship between the magnitude of the anti-variety effect associated with a tariff and the level of the complimentary nature of the varieties. An interesting extension would be to allow for multiple policy tools available to investigate whether the import subsidy result holds when there is the option to subsidize domestic production. Finally, I show that the social planner’s optimal tariff is always a subsidy. This is contrary to the standard result of the social optimum being at free trade.
APPENDIX

A Optimal Tariff Simplification

The first order condition is:

$$\frac{\partial V_k}{\partial \tau_k} = \frac{\mu}{C_{xk}} \frac{\partial C_{xk}}{\partial \tau_k} + \frac{1}{\varepsilon \alpha} \frac{\partial C_D}{\partial \tau_k} - B_k \frac{\partial i_{kD}}{\partial \tau_k} + \frac{C_X}{\alpha} + \frac{\tau_k}{\alpha} \frac{\partial C_X}{\partial \tau_k} = 0 \quad (A-1)$$

where $C_D$ is aggregate demand of the domestically produced (by a domestic firm) heterogeneous good. To simplify this, note the following:

$$C_D = \int_0^{i_{kD}} p_k(i)^{-\varepsilon} \mu \left[ \frac{1}{p_k(i)} \int_0^{i_{kD}} p_k(i)^{-\varepsilon} di \right]$$

$$\frac{\partial C_D}{\partial \tau_k} = \frac{\partial}{\partial \tau_k} \left[ \frac{\mu}{P_k} \int_0^{i_{kD}} p_k(i)^{-\varepsilon} di \right] = -\left( \frac{\mu}{P_k} \int_0^{i_{kD}} p_k(i)^{-\varepsilon} dP_k \right) x(i_{kD}) \frac{\partial i_{kD}}{\partial \tau_k}$$

Furthermore, recall that

$$B_k = \left( \frac{1}{\varepsilon \alpha} \right) \frac{\mu}{P_k}$$

Therefore, the first order condition (A-1) becomes

$$\frac{\partial V_k}{\partial \tau_k} = \frac{\mu}{C_{xk}} \frac{\partial C_{xk}}{\partial \tau_k} - \frac{1}{\varepsilon \alpha} \left( \frac{C_D^k}{P_k} \frac{\partial P_k}{\partial \tau_k} \right) + \frac{C_X}{\alpha} + \frac{\tau_k}{\alpha} \frac{\partial C_X}{\partial \tau_k} = 0 \quad (A-2)$$
Dixit and Stiglitz (1977) show that

\[ C_{xk} = \frac{I_k s(P_k)}{P_k} \]

where \( s(P_k) \) is the propensity to consume the heterogeneous good. Quasilinear utility implies that \( I_k s(P_k) = \mu \). Thus

\[ \mu = P_k^{\frac{1}{\varepsilon}} C_{xk} \]

\[ \Rightarrow 0 = \frac{1}{1-\varepsilon} P_k^{\frac{1}{\varepsilon}} C_{xk} \frac{\partial P_k}{\partial \tau_k} + P_k^{\frac{1}{\varepsilon}} \frac{\partial C_{xk}}{\partial \tau_k} \]

\[ \Rightarrow \frac{1}{\varepsilon \alpha P_k} \frac{\partial P_k}{\partial \tau_k} = \frac{1}{C_{xk}} \frac{\partial C_{xk}}{\partial \tau_k} \]

This result implies that (A-2) can be written as

\[ \frac{\partial V_k}{\partial \tau_k} = \frac{\mu - C_D}{\varepsilon P_k} \left( \frac{\partial P_k}{\partial \tau_k} \right) + C_X + \tau_k \frac{\partial C_X}{\partial \tau_k} = 0. \]  

(A-3)

**B  Nash Tariff without FDI**

Totally differentiating the equilibrium conditions (8) and (9) yields:

\[ \frac{\partial i_{kD}}{\partial \tau_k} = \frac{f(i_{kD})}{f'(i_{kD}) \frac{\partial P_k}{\partial \tau_k}} \frac{\partial P_k}{\partial \tau_k} > 0 \]  

(B-1)

\[ \frac{\partial i_{jX}}{\partial \tau_k} = \frac{f(i_{jX})}{f'(i_{jX})} \left[ \frac{1}{P_k} \frac{\partial P_k}{\partial \tau_k} + \frac{\varepsilon}{t_k} \right] < 0. \]  

(B-2)

Note that

\[ \frac{\partial P_k}{\partial \tau_k} = \left[ \frac{1}{\alpha^{1-\varepsilon}} \right] \left[ \frac{\partial i_{kD}}{\partial \tau_k} + (1-\varepsilon) t_k^{-\varepsilon} i_{jX} + t_k^{1-\varepsilon} \frac{\partial i_{jX}}{\partial \tau_k} \right]. \]

Using (B-1) and (B-2), this can be simplified to

\[ \frac{\partial P_k}{\partial \tau_k} = \frac{-\theta}{\alpha^{1-\varepsilon} + \phi} \]  

(B-3)
where

\[ \phi \equiv \left[ \frac{f(i_{kD})}{f'(i_{kD})} + i_k^{1-\varepsilon} f(i_{jX}) \right] \frac{1}{P_k} \]  

(B-4)

\[ \theta \equiv \frac{\varepsilon}{t_k^\varepsilon} \left[ \alpha i_{jX} + \frac{f(i_{jX})}{f'(i_{jX})} \right]. \]  

(B-5)

I can manipulate (B-4) and (B-5) and rewrite (B-3) in terms of elasticities.

\[ \phi = \left[ \frac{i_{kD}}{\delta(i_{kD})} + \frac{i_k^{1-\varepsilon} i_{jX}}{\delta(i_{jX})} \right] \frac{1}{P_k} \]

\[ \alpha^{1-\varepsilon} + \phi = \frac{1}{P_k} \left[ \frac{[\delta(i_{kD}) + 1] i_{kD} \delta(i_{jX}) + [\delta(i_{jX}) + 1] i_k^{1-\varepsilon} i_{jX} \delta(i_{kD})}{\delta(i_{kD}) \delta(i_{jX})} \right] \]

\[ \theta = \frac{\varepsilon i_{jX}}{t_k^\varepsilon} \left[ \frac{\alpha \delta(i_{jX}) + 1}{\delta(i_{jX})} \right]. \]

Therefore

\[ \frac{\partial P_k}{\partial \tau_k} = -\varepsilon P_k i_{jX} \left\{ \frac{\alpha \delta(i_{jX}) + 1}{\delta(i_{kD}) + 1} \frac{\delta(i_{jX}) + 1}{\delta(i_{jX}) + 1} \frac{t_k^{1-\varepsilon} i_{jX} \delta(i_{kD})}{\Phi} \right\}. \]  

(B-6)

Recall that the optimal tariff is

\[ \tau_k^* = \left[ \frac{\partial C_X^k}{\partial \tau_k} \right]^{-1} \left[ \frac{C_D^k - \mu}{\varepsilon P_k} \left( \frac{\partial P_k}{\partial \tau_k} \right) - C_X \right] \]

\[ = \left[ \frac{\partial C_X^k}{\partial \tau_k} \right]^{-1} \left[ \frac{(\mu - C_D)}{t_k^\varepsilon} \left( \frac{\alpha \delta(i_{jX}) + 1}{\delta(i_{jX}) + 1} \frac{t_k^{1-\varepsilon} i_{jX} \delta(i_{kD})}{\Phi} \right) - C_X \right] \]

where \( \Phi = [\delta(i_{kD}) + 1] i_{kD} \delta(i_{jX}) + [\delta(i_{jX}) + 1] i_k^{1-\varepsilon} i_{jX} \delta(i_{kD}) \). Using the fact that

\[ C_D = \frac{\mu \alpha^\varepsilon i_{kD}}{P_k} \]

\[ C_X = \frac{\mu \alpha^\varepsilon i_{jX}}{t_k^\varepsilon P_k} \]

\[ P_k = \left[ \frac{1}{\alpha^{1-\varepsilon}} \right] (i_{kD} + t_k^{1-\varepsilon} i_{jX}), \]

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the optimal tariff can be written as:

\[ \tau^*_k = \left[ \frac{\partial C_X}{\partial \tau_k} \right]^{-1} \left[ \frac{C_X}{\alpha} \right] \left[ \frac{(1 - \alpha) \delta(i_{kD})[i_{kD} + t_k^{1-\varepsilon}i_{jX}] - \alpha i_{kD} \delta(i_{jX})[1 + \alpha \delta(i_{kD})]}{\delta(i_{kD}) + 1}[i_{kD} \delta(i_{jX}) + \delta(i_{jX}) + 1]t_k^{1-\varepsilon}i_{jX}\delta(i_{kD})} \right]. \]

Note that the derivative of aggregate consumption of the imported good is negative and \( C_X \alpha > 0 \). Therefore, the optimal tariff will be positive if and only if the numerator of the third term is negative, or

\[ (1 - \alpha) \delta(i_{kD})[i_{kD} + t_k^{1-\varepsilon}i_{jX}] < \alpha i_{kD} \delta(i_{jX})[1 + \alpha \delta(i_{kD})] \]

\[ \Rightarrow \delta(i_{kD}) \mu < \varepsilon C_D \delta(i_{jX})[1 + \alpha \delta(i_{kD})]. \]
References


