PREFERENTIAL TRADE AND WELFARE WITH DIFFERENTIATED PRODUCTS

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Abstract: We consider analytically and numerically the welfare tradeoffs inherent in a preferential trade area (PTA) with products differentiated by region of origin. For a small open economy in such a setting, welfare gains are associated with higher trade volumes within the PTA. However, welfare losses are induced by declining tariff revenues on trade with nonmember countries. We show that both effects are concave, while one is a non-monotonic and the other a potentially non-monotonic function of pre-PTA partner trade shares. Therefore, the relationship between initial partner import shares and direct static welfare impacts of a PTA are theoretically ambiguous. This finding contrasts with conventional results in the homogeneous-goods case, whereby the smaller is the pre-agreement trade volume with a potential partner the more beneficial is a PTA.

Keywords: preferential trade agreements, differentiated products

JEL Classifications: F13, F15

1. Introduction

The static welfare outcome of a preferential trading agreement (PTA) follows a well-known application of second-best trade theory. Preferential tariffs can alter post-tariff prices on goods from competing locations and cause imports from inefficient partner countries to displace imports from more efficient suppliers elsewhere. This negative impact is offset by a tendency for consumers to substitute away from high-cost domestic goods in favor of more efficiently produced imports from the partner.[1]

In light of this welfare ambiguity, trade economists have built rules-of-thumb, based on theory, to inform policy. One example is the debate on the relationship between the initial share of trade with a potential partner and the prospects for gains or losses in a PTA (Schiff, 1997). The traditional view, set forth in the seminal work of Richard Lipsey (1970), holds that a PTA between countries that already trade in large volumes with one another is less likely to be trade-diverting as the potential partner is already a low-cost supplier. Consider a small country facing fixed terms of trade with both the potential partner and the rest of the world (ROW). Products are differentiated on a national basis according to a Cobb-Douglas general welfare function. In this context, Lipsey found that for a given volume of foreign trade, a PTA is 'more likely to raise welfare the larger is the proportion of these imports obtained from the country's union partners and the less is the proportion devoted to imports from the outside world.'[2]

In contrast, Riezman (1979) found that a sufficient condition for partners to gain from a customs union is that their mutual volume of trade is relatively small. The difference arises in the endogeneity of tariffs, which are set to maximize national welfare. Thus, in a three-country, three-good model, the more relatively similar are countries (and, hence, the smaller is their mutual Heckscher-Ohlin volume of trade), the greater is the potential of a union to improve joint terms of trade with the rest of the world.[3] In a different context, Schiff (1997) and Panagariya (1996) present models in which a country is large relative to its potential partner but is small in comparison with the rest of the world. Here, no opportunity for efficiency-enhancing trade exists

as partner-country prices are driven up to home-country levels. However, inefficient trade arises and, therefore, the smaller is the initial trade share with the partner the lower are welfare losses.

Riezman's article was the foundation for the bulk of recent work on PTAs, in which countries optimize their tariffs, as a function of market size, upon joining the agreement. For example, the model of Bond, Riezman, and Syropoulos (2004) considers regional integration in the context of optimal tariffs and welfare. Under the assumption of symmetric member size, they find that regional free trade is more attractive the greater is the union's size relative to the ROW.[4]

As this brief review suggests, there remains ambiguity about size, partner trade volumes, and welfare in the literature. In this paper we revisit Lipsey's question of potential welfare gains under different initial partner trade shares. Our point of departure is to note an important limitation of his approach, which is the assumption that the expenditure shares of imported products are fixed on a national basis. His assumption of Cobb-Douglas preferences for goods from different sources guarantees that the expenditure share of imports from ROW does not fall in response to formation of the PTA. This is highly unrealistic but largely governs the welfare analysis.

Thus, we generalize the expenditure relation Lipsey described by allowing bilateral trade shares to respond endogenously to the formation of a PTA. As in Lipsey's model, products are differentiated across countries and terms of trade are fixed.[5] We first explore the case where goods in a single import category are differentiated by region under a constant elasticity of substitution and a fixed expenditure on imports. We compute directly the welfare impacts arising from trade changes with both the partner country and the rest of the world. We show that both effects are non-monotonic and concave functions of the partner's initial volume share of imports. Thus, there is an ambiguous theoretical relationship between the pre-agreement share of partner trade and the direct welfare impact of a PTA. Simple computations with a particular substitution elasticity and tariff rate show that welfare initially declines as partner import share rises to about 25 percent, then rises monotonically as that share increases to unity. Further simulations

demonstrate how these welfare impacts vary with the initial tariff level and the elasticity of substitution.

2. Welfare Impacts with Differentiated Products

We extend the Vousden (1990) model of a small country to demonstrate the importance of partner trade shares. Assume that a small country (A) trades with two regions, a potential partner (B) and the rest of the world (R). Country A's importable goods are differentiated by region of origin, with imports labeled M_B and M_R. These imports are imperfect substitutes and are purchased at exogenous prices.[6] Initially, suppose that imports face no domestic competition. The basic implications of a PTA with B are illustrated in Figure 1, which is presented simply as a heuristic device that helps organize thinking. At an initial non-discriminatory ad valorem tariff of

$t = \left(\frac{P_i^A}{P_i^*} - 1 \right)$ within a sector (i = B, R), A imports quantities $M_B{}^1$ and $M_R{}^1$. Suppose that A

establishes a PTA that eliminates the tariff on B but maintains the tariff on R. Consumer surplus in A's market for the B good increases by the area $P_B{}^A ACP_B{}^*$, while tariff revenues fall by area $P_B{}^A ABP_B{}^*$, resulting in a net welfare gain of area ABC. We call this the direct effect (DE) associated with increased imports from the partner. However, because imports from B and R are imperfect substitutes, the fall in the price of the B good reduces country A's demand for M_R, shown as a shift in Hicksian demand from $D_R{}^1$ to $D_R{}^2$. We define the revenue loss of area EFGH as the substitution effect (SE) of the PTA.

The net welfare effect in the import market, measured as the area ABC - EFGH, depends on three key parameters: the own-price elasticity of compensated demand for M_B, the elasticity of substitution between B and R imports, and the share of total import expenditures originating from B initially.

We assume that utility is separable into import and domestic commodity groups such that conditional orderings on goods in a group are independent of consumption levels outside the group.[7]

The representative agent allocates a fixed amount of income I to the purchase of imports. Her CES import sub-utility function, which exhibits a constant elasticity of substitution ($\eta > 1$), is given by

$$u(M_B, M_R) = [\delta_B M_B^{(\eta-1)/\eta} + \delta_R M_R^{(\eta-1)/\eta}]^{\eta/(\eta-1)}. \tag{1}$$

Here, δ_B and δ_R are distribution parameters in the CES function between imports from B and ROW, respectively.

Given the import budget constraint, the standard procedure for deriving the constrained maximum gives the Marshallian demand function for imports, m_i (p, I), and import share parameter, s_i, from region i (i = B, R).

$$m_i(\mathbf{p}, I) = \frac{\delta_i^\eta p_i^{1-\eta}}{\sum_j \delta_j^\eta p_j^{1-\eta}} \frac{I}{p_i} \tag{2}$$

$$s_i = \frac{\delta_i^\eta p_i^{1-\eta}}{\sum_j \delta_j^\eta p_j^{1-\eta}} \tag{3}$$

In these equations the subscript j in the summations refers also to B, R. The own-price elasticity is $\xi_i = -\eta - (1 - \eta) s_i$. Note that because this is an expression in the substitution elasticity and import share the import demand elasticity itself will not appear in our welfare formulas below.

Marshallian consumer surplus generated from preferential removal tariff, t, is derived by integrating over demand.

$$CS = \int_{P_B^*(1+t)}^{P_B^*} \frac{\delta_B^\eta p_B^{1-\eta}}{\delta_B^\eta p_B^{1-\eta} + \delta_R^\eta p_R^{1-\eta}} \frac{I}{p_B} dp_B \tag{4}$$

Let $u = \delta_B^\eta p_B^{1-\eta} + \delta_R^\eta p_R^{1-\eta}$ and $du = (1-\eta)\delta_B^\eta p_B^{-\eta}$. Using this u-substitution, equation (4) simplifies to the natural logarithm

$$CS = \frac{I}{(1-\eta)} \int_{P_B^*(1+t)}^{P_B^*} \frac{du}{u} = \frac{I}{(1-\eta)} \log|u| \Big|_{P_B^*(1+t)}^{P_B^*}$$

By the fundamental theorem of calculus, and recalling that $\log(a/x) = \log a - \log x$, equation (4) can be rewritten as

$$CS = \frac{I}{1-\eta} \log \frac{\delta_B^\eta p_B^{1-\eta} + \delta_R^\eta p_R^{1-\eta}}{\delta_B^\eta p_B^{1-\eta}(1+t)^{1-\eta} + \delta_R^\eta p_R^{1-\eta}} \tag{5}$$

The import direct effect $DE(s_B)$ is defined as consumer surplus gains less tariff revenue losses on partner imports generated by a preferential removal of the import tariff. By substituting (3) into (5), this is given by

$$DE(s_B) = \frac{-I}{1-\eta} \log[(1-s_B) + s_B(1+t)^{\eta-1}] - \frac{Its_B}{1+t} \tag{6}$$

The expression for DE is a reduced form as the post-PTA import shares depend on the partner's initial share s_B, the tariff t, and the elasticity of substitution η. The first term of equation (6) is the increase in consumer surplus on B imports and the second term represents the loss of tariff revenue on those goods.[8]

PROPOSITION 1: Suppose import preference orderings of a representative agent are given by equation (1), world prices are fixed, and import expenditures are fixed. The relationship between the direct effect on welfare from a PTA and the share of total pre-agreement imports originating from the PTA member country is of ambiguous sign.

PROOF:

The derivative of the DE function with respect to s_B is given by

$$DE'(s_B) = \frac{I}{1-\eta} \frac{1-(1+t)^{\eta-1}}{(1-s_B) + s_B(1+t)^{\eta-1}} - \frac{It}{(1+t)} \tag{7}$$

The first term on the right-hand side is positive, indicating that the consumer surplus generated by removing the tariff is increasing in B's initial share of imports. However, the second term is also positive because the loss of import tariff revenues is also increasing in this share. In consequence, the sign is ambiguous.

We plot DE for all partner import shares in Figure 2, where as a benchmark case we set the MFN tariff equal to ten percent and the elasticity of substitution to four. Analysis of equation (6) at the share endpoints shows that $DE(0) = 0$ and $DE(1) > 0$. If country A initially imported nothing from the proposed partner there would be no direct gain from a PTA. At the other extreme, if all initial imports originated from B then the agreement would be equivalent to multilateral free trade and the direct gain would be strictly positive. Setting equation (7) equal to zero and solving for the DE-maximizing share gives

$$\widetilde{s}_B = \frac{1}{1-(1+t)^{\eta-1}} + \frac{1+t}{t(\eta-1)}. \tag{8}$$

The first RHS term of equation (8) is negative, while the second term is positive, but not necessarily less than one. It follows that $\widetilde{s}_B$ may obtain outside the relevant interval $(0,1)$. Thus, $DE(s_B)$ is maximized at $s_B^* = \min[\widetilde{s}_B, 1]$. The second derivative of (6) with respect to s_B is

$$DE''(s_B) = \frac{I[1-(1+t)^{\eta-1}]^2}{(1-\eta)[1-s_B+s_B(1+t)^{\eta-1}]^2} < 0. \tag{9}$$

The second derivative is negative, indicating that the DE measure is maximized at an interior solution or at $s_B = 1$. Thus this effect is a concave and possibly non-monotonic function of the initial partner import share.

The substitution effect (SE) depends on the pre-PTA and post-PTA import expenditures on the good originating in the rest of the world. Algebraically, $SE(s_B) = t\, P_R^* [m_R^1(s_B) - m_R^2(s_B)]$, where t is the MFN tariff, $m_R^1(s_B)$ indicates pre-PTA imports, and $m_R^2(s_B)$ indicates post-PTA imports from R. By definition, $m_R^1(s_B) = (1-s_B)\, I\, / [P_R^* (1+t)]$, where s_B is B's initial import share.

Thus, SE can be written as a function of the partner's initial import share (s_B) from equation (3), import expenditures (I), and the initial MFN tariff rate (t).

$$SE(s_B) = \frac{tI(1-s_B)}{(1+t)}\left[1 - \frac{(1+t)^{1-\eta}}{(1-s_B)(1+t)^{1-\eta} + s_B}\right]$$ (10)

PROPOSITION 2: Suppose import preference orderings of a representative agent are given by equation (1), world prices are fixed, and import expenditures are fixed. The relationship between the substitution effect, or ROW tariff revenues foregone from a PTA, and the share of total pre-agreement imports originating from the PTA member country is ambiguous in sign.

    PROOF:

The derivative of the SE function (10) with respect to s_B is given by

$$SE'(s_B) = \frac{tI}{(1+t)}\left\{\frac{(1+t)^{1-\eta}}{\left[(1-s_B)(1+t)^{1-\eta} + s_B\right]^2} - 1\right\}$$ (11)

The sign of equation (11) is given by the sign of the expression in the braces, which is ambiguous because its first term is positive and either greater than or less than one.

    Equation (10) is plotted as SE in Figure 2 for the same parameters. The substitution effect is zero at the share endpoints, that is SE(0) = SE(1) = 0. The second derivative with respect to s_B is

$$SE''(s_B) = \frac{-2tI(1+t)^{-\eta}(1-(1+t)^{1-\eta})}{\left[s_B + (1-s_B)(1+t)^{1-\eta}\right]^3} < 0.$$ (12)

Thus SE(s_B) is a concave function. Because SE(0) = SE(1) = 0, by the mean-value theorem there exists a share s_B^* on the open interval (0,1) such that $SE'(s_B^*)$=0. The loss from consumer substitution out of imports from R is maximized at a share on the open interval (0,1) and is hence a non-monotonic function of partner import share.

PROPOSITION 3: Suppose import preference orderings of a representative agent are given by equation (1), world prices are fixed, and import expenditures are fixed. The

relationship between welfare and the share of total pre-agreement imports originating

from the PTA member country is ambiguous in sign.

PROOF:

The overall welfare effect, $W(s_B)$, of a PTA is DE less SE. The derivative of $W(s_B)$ is given by

equation (7) minus equation (11) and reduces to

$$W'(s_B) = \frac{I[(1+t)^{1-\eta} - 1]}{(1-\eta)[(1-s_B)(1+t)^{1-\eta} + s_B]} - \frac{It(1+t)^{-\eta}}{[(1-s_B)(1+t)^{1-\eta} + s_B]^2} \qquad (13)$$

Both terms on the RHS are positive and equation (13) is ambiguous in sign. The

second derivative is given by equation (9) minus equation (12) and reduces to

$$W''(s_B) = \frac{I[1 - (1+t)^{1-\eta}]}{(1-\eta)[(1-s_B)(1+t)^{1-\eta} + s_B]^3} \left\{ [1 - (1+t)^{1-\eta}][(1-s_B)(1+t)^{1-\eta} + s_B] + \frac{t(1-\eta)}{(1+t)^{\eta}} \right\}$$

$W''(s_B)$ is positive and thus welfare is a convex function of the initial share of partner imports.

The welfare effect of a PTA in the benchmark is also drawn in Figure 2. Clearly, $W(0) =$

0 and $W(1) = DE(1) > 0$. The welfare gain is maximized at $s_B =1$ because the solution

corresponds to free trade. However, there is no presumption that the welfare gain is larger as the

initial partner trade share grows larger. Rather, the opposite is true in this simulation for low

initial trade shares.

It is evident from Figure 2 that the reason welfare falls initially as the partner trade share

rises from zero is that the losses from the substitution effect outweigh the gains from the direct

effect of the preferential trade agreement. The intuitive reason for this is straightforward and may

be understood by referring again to the basic theory in Figure 1. With a very low (high) partner

(ROW) trade share the size of any "triangle" welfare gain ABC is small for any tariff cut in

relation to the substantial "rectangle" loss EFGH. As the ROW initial share rises the SE

necessarily diminishes at some point relative to the DE.

Thus, our basic result is consistent with Lipsey's (1970) view, although for a different reason. Lipsey's claim that a high initial partner trade share would expand the welfare gains from a PTA stemmed from his view that this situation implied the partner to be a low-cost producer. In our case the result comes on the demand side from national product differentiation.

3. Extended Analysis

3.A. The Roles of Tariffs and Substitution Elasticity

As the last paragraph would suggest, the tariff rate and the elasticity of substitution play significant roles in determining welfare impacts of the PTA. The size of the initial tariff matters largely for the revenue impacts. In Figure 3 we depict the welfare changes of the trade agreement under five, ten and twenty-percent initial MFN tariffs, keeping the substitution elasticity at its benchmark value. In each case we get a qualitatively similar result: welfare in country A initially declines in partner trade share, then rises and becomes positive at a 100-percent share (effectively free trade). However, the size of these effects is significantly smaller for a small initial tariff and larger for a large tariff. Indeed, it is no surprise that eliminating a twenty-percent tariff on a significant share of trade (a high partner share) generates large welfare gains in country A. It is also noteworthy that the share at which welfare changes become positive rises as the tariff rate falls. Thus we find a "magnification effect" such that for relatively low partner trade shares, the higher is the initial tariff rate the greater would be the decline in welfare from a PTA. In contrast, for relatively high trade shares, the higher is the initial tariff rate the greater is the gain in welfare from a PTA.

Consider next the effect of varying the elasticity of substitution. Intuitively, in Figure 1, the larger is this parameter the greater is the initial fall in demand for the ROW good and, therefore, the larger is SE relative to DE. We should anticipate bigger welfare losses (and smaller welfare gains) when the substitution elasticity is high. As we show in Figure 3, for three values of this elasticity (3, 4 and 5) this is exactly the outcome we find. Note that this substitution

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parameter does not matter at the endpoints, when either the partner country B or ROW supplies all of A's imports of this good.

3.B. Domestic Production

Our model generalizes Lipsey's assumption of Cobb-Douglas preferences across trading partners, which implies fixed expenditure shares on imports from B and ROW. Our approach adopts a CES sub-utility function that holds total import expenditures constant but permits price changes to affect imports from each country. While this is a substantive extension it still leaves unaddressed the possibility of substitution effects with domestic production. Specifically, there may be a third differentiated variety produced in country A that competes with versions from partner B and ROW but is not subject to the import tariff. Adding this complexity, however, would not change the basic message of ambiguity between partner trade shares and welfare impacts. The PTA would still reduce the price of B's good in A, diminishing demand for both the A and ROW varieties, with some secondary feedback effects among these goods. This situation would add some loss in CS on the A product, diminish the loss in CS on the ROW good, and still have the primary tariff-revenue losses. Because the extent of these impacts still would vary with the initial partner trade share the ambiguity with welfare would remain.

3.C. Internal Terms of Trade

We have purposely kept the analysis as simple as possible in order to illustrate our basic point: in a world of product differentiation a PTA between a small nation and an (implicitly) large nation has ambiguous effects on intra-agreement welfare. For this reason we have kept prices of goods from B and ROW exogenous as A cuts its tariff rate. It is possible, of course, that partners A and B are both small relative to ROW but have market power relative to one another. For example, this might be the case among members of the Central American Free Trade Agreement in their mutual trade, while all have extensive trade with the United States (ROW) as well.

Rather than develop the relevant simulations, we simply note here that the addition of this complexity would not change the basic result of ambiguity in welfare. Again, as a heuristic

exercise, consider the basic economics in Figure 1 and imagine that there is an upward-sloping export-supply function in this good from country B, holding the ROW price constant. In this case the preferential tariff elimination in A would establish a terms-of-trade loss (gain) for A (B), tending to reduce the initial DE welfare gain for A and possibly making it negative.[9] At the same time the smaller reduction in the price of B's good in the A market would limit the downward shift in demand for the ROW good, which would, ceteris paribus, reduce the initial SE welfare loss. In Figure 2 both DE and SE would get flatter in the neighborhood of the origin (and DE could slope downward) but welfare would still decline in this case of a small initial partner share. Eventually welfare must rise in the general case of an arbitrary initial tariff as partner share rises and the PTA approaches global free trade.

This outcome may not hold if country A chooses to set a pre-PTA internally optimal tariff against potential partner B as a function of this initial trade share (and export-supply elasticity). In that case the preferential tariff elimination would make both DE and SE sources of welfare loss in the neighborhood of the initial equilibrium. Indeed, at a large initial partner share the effect could be to deteriorate A's welfare, rather than to improve it as we find. However, this is a considerably different situation than the case we analyze, in which countries do not optimize tariff rates strategically.

To summarize, moving away from the assumption of a small home country (A) significantly complicates the analysis. Solving this problem requires specifying the determinants of the partner country's (B) export-supply function. For standard functional forms, such as a constant elasticity of transformation, there would be a non-linear relationship between this nation's export-supply elasticity and the initial trade share. Deriving closed-form solutions to this, and other generalities, remains a task for future research.

3. Concluding Remarks

This paper considers the welfare implications of a discriminatory preferential trading arrangement in a general-equilibrium model where imports are differentiated by region of origin and terms of trade are fixed. The relationship between the initial (pre-PTA) relative volume of trade with the potential partner and welfare changes is shown to be theoretically ambiguous. Both the welfare-increasing direct effect and the welfare-reducing substitution effect are concave, and potentially non-monotonic, functions of the partner's pre-agreement import share. Hence, the relationship between initial trade patterns and welfare changes resulting from a PTA depends on parameters and becomes an empirical issue.

From a policy standpoint our analysis underlines two parameters that authorities in small countries should consider when contemplating joining a PTA: the initial tariff rate and the elasticity of substitution among import sources. Preferentially eliminating a high tariff will be detrimental in static terms if the country has a small share of imports from the partner but the gains become large as that share rises. Those losses are smaller, and the gains bigger, the lower is the substitution elasticity, in which case there is relatively little discrimination in demand against ROW imports. These observations could form one basis of a relevant empirical prediction of potential gains from a PTA.

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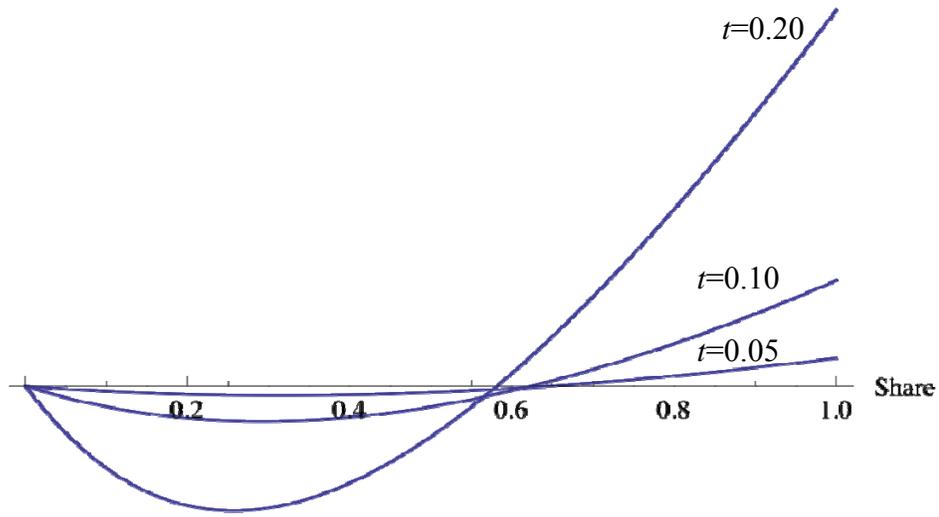Press.

Figure 1: Basic Welfare Representation
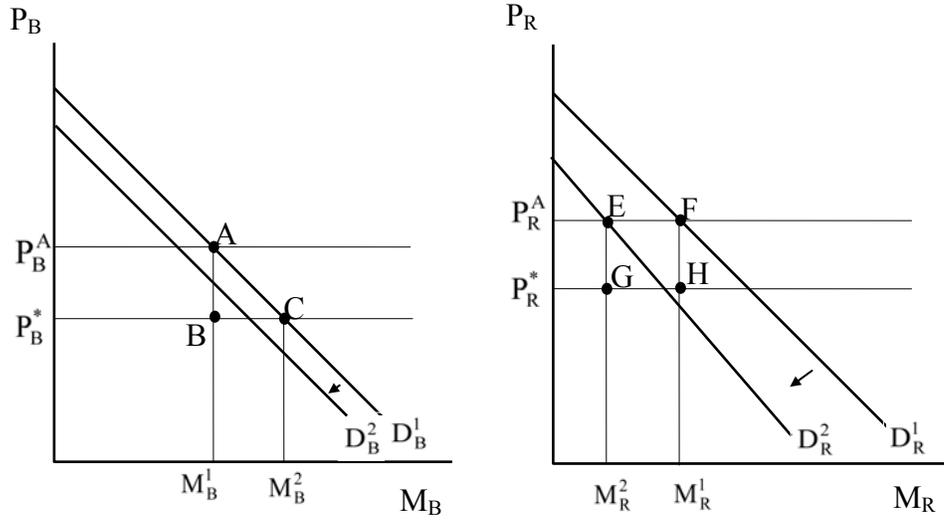
Figure 2: Welfare Effects with Differentiated Imports, Baseline Scenario

Welfare

DE

W

SE

0.2   0.4   0.6   0.8   1.0   Share
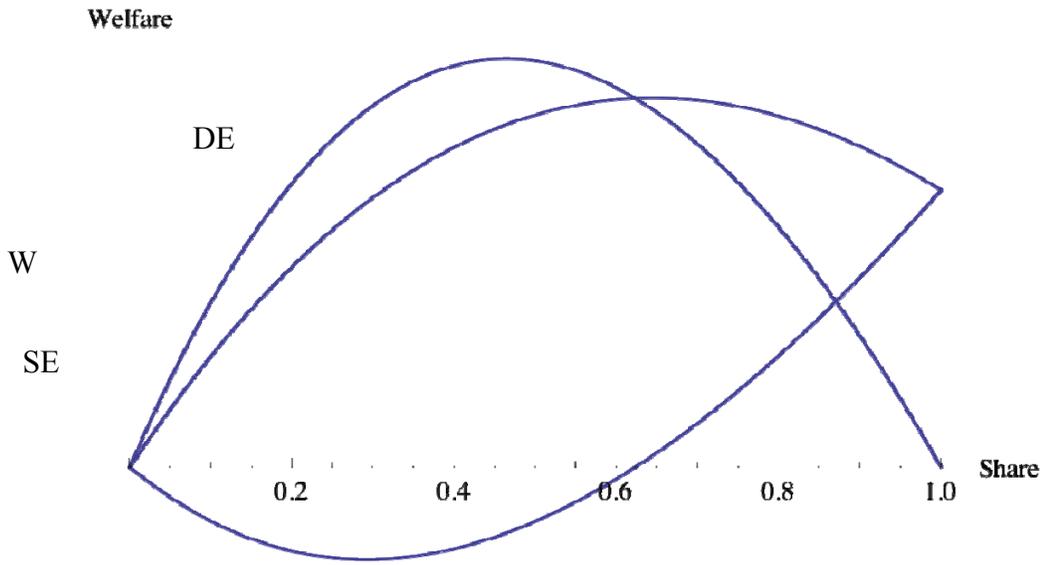
Source: Author simulation with $t = 0.10$ and $\eta = 4$
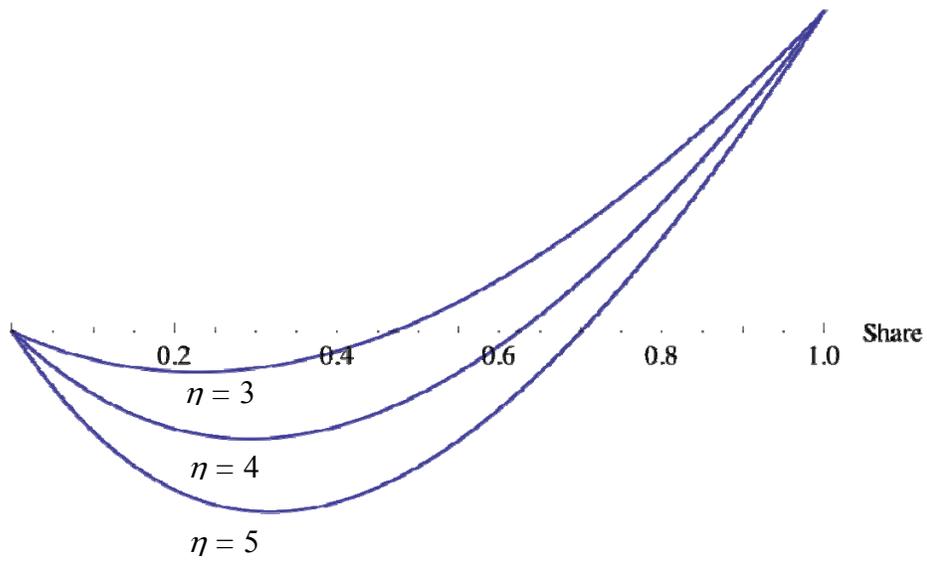
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Figure 3: Welfare Sensitivity Analysis: Tariffs

Welfare

Source: Author simulation with $t = 0.05$, 0.10, and 0.20 and $\eta = 4$

Figure 4: Welfare Sensitivity Analysis: Elasticity of Substitution

Welfare

Source: Author simulation with $t = 0.10$ and $\eta = 3$, 4, and 5

Endnotes

[1] In traditional terminology these effects were referred to as trade diversion and trade creation, respectively. However, these simple terms can be misleading and more recent parlance associates them with negative terms of trade (TOT) effects and positive volume of trade (VOT) effects, which are more general in scope (Kowalczyk, 2000). We opt here to use terms that emerge directly from the theory.

[2] Lipsey also noted that a PTA is more likely to increase welfare the larger is spending on domestic products relative to imports.

[3] Lloyd (1982) summarizes these results in a unified framework.

[4] Current work focuses on the endogenous formation of PTAs (Baier and Bergstrand, 2004) and the development of PTA networks (Chen and Joshi, 2010; Furusawa and Konish, 2007).

[5] Jones (1993), De Melo and Robinson (1989), and Rousslang and Suomela (1988) provide a useful general analysis of trade protection in the differentiated-goods framework.

[6] We describe the general implications of permitting country A to be large in relation to partner country B, thereby experiencing terms-of-trade effects, in a later section.

[7] Commodity vectors may be partitioned into groups as group subutility functions are homothetic (Deaton and Muellbauer 1980).

[8] Consumer surplus is a valid measure of the change in welfare as the CES subutility function is homothetic.

[9] This generalization was first obtained in the model of Mundell (1964) who finds that a discriminatory tariff reduction by a member country will improve the terms of trade of the partner country when initial tariff rates are relatively low.