Technical Appendix to Economic Determinants of Free Trade Agreements *Revisited*: Distinguishing Sources of Interdependence **Not Intended for Publication***

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1 Theoretical Framework

Our theoretical starting point is the general equilibrium Krugman-type monopolistic competition model of international trade in Baier and Bergstrand (2004). Using a two-industry model with two factors of production (K, L), this model showed theoretically that two countries i and j would have a larger net utility gain from an FTA the larger their economic (GDP) sizes, the more similar their GDPs, the closer the two countries to each other, the more remote the two countries from ROW, the larger their relative factor endowment differences (up to a point), and the smaller their relative factor endowment differences relative to the ROW's; these considerations were also implicit in E-L. To focus on the core issues in this paper of cross-FTA effects versus own-FTA effects, we employ a more parsimonious version of that model, with only one industry producing slightly differentiated products under increasing returns to scale and one factor (labor).[1]

We note now several caveats regarding certain theoretical issues. First, the Krugman-type model in B-B is just one of several possible models to illustrate the potential effects of economic size and similarity, distance and remoteness, and third-country FTA and third-country-pair FTA effects on the potential net utility gains of FTA_{ij} (and, by implication in our qualitative choice framework later, the likelihood of FTA_{ij}). B-J and C-J offer complementary frameworks to motivate specifications of their logit/probit models for FTA_{ij}.[2] However, B-J and C-J use three-country frameworks, precluding potential analysis of third-country-*pair*'s FTAs (FTA_{kl}); our model allows six countries on three different continents.

Second, recent developments in trade theory address heterogeneous firms, cf., Melitz (2003). Arkolakis, Costinot, and Rodriguez-Clare (2009) find that, in the class of models used here (Krugman, 1980) – as well as the models in Eaton and Kortum (2002), Anderson and van Wincoop (2003), Melitz (2003), and some variations of Melitz (2003) – with two critical elements (CES utility and a gravity equation), there exists a common estimator of the "gains from trade." This estimator depends upon only two aggregate statistics: the share of expenditures of a country on imports and a gravity-equation-based estimate of the elasticity of trade flows with respect to variable trade costs. Consistent with that paper, Feenstra (2009) finds in a standard Melitz-type model that the extensive margin of imports has a welfare contribution as

[1]In B-B, the two relative factor endowment variables added only 4 percentage points to overall pseudo-R^2 values in the empirical work.

[2]E-L was motivated by B-B.

a result of trade liberalization that exactly offsets the welfare loss from the reduced extensive margin of domestic goods. Hence, for our purposes and in this class of models, this recent research suggests that heterogeneity across firms in a sector is not central for analyzing the *welfare* effects of trade liberalization.

Third, as in B-B, E-L, and C-J, we assume that each government maximizes national welfare in making decisions about having FTAs. In reality, governments' objective functions are not constrained to only maximizing national welfare; political factors matter. Recent theoretical political economy models by Grossman and Helpman (1995) and Krishna (1998) suggest that trade-*diverting* FTAs are more likely to surface, once campaign contributions and special interests are accounted for. Yet, Ornelas (2005b,c) shows that such agreements are less likely, once these models allow for endogenous tariff formation. Though the results are founded upon linear demand and cost functions and ignore transport costs, the Ornelas (2005c) model has some very powerful implications. Governments tend to lower external tariffs after forming an FTA. He finds that this effect is so strong it results in greater trade flows among members *and* between members and nonmembers. Governments support only FTAs that enhance their own countries' welfare, in spite of political motivations. Also, FTAs can play a role in reducing obstacles to multilateral liberalization, helping spur global free trade, as in Saggi and Yildiz (forthcoming, 2010). Freund and Ornelas (2009, p. 24) conclude that the limitation in Baier and Bergstrand (2004) of not accounting for political-economy factors may not be a "problem after all."

The remainder of this section has five parts. Section 1.1 summarizes our model, a one-sector, one-factor version of the B-B model. Section 1.2 discusses the parameterization of the numerical version of the general equilibrium (GE) model, with the exception of initial tariffs. In section 1.3, we discuss the selection of initial tariffs suggested by the Nash equilibrium in a symmetric case, and the role of tariff/FTA complementarity. In section 1.4, after first summarizing the expected effects of core variables (GDP size, GDP similarity, bilateral distance, and remoteness) on FTA net welfare gains, we discuss two comparative static results from the numerical GE model that inform us about the cross-FTA and own-FTA effects, addressing the relevance of trade-diversion, terms-of-trade, and FTA-complementarity effects. Section 1.5 addresses some caveats and reports on the robustness of these comparative statics with respect to varying parameter values.

1.1 The Model

Our purpose in this section is to offer a very parsimonious model that will be used later to generate some comparative statics to guide construction of useful empirical multilateral and *ROW* FTA indexes that ideally will help to explain *what we observe* in a series of cross-sections about the larger and larger number of FTAs in the world. As in B-J and C-J, the model is static; consequently, our approach is to explain in any year (that is, in a cross-section) the long-run equilibrium, as in B-B, E-L, B-J, and C-J.

1.1.1 Consumers

The model consists of N countries and one sector. We assume Dixit-Stiglitz preferences for the representative consumer, captured formally by a constant elasticity of substitution (CES) utility function. Let $c_{ij}(k)$ be consumption in country j by the representative consumer of the differentiated good produced by firm k in country i. Let σ denote the elasticity of substitution in consumption between varieties of goods with $\sigma > 1$. Let n_i be the number of varieties of goods produced in country i. The utility function u_j is given by:

$$u_j = \left[\sum_{i=1}^{N} \int_{n_i} c_{ij}(k)^{\frac{\sigma-1}{\sigma}} dk \right]^{\frac{\sigma}{\sigma-1}}. \tag{1}$$

Within a country, firms are assumed symmetric, which then allows eliminating firm notation k. We assume one factor of production, labor (L). Let w_j denote the wage rate of the representative worker in country j.

In this model, we include Samuelson iceberg-type trade costs (inclusive of government-mandated trade barriers) that are allowed to be asymmetric among all country pairs. We assume that t_{ij} units of a good have to be shipped from county i to ensure that one unit arrives in country j (assuming $t_{ij} \geq 1$ and $t_{ii} = 1$). Also, let τ_{ij} denote the gross tariff rate on goods imported into j from i (assuming $\tau_{ij} \geq 1$ and $\tau_{ii} = 1$).

The consumer is assumed to maximize equation (1) under the budget constraint:

$$w_j + TAR_j = \sum_{i=1}^{N} n_i p_i t_{ij} \tau_{ij} c_{ij}, \tag{2}$$

where TAR_j is tariff revenue in j redistributed lump-sum back to households in j and p_i is the producer's price of good g in country i. This maximization yields a set of demand equations for national economy j with L_j households:

$$X_{ij} = \frac{n_i \left(p_i t_{ij} \tau_{ij}\right)^{-\sigma}}{\sum_i (n_i/\tau_{ij})(p_i t_{ij} \tau_{ij})^{1-\sigma}} Y_j, \tag{3}$$

where X_{ij} is demand in country j for goods from country i and Y_j denotes national income in j. In the absence of lump-sum tariff redistributions, the term (n_i/τ_{ij}) in equation (3) reduces to n_i. Equation (3) shows that the model embeds "structural gravity."

1.1.2 Firms

All firms in the industry are assumed to produce under the same technology. The output of goods produced by a firm in country i, denoted by g_i, requires l_i units of labor, as well as an amount ϕ of fixed costs, expressed in terms of units of labor. The production function – similar to that in Krugman (1980) – is given by:

$$l_i = \phi + g_i, \tag{4}$$

where we assume as traditional a constant marginal product of labor (set to unity). Firms maximize profits subject to the technology defined in equation (4), given the demand schedule derived in Section (1.1.1). In this model, profit maximization leads to a constant markup over marginal production costs and there are zero profits in equilibrium due to free entry and exit. Profit maximization ensures:

$$p_i = \frac{\sigma}{\sigma - 1} w_i. \tag{5}$$

Zero profits in equilibrium ensure:

$$g_i = \phi \left(\sigma - 1\right). \tag{6}$$

1.1.3 Factor Endowment Constraint

We assume that endowments of labor, L_i, are exogenously given and internationally immobile. Assuming full employment, the following factor market condition holds:

$$L_i = n_i l_i \tag{7}$$

or

$$n_i = (\phi\sigma)^{-1} L_i. \tag{8}$$

The zero profit conditions and the clearing of goods and factor markets lead to balanced multilateral trade for each economy.

1.2 Numerical Simulation: Parameter Selection

We calibrate the model for a world economy with potentially asymmetric labor endowments and bilateral trade costs. Our model can then be simulated to motivate testable hypotheses regarding the relative effects on the net utility gain of FTA_{ij} of FTAs of i and j with third-countries k (own-FTA effects) and of FTAs of third-country-pairs kl (cross-FTA effects).

We calibrate the model identically to that in B-B; since the model is simpler, some parameters specified there are absent here. For the utility function, we have one parameter, the elasticity of substitution between varieties of goods (σ). We set σ=4 as in B-B. For technology, we set the fixed cost term in the production function to unity ($\phi = 1$), without loss of generality. We will discuss later the sensitivity of our results to variation in these parameters. Initially, factor endowments of labor are assumed identical across all countries in the symmetric benchmark equilibrium with values of $L_i = 100$ for all countries.

The number of firms, product varieties, labor employments, wage rates, consumption levels, and price levels in each country can be determined uniquely given the parameters of the model (σ, ϕ), labor endowments, and initial transport cost and tariff rates. Following B-B, we separate transport costs into intra-continental and inter-continental "iceberg" components. Let a denote the portion of the good that "melts" intra-continentally and b the portion that melts inter-continentally; hence, within continents $t_{ij} = 1/(1 - a)$ and between countries on different continents $t_{ij} = [1/(1-a)][1/(1-b)]$. We will allow both a and b to vary between their full potential values of 0 (i.e., zero transport costs) and 1 (i.e., prohibitive transport costs) to show sensitivity of the results to variation in transport costs.

As in B-B, we assume the existence in each country of a social planner, which sets tariff rates $(\tau_{ij}-1)$ initially at 0.3. We discuss the choice of this value in the next section. Based upon initial parameter values, the social planner in each country considers whether its representative consumer's utility would be better off or worse off from forming an FTA. For a country's planner to form a new – or join an existing – FTA, the change in utility from doing so must be positive.

1.3 Numerical Simulation: Nash Equilibrium Tariffs and Tariff Complementarity

The purpose of this section is to show the model is amenable to calculating Nash equilibrium tariff rates, to rationalize setting initial tariff rates at 0.3, and to demonstrate the existence of "tariff/FTA complementarity" in our model. As noted in B-B, the ideal approach would be to consider the Nash equilibrium tariffs. The Nash equilibrium tariffs in a post-integration situation are likely to differ from those in the pre-integration situation.

First, given the parameter settings just noted above, we calculate the Nash equilibrium tariffs in the six-country case with zero intra-continental and intercontinental transport costs. For six symmetric economies, the Nash equilibrium tariffs are approximately 0.3. Hence, for comparative statics in subsequent sections, we set tariffs initially at 0.3.

Second, in the presence of endogenous tariffs, we can also show that the model potentially allows for "tariff complementarity." Bagwell and Staiger (1998) showed in a simple static model with three symmetric economies with endogenous tariffs that when two countries (exogenously) lower their mutual tariffs to zero (i.e., an FTA) that it is in each of their interests to lower their external tariff to the third nonmember country. In particular, in the context of a three-country model with each country's import market served by competing exports from the other two, linear demand curves ($D_{ij} = \alpha - \beta P_{ij}$ where D_{ij} (P_{ij}) is quantity demanded (price) in j for i's product), and optimal endogenous tariffs, each of the three countries' initial tariff rates equals 0.38β. If two countries i and j form exogenously an FTA, the post-integration Nash equilibrium tariffs for i and j on products from ROW fall to 0.14β, or by 63 percent. Moreover, ROW's tariff on products from either i or j remain unchanged at 0.38β.

A similar result occurs in our model. For comparison to the example above, as well as for computational convenience, consider a three-symmetric-country version of our model (i, j, k). In the three-country case with CES preferences, our initial Nash equilibrium tariffs are 0.4. Consider an exogenous FTA between i and k, as in Bagwell and Staiger (1998). In our model, the optimal post-integration endogenous tariff rates for countries i and k fall to less than 0.20 (decreasing by more than 50 percent) and the optimal tariff for j remains at 0.4. Thus, as Bagwell and Staiger conclude, this suggests a role for FTAs being *building blocs* rather than stumbling blocs toward multilateral liberalization. Moreover, this suggests for our purposes that (static) tariff-complementarity implies – for country i – that an FTA between i and k increases the net utility gain from i forming an FTA with j; we will call this "FTA complementarity." Moreover, this suggests that – in a four-country case – an exogenous FTA between k and l implies those two countries' external tariffs will fall, but there will be no tariff/FTA-complementarity effects on i or j.[3]

1.4 Numerical Simulation: Comparative Static Results

We use the numerical version of our model to generate two new comparative statics regarding cross-FTA and own-FTA effects. Prior to discussing those results, section 1.4.1 summarizes the expected effects on the net utility gains of an FTA between country-pair ij (FTA_{ij}) of several bilateral economic determinants established in Baier and Bergstrand (2004). In section 1.4.2, we address two new comparative statics regarding the relative impacts on net utility gains of

[3]Such effects also hold for customs unions, with some quantitative differences. Some caveats are in order regarding these conclusions. First, as in Bagwell and Staiger (1998, section 2), this example is nested in a non-cooperative Nash equilibrium, and thus ignores that FTAs in reality are created in a possible environment of multilateral cooperation. Thus, we assume that there is some cost to attaining multilateral free trade, such as enforcement of multilateral agreements. Second, Bagwell and Staiger go on to address two other effects, a tariff-discrimination effect and a punishment effect, that can potentially offset the tariff-complementarity effect, and lead two FTA members to raise external tariffs. Consequently, Bagwell and Staiger (1998) suggest that developing countries that have formed FTAs might have (due to ineffective multilateral liberalization) incentives to reduce external tariffs, whereas developed countries that have formed FTAs might have (because of more successful multilateral liberalizations) incentives to raise external tariffs. Finally, Ornelas (2005c) addresses these considerations allowing for endogenous external tariffs and FTAs and political economy considerations, and argues that FTAs tend to induce members' governments to reduce external tariffs. Ornelas introduces two effects that suggest FTAs will tend to promote reductions in members' external tariffs and further liberalization multilaterally. One effect, a "strategic effect," reflects the weakening of the "profit-sharing" motive for protection when two countries form an FTA. Since partners' firms capture free access to the home market, they capture that market share taken away from outside firms, reducing incentives for the FTA members' governments to raise external tariffs. Ornelas' other effect is a "distributive" one. The formation of an FTA shifts home market shares from domestic firms to members' counterparts, reducing the ability of FTA governments to shift surplus from consumers to producers through higher external tariffs. This creates a channel for FTA governments to lower external tariffs. See Freund and Ornelas (2009) for an excellent survey on these issues.

FTA_{ij} of cross-FTA and own-FTA effects in the context of a Krugman-type model. Following B-B, initially we assume three continents $(1, 2, 3)$ with two countries on each continent (A, B).[4]

1.4.1 Established Bilateral Economic Determinants

This section summarizes the effects of several "core" economic variables influencing the net utility gains for countries i and j of FTA_{ij} as established in B-B. The rationale is to justify including these core variables later in our empirical specifications. See B-B for details.[5]

One of the key implications from Krugman (1991a,b), Frankel, Stein, and Wei (1995), Frankel (1997), and B-B is that *natural* (intra-continental) FTAs are unambiguously welfare superior to unnatural (inter-continental) FTAs; hence, two countries' social planners are more likely to form an FTA the smaller the distance between them (and if they share the same continent). For a given distance between a country-pair and ROW, the closer are two countries, the lower their transport costs and consequently the higher their trade volume. Elimination of the *ad valorem* tariff between close FTA members alleviates the price distortion on a large amount of trade, improving real income and utility of consumers more in intra-continental FTAs, as shown in Figure 1. In this class of models, all trade volume increases are at the intensive margin.[6]

The utility gain from an FTA between two countries increases as both countries' economic sizes increase proportionately (holding constant their relative size). In Figure 1, all countries are equivalently sized in labor (and GDP). As in B-B, consider asymmetric sizes in terms of absolute factor endowments to determine the scale-economies cum taste-for-variety effects. For brevity, we limit our comparative statics to natural trade partners only. We allow countries on continent 1 $(1A, 1B)$ to have larger absolute endowments of labor than countries on continent 2 $(2A, 2B)$, and $2A$ and $2B$ to have larger absolute endowments than countries on continent 3 $(3A, 3B)$; however, for any country-pair on the same continent, GDPs are identical. As above, we consider a single FTA between a pair of countries on one continent (different from B-B).

[4] A "visualization" of the "world" is shown in Figure 4, to be discussed later.

[5] The reader familiar with B-B may skip this section.

[6] The model assumes homogeneous productivities across firms in a country, as addressed earlier in section 1. There are other approaches as well to suggest why FTAs tend to be formed among closer, rather than distant, countries. Zissimos (2009), for instance, adapts the model of Yi (1996) to show that – since more rents are dissipated through transportation between regions rather than within them – regional FTAs eliminate the greater harmful "rent-shifting" among members and also has greater beneficial terms-of-trade effects. This reduction of harmful "rent-shifting" pushes countries more toward forming regional FTAs.

Figure 2 presents two surfaces, with the top one illustrating the welfare gain for either country $1A$ or $1B$ of an FTA between large economies $1A$ and $1B$ and the bottom surface illustrating the gain for either country $3A$ or $3B$ of an FTA between small economies $3A$ and $3B$. We emphasize two results. First, an FTA between two small economies is *still* welfare-improving. This result differs from that in Figure 2 of B-B where all natural partners went into an FTA simultaneously. With only one agreement at a time, even small countries can benefit from a bilateral FTA; hence, the trade-creation effect dominates the trade-diversion effect. This comparative-static result – that small countries can benefit on net from FTAs on the same continent – is new. Second, as in B-B, large countries benefit more than small countries from FTAs. Intuitively, welfare gains from an FTA should be higher for countries with larger absolute factor endowments (and thus larger real GDPs) due to reducing price distortions on a larger set of goods. An FTA between two large partners $(1A, 1B)$ increases the volume of trade (at the intensive margin) in more varieties than an FTA between two small partners $(3A, 3B)$ and reduces trade in fewer varieties from nonmembers than two small partners would, improving utility more among two large countries relative to that among two small countries. Also, the consequent larger increase in trade among two large economies from a bilateral FTA causes a larger net expansion of demand and hence a larger rise in real income (and terms of trade). Small countries $3A$ and $3B$ face considerable trade diversion when $1A$ and $1B$ form an FTA; the fall in relative demand for the small countries' production causes an erosion of terms of trade.

The utility gain from an FTA between two countries increases the more similar their economic sizes (for a given total real GDP of the country-pair). In this class of models, the more similar are the real GDPs of two countries on the same continent the larger the welfare gains from an FTA, for a given total GDP of the pair. In the previous comparative static, countries on the same continent had identical economic sizes. If $1A$ and $1B$ have identical shares of the two countries' factor endowments, the formation of an FTA provides gains from an increase in the volume of trade (at the intensive margin) as the tariff distortion is eliminated on much trade. By contrast, if $1A$ has virtually all of the labor on continent 1, formation of an FTA provides little welfare increase, since there is virtually no trade between $1A$ and $1B$ because $1B$ produces few varieties. Figure 3 illustrates this. The top surface shows the welfare gain for $1A$ when $1A$ and $1B$ are identically sized. The bottom surface shows the welfare gain for $1A$ when it has a larger share of the continent's labor force. Since $1A$ is larger, it gains less from an FTA with $1B$. This result was found already in B-B, but we present it here for completeness.

1.4.2 Cross-FTA and Own-FTA Effects

The following two hypotheses (*Hypotheses 1* and *2*) address the effects of *existing* FTAs on the welfare gains of *subsequent* FTAs. It is important to note, however, that our model is a static one (a single period), so there is no formal sense of "time." The model can, however, generate numerical welfare effects of an FTA between a country-pair *conditioned upon* various alternative scenarios, such as an FTA or no FTA between another country-pair. It is in this manner we use our model's comparative statics to motivate for the empirical analysis later of a series of cross-sections how existing FTAs influence the likelihood of FTAs in subsequent years. In order to "hold constant" as many effects as possible in our nonlinear model, we resume the assumption that all countries have identical absolute factor endowments, to eliminate asymmetries in economic size.

As suggested earlier, the two hypotheses are distinguished because *Hypothesis 1* addresses cross-FTA effects and *Hypothesis 2* addresses own-FTA effects. Figures 4a and 4b illustrate the two hypotheses, *1* and *2*, respectively. Figure 4a illustrates the case of two countries, $1A$ and $1B$ – say, the United States and Mexico – forming an FTA *conditioned upon* two other countries, $2A$ and $2B$ – say, France and Germany – already having an FTA. By contrast, Figure 4b illustrates the case of two countries, $1A$ and $1B$ – say, the United States and Mexico – forming an FTA *conditioned upon* one of the countries, $1A$ (say, the United States), already having an agreement with another country, $2A$ (say, Canada). It is important to note that – while countries $2A$ and $2B$ represent two countries on different continents – our framework allows inter- and intra-continental transport costs to vary between zero and prohibitive. Moreover, most models discussing potential trade diversion, terms-of-trade impacts, and tariff-complementarity effects omit natural trade costs.

Hypothesis 1 (Cross-FTA): The utility gain from an FTA between two countries $1A$ and $1B$ increases due to an existing FTA between two *other* countries – on the same or different continents – due to potential trade diversion, trade creation, and terms-of-trade effects.

We consider first the case of two countries $1A$ and $1B$ forming a bilateral FTA; we assume that all six countries initially have a tariff rate of 30 percent on each others' products, as discussed earlier.[7] We know from earlier comparative statics (Figure 1) that – conditioned upon no other FTAs in existence – such an FTA is necessarily welfare-improving. Figure 5a actually illustrates two surfaces. The bottom surface is the welfare gain for $1A$ of an FTA between countries $1A$ and $1B$ and no other FTA existing among all countries; we denote this $FTA_{1A,1B}$.

Suppose now instead that $2A$ and $2B$ already have an FTA. Figure 5a also illustrates the welfare gain to $1A$ of the formation of an FTA with $1B$ *conditioned on* an existing agreement between $2A$ and $2B$; this is the top surface. While the two surfaces are similar, the *existence* of $FTA_{2A,2B}$ increases unambiguously the gain in welfare of an FTA between $1A$ and $1B$. This is confirmed in Figure 5b which shows the (vertical) difference between the two surfaces, that is, the gains to $1A$ from an FTA between $1A$ and $1B$ conditioned on $FTA_{2A,2B}$ *less* the gains to $1A$ from $FTA_{1A,1B}$ without conditioning. Figure 5b reveals that the gain to $1A$'s utility of $FTA_{1A,1B}$ attributable to $FTA_{2A,2B}$ is positive for *all possible* intra- and inter-continental transports costs (from zero to prohibitive), given initial tariffs of 30 percent and $\sigma = 4$. This figure suggests that country $1A$'s (and, by symmetry, $1B$'s) "demand for membership" in an FTA with country $1B$ ($1A$) will tend to be higher if $2A$ and $2B$ have an *existing* FTA. The positive difference is the role of "third-country-pairs" creating *competitive liberalization*.[8]

Intuitively, when $2A$ and $2B$ form an FTA, each of $1A$ and $1B$ experience trade diversion, a loss of terms of trade, and erosion in real income. When a country pair $(2A, 2B)$ is remote – that is, when b is large – there are negligible volume-of-trade and terms-of-trade (real income) effects on $1A$'s utility from the formation of $FTA_{2A,2B}$ because there is little trade to be diverted between country $1A$ and countries $2A$ and $2B$. However, if inter- (and intra-) continental trade costs are low, then $1A$ trades considerably with $2A$ and $2B$; an FTA between $2A$ and $2B$ causes substantive trade diversion for $1A$, eroding $1A$'s volume of trade with $2A$ and $2B$ and $1A$'s utility and real income, but improving $1A$'s volume of trade with $1B$. Consequently, the formation of $FTA_{1A,1B}$ has an even larger impact on $1A$'s utility – in the presence of $FTA_{2A,2B}$ than in its absence – because the elimination of tariffs from $FTA_{1A,1B}$ on the greater volume of trade between $1A$ and $1B$ due to $FTA_{2A,2B}$ more than offsets the terms-of-trade loss due to trade diversion from $FTA_{2A,2B}$. $FTA_{2A,2B}$ effectively has made countries $1A$ and $1B$ more

[7] In the next section's sensitivity analysis, we examine the robustness of these comparative statics to other initial tariff levels.

[8] The comparative-static effect is qualitatively identical if the other FTA is between two countries on another continent $(3A, 3B)$.

"economically remote" and this isolation has made $1A$ and $1B$ economically more natural trade partners, enhancing the gains from an FTA. We note now that, at low transport costs, the net utility gain for $1A$ (and, by symmetry, $1B$) is at most 0.02 of one percent. We will discuss the sensitivity of the results to alternative values of σ, ϕ, and initial tariff rates later.

Hypothesis 2 (Own-FTA): The utility gain from an FTA between two countries $1A$ and $1B$ increases due to the existence of an FTA between either of these countries with *another* (third) country, and the gain is likely larger than in the previous case.

Consider again the case of two countries $1A$ and $1B$ forming a bilateral FTA; as before, we assume initially that all six countries have a tariff rate of 30 percent on each others' products. Figure 6a illustrates two surfaces. The bottom surface is the welfare gain for $1A$ of an FTA between countries $1A$ and $1B$ and no other FTA existing among all countries, as in Figure 5a; we denote this $FTA_{1A,1B}$.

Suppose now instead that $1A$ and $2A$ already have an FTA. Figure 6a also illustrates the welfare gain to $1A$ of the formation of an FTA with $1B$ *conditioned on* an existing agreement between $1A$ and $2A$; this is the top surface in Figure 6a. While the two surfaces are similar, the *existence* of $FTA_{1A,2A}$ increases unambiguously the gain in welfare of an FTA between $1A$ and $1B$ – this is referred to in this paper as the "*own-FTA*" effect. This is confirmed in Figure 6b which shows the (vertical) difference between the two surfaces, that is, the gains to $1A$ from an FTA between $1A$ and $1B$ conditioned on $FTA_{1A,2A}$ *less* the gains to $1A$ from $FTA_{1A,1B}$ without conditioning. Figure 6b reveals that the gain to 1A's utility of $FTA_{1A,1B}$ attributable to $FTA_{1A,2A}$ is positive for all possible intra- and inter-continental transports costs (from zero to prohibitive). This figure suggests that country $1A$'s "demand for membership" in an FTA with country $1B$ will tend to increase if $1A$ has an *existing* FTA with another country. Moreover, the effect is largest when trade costs are low. Note importantly that this is *not* due to potential trade diversion of $1B$; country $1A$ is already in an agreement with $2A$, so this is different from the trade diversion arguments in E-L and B-J. The economic intuition behind this is the following. At high trade costs, there is little trade between $1A$ and $2A$ so there can be little impact of $FTA_{1A,2A}$ on the gains to $1A$ from $FTA_{1A,1B}$. However, at low transport costs, $1A$ trades considerably with $2A$, and $FTA_{1A,2A}$ causes considerable trade diversion for $1A$ *with* $1B$, unlike the case of $FTA_{2A,2B}$ which increases $1A$'s trade with $1B$.

Two issues are worth noting. First, in contrast with the previous hypothesis, since $1A$ and

$1B$ are trading less in the presence of $FTA_{1A,2A}$ than in its absence, this lower volume of trade erodes the relative gain to $1A$'s welfare of $FTA_{1A,1B}$. Second, one cannot ignore that $FTA_{1A,2A}$ increased the terms of trade and real income of country $1A$ (as well as that of $2A$). This improvement in terms of trade and real income has a positive benefit for improving $1A$'s utility gain from $FTA_{1A,1B}$, conditioned upon $FTA_{1A,2A}$. The combination of these effects suggests that $1A$ has an incentive to form an FTA with $1B$; we term this "FTA-complementarity."[9]

We emphasize the relatively larger potential benefits from $FTA_{1A,1B}$ from the existence of $FTA_{1A,2A}$ (cf., Figure 6b) compared with the existence of $FTA_{2A,2B}$ (cf., Figure 5b) as measured by the percent change in utility. This is because $FTA_{1A,2A}$ causes a large increase in terms of trade and real income for $1A$ while $FTA_{2A,2B}$ causes a loss of terms of trade and real income for $1A$, even though $FTA_{1A,2A}$ leads to less trade volume between $1A$ and $1B$ and $FTA_{2A,2B}$ leads to more trade volume between $1A$ and $1B$. Hence, the percentage gain in utility for $1A$ from $FTA_{1A,1B}$ conditioned on $FTA_{1A,2A}$ is greater than that from $FTA_{1A,1B}$ conditioned on $FTA_{2A,2B}$ owing to the *terms-of-trade* effects.

Moreover, while $2A$ experiences some trade diversion with respect to $1B$ due to $FTA_{1A,1B}$, $2A$ still has an incentive to be in an FTA with $1A$. As Figure 6c reveals, $2A$ still experiences a utility gain from $FTA_{1A,2A}$ even conditioned on $FTA_{1A,1B}$. Thus, $2A$ has an incentive to be in an FTA with $1A$ even if it knew $1A$ would form an FTA with $1B$ at some point in the future.

Finally, as we would expect based upon the "domino effect" hypothesis, $1B$ suffers trade diversion and loss of real income from $FTA_{1A,2A}$. Despite the loss of real income, $1B$ on net benefits from an FTA with $1A$, raising $1B$'s demand for membership in $FTA_{1A,1B}$ (figure omitted for brevity).[10]

Consequently, these comparative statics suggest that an increase in the number of FTAs that, say, country $1A$ has with other (non-$1B$) countries increases the net utility gains of $FTA_{1A,1B}$. We note from Figure 6b that (at low transport costs) utility gain for $1A$ of $FTA_{1A,1B}$ conditioned on $FTA_{1A,2A}$ is about 0.7 percent. This gain is about 35 times greater than the

[9] We refer to the incentive for $1A$ to form an FTA with $1B$, conditioned on $FTA_{1A,2A}$, as FTA complementarity; it is a "selective" form of tariff complementarity. FTA complementarity differs from tariff complementarity because it does not address MFN external tariffs, and it targets a specific form of tariff liberalization, namely, another FTA. However, this is similar, but not identical, to using Nash equilibrium tariffs, the typical setting for discussing (static) tariff complementarity.

[10] The figure is omitted because it is qualitatively identical to Figure 6c. To see this, consider Figure 6c at zero transport costs. In this case, all countries are identical and on the same continent. The utility gains for $1B$ from $FTA_{1A,1B}$ conditioned on $FTA_{1A,2A}$ are identical to those for $2A$ from $FTA_{1A,2A}$ conditioned on $FTA_{1A,1B}$.

gain to $1A$ of $FTA_{1A,1B}$ conditioned on $FTA_{2A,2B}$, cf., Figure 5b, which was at most 0.02 percent. These relative values suggest that marginal own-FTA effects may well dwarf marginal cross-FTA effects in our empirical analysis later. However, before that, we discuss in the next section the robustness of these comparative statics to several considerations.

1.5 Caveats

1.5.1 Sensitivity Analysis

Since our comparative statics are determined over the entire span of inter- and intra-continental trade costs from zero to prohibitive (i.e., $0 \leq a, b \leq 1$), the only other three parameters in our model influencing the comparative statics are the fixed cost parameter (ϕ), the elasticity of substitution in consumption (σ), and initial tariff rates (τ_{ij}). In our baseline model, we have assumed $\phi = 1$, $\sigma = 4$, and initially $\tau_{ij} = 0.3$; then any bilateral FTA reduces τ from 0.3 to 0. We now consider the sensitivity of our comparative statics to variation in these values. For the impatient reader, the comparative statics discussed above are insensitive to the value of ϕ, but are sensitive to values of σ and initial levels of τ_{ij}.

First, consider the fixed cost parameter, ϕ, which was initially set arbitrarily equal to 1. It turns out the results are insensitive to variation in ϕ; it is an innocuous parameter. We re-ran the comparative statics using instead a value of $\phi = 10$, i.e., an order-of-magnitude change in the value of the parameter. The comparative statics were insensitive to this change.

Second, consider the elasticity of substitution, σ. Anderson and van Wincoop (2004) report a wide range of empirical estimates of σ. In general, they argue that a reasonable range of values of σ is between 5 and 10. However, some time-series analyses estimate σ lower than 5, and Krugman (1991a) suggested that a reasonable range is $2 < \sigma < 10$. Consequently, we re-ran our comparative statics for values of σ of 2 and 10 also. We found that Figures 5 and 6 were qualitatively identical for $\sigma = 10$. Own-FTA and cross-FTA effects were both positive and the relative utility gain was higher for own-FTA effects (relative to cross-FTA effects); this suggests that the results are robust for $4 < \sigma < 10$. However, for $\sigma = 2$, the cross-FTA effect was negative; with a lower elasticity of substitution, the negative terms-of-trade effect from trade diversion offsets the positive volume-of-trade effect, so that this source of competitive liberalization did not promote more FTAs. Since the own-FTA effect remained positive at $\sigma = 2$, the own-FTA effect still dominated the cross-FTA effect for promoting FTAs.

Third, consider the initial values of tariffs, $\tau_{ij} = 0.3$. The positive effects of own-FTAs and cross-FTAs tend to be stronger the higher the initial values of τ, as for σ. At higher initial values of τ, the own-FTA and cross-FTA effects are positive at $\sigma = 4$. At τ initially equal to 0.4, the own-FTA and third-country-pair-FTA effects are both positive even at $\sigma = 2$. However, if $\tau = 0.15$ initially, both own-FTA and cross-FTA effects are negative. At lower initial values of τ, the terms-of-trade changes are not very large, dampening the net positive impacts.

However, one theoretical result *is* robust whenever the own-FTA and cross-FTA effects are positive. In such cases, the own-FTA effects (in terms of $1A$'s welfare) are *always larger* than the cross-FTA effects. This robust result suggests that the own effect of one more existing FTA among either i or j with k likely contributes more to the probability of FTA_{ij} than the effect of one more existing third-country-pair FTA between k and l (cross-FTA effect).

1.5.2 Regionalism

In reality, we often observe enlargements of FTAs. Hence, we often observe $FTA_{1A,1B}$ *and* $FTA_{1A,2A}$ conditioned upon the existence of $FTA_{1B,2A}$, that is, enlargement of $FTA_{1B,2A}$ to include $1A$. For instance, the Canadian-US FTA was formed in 1989. In the early 1990s, Mexico wanted to form an FTA with the United States. However, the Canadian-US FTA was followed by NAFTA (Canada, Mexico, and United States), rather than maintaining separate bilateral FTAs between Canada and the United States and between Mexico and the United States. Of course, expansion of the European Community/Union has been by enlargement.

We return to our baseline parameter values for σ, ϕ, and initial values of τ_{ij}. Consider instead the gain in utility to country $1A$ from an FTA with $1B$ *and* one with $2A$ *conditioned upon* an FTA already existing between $1B$ and $2A$, i.e., enlargement of $FTA_{1B,2A}$. It turns out (figures omitted for brevity) that $1A$'s utility actually declines from $FTA_{1B,2A}$ already being in place. The economic reason behind this is the following. The formation of $FTA_{1B,2A}$ causes a large amount of trade diversion for $1A$ at low transport costs. This has a very large negative impact upon its terms of trade, especially at low intra- and inter-continental transport costs, $\sigma = 4$, and initial tariffs of 0.3. However, as before at higher initial tariffs (say, 0.4), the net welfare gain to $1A$ of forming an FTA with $1B$ and with $2A$ – that is, enlargement – is enhanced by the existence of $FTA_{1B,2A}$. Hence, the demand for membership by $1A$ is enhanced if the decline in tariffs is sufficiently great and the elasticity of substitution is sufficiently high.

Consequently, in the context of our model, Baldwin's "domino theory" does not *necessarily* hold; it depends on the values of σ and initial tariffs.

1.5.3 Special Interests and Political Economy

Finally, we return to some of the caveat discussion raised earlier regarding special interests and political economy. Regarding these issues, we conjecture our model could be enhanced to account for an influence of special interests in the government's objective function. We have no reason to believe that the relative importance of these considerations would be any different in our model relative to other models, such as those in Ornelas (2005a,b,c). Extensions to incorporate considerations as raised in Ornelas (2005a,b,c) would be useful, but are beyond this paper's scope.

Also, consider alternative notions of "competitive liberalization" to that applied here. To limit the number of comparative static exercises, we have only considered symmetric economies in our two hypotheses. Here, competitive liberalization refers to the impact of an FTA between France and Germany on the net utility gains of an FTA between the United States and Canada. Another notion of competitive liberalization considers asymmetrically-sized economies. For instance, one alternative notion of competitive liberalization allows for a large country (say, the United States) setting an FTA agenda (in the presence of MFN reduction rigidities), and using its economic size to extract "competition" between numerous small open economies looking to access the U.S. market. In the context of the B-B model, smaller economies have larger incentives to form an FTA with a large partner. While such considerations may be possible within the B-B model, such comparative static exercises are beyond the scope of this paper.

In the next section, we use guidance from our two comparative statics to postulate a logit model to examine each of these hypotheses and find evidence of own-FTA and cross-FTA effects using multilateral FTA and *ROW* FTA indexes, respectively. However, examination of any of Figures 5-6 suggests that the quantitative effect of an existing FTA on the welfare gain for a country from a subsequent FTA is sensitive to the level of intra- and inter-continental transport costs (which of course are related in reality to distance). One possibility is to weight other FTAs in the multilateral (and *ROW*) FTA indexes by inverse-distances (as has been done previously). We will address the issue in an alternative way later when we explore the estimated marginal response probabilities, distinguishing between natural (close) and unnatural (distant)

FTA partners.

Fig. 1: Percent Change in 1A's Utility from a Natural (Top) or Unnatural (Bottom) FTA

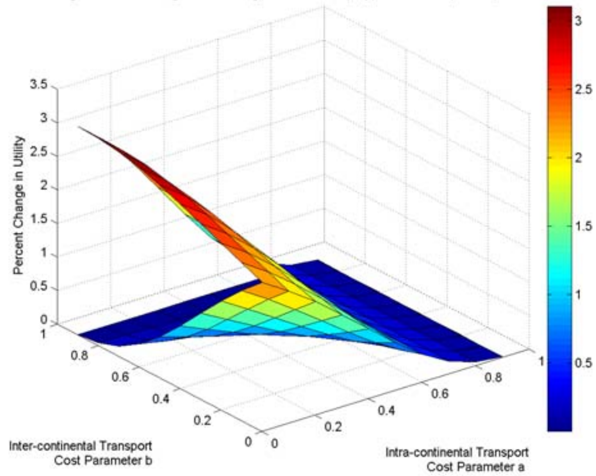

Fig. 2: Percent Change in 1A's Utility from an FTA Between Large (Top) or Small (Bottom) Economies

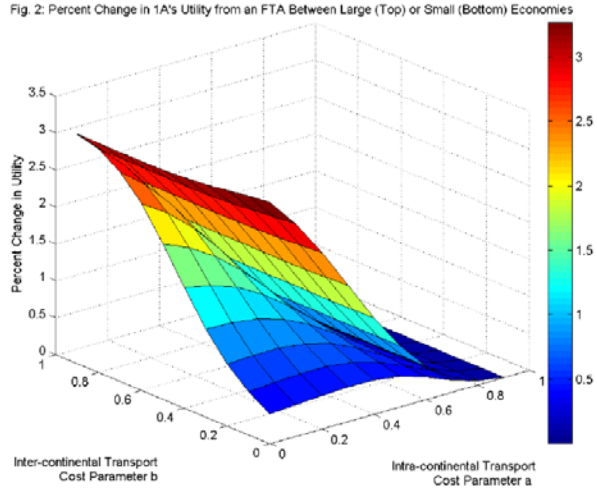

Fig. 3: Percent Change in 1A's Utility from an FTA between Similarly Sized (Top) Economies or Dissimilarly Sized (Bottom) Economies

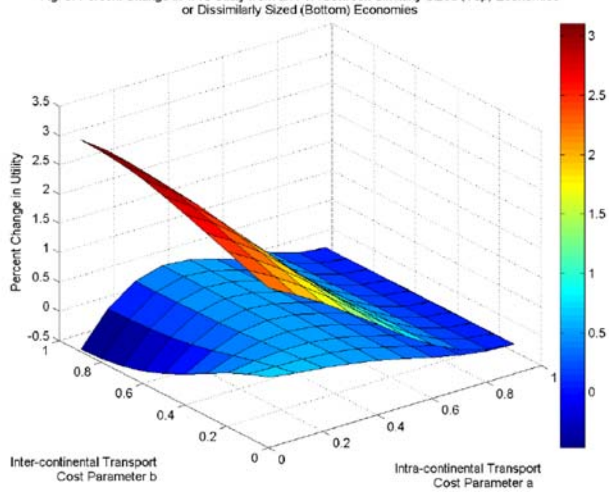

Figure 4a: Hypothesis 4 (Cross-FTA Effect)

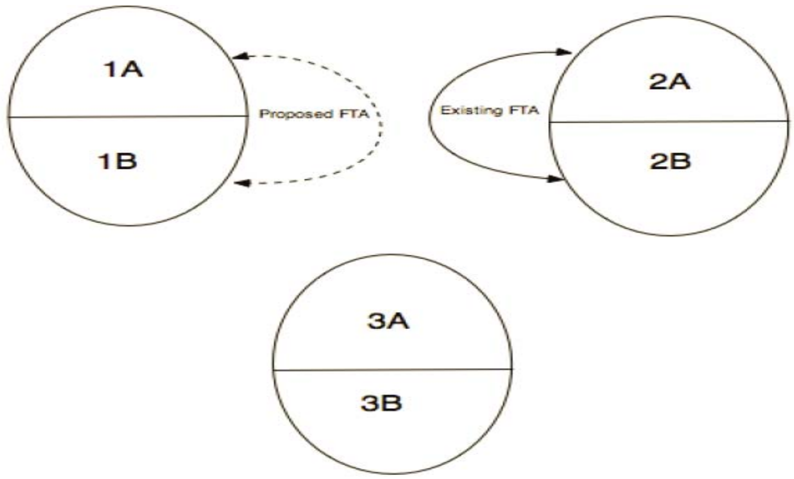

Figure 4b: Hypothesis 5 (Own-FTA Effect)

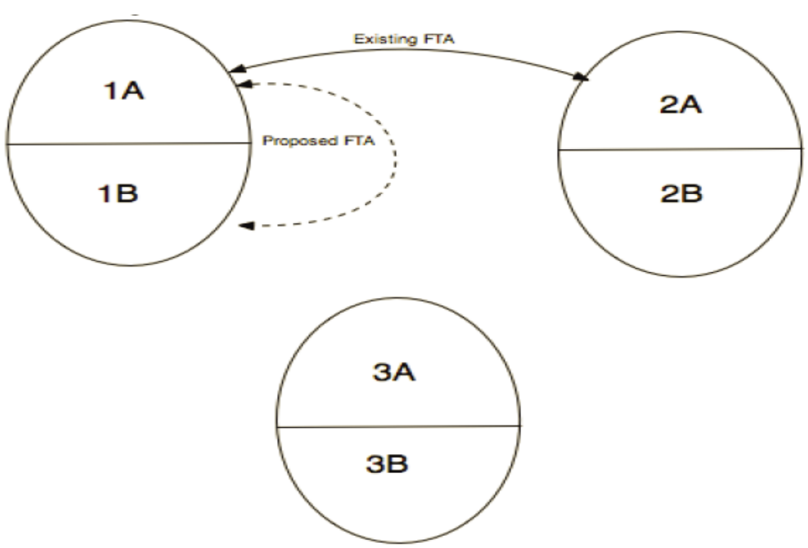

Fig.5a: Percent Gain in 1A's Utility from FTA (1A,1B)
Conditional on FTA (2A,2B)(Top) and from FTA (1A,1B) Unconditional(Bottom)

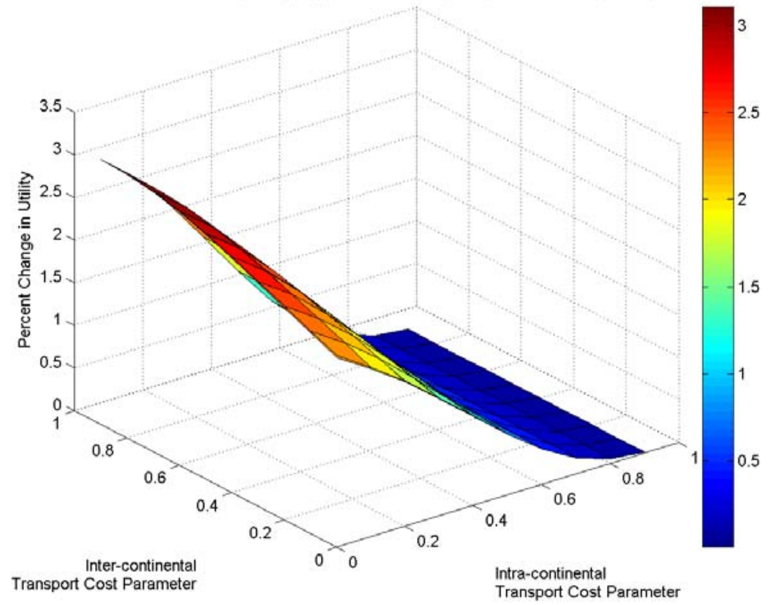

Fig.5b: Percent Gain in 1A's Utility from FTA(1A,1B),
Due to FTA(2A,2B)

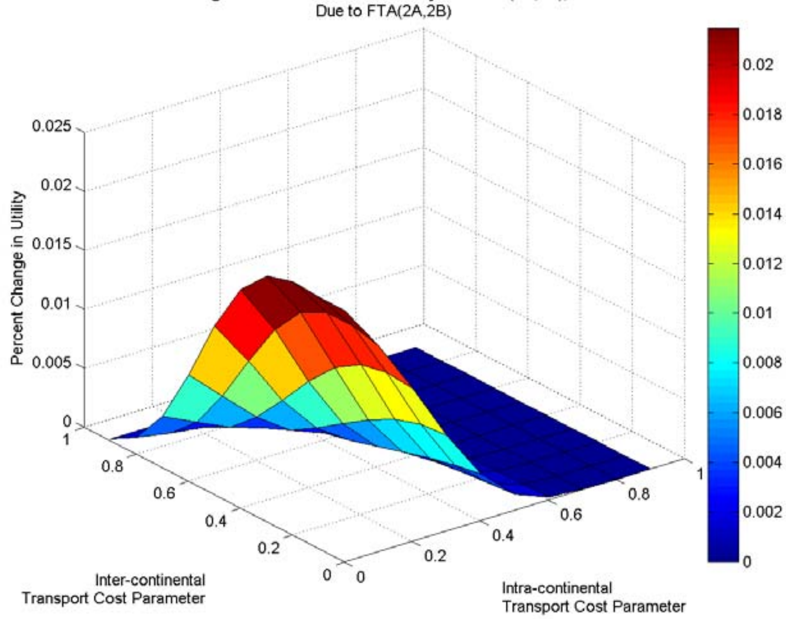

Fig. 6a: Percent Change in 1A's Utility from FTA (1A,1B)
Conditional on FTA (1A, 2A)(Top) and from FTA (1A,1B) Unconditional(Bottom)

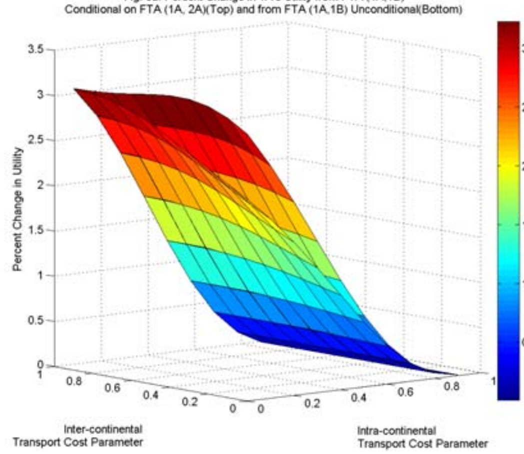

Fig.6b: Percent Change in 1A's Utility from FTA (1A,1B) Owing to FTA(1A,2A)

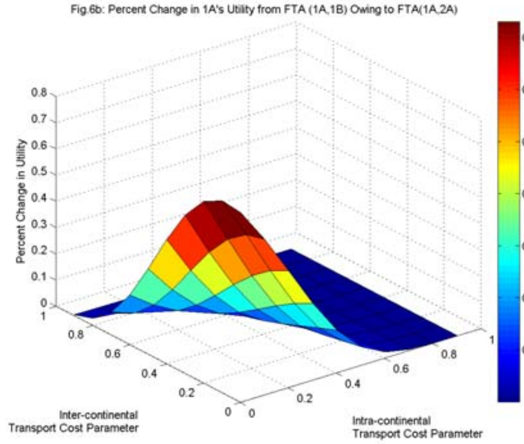

Fig.6c: Percent Change in 2A's Utility from FTA (1A,2A)
Conditional on FTA (1A,1B)