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International Trade, Regional Free Trade Agreements, and Economic Development

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Abstract

In 1991, Krugman illustrated that natural (regional) free trade agreements (FTAs) are likely to be welfare-enhancing if intercontinental transport costs are prohibitively high, but are likely to be welfare-reducing if such costs are zero. In 1995, Frankel, Stein and Wei extended the analysis to consider positive but nonprohibitive transport costs. This paper extends these models to allow for countries of different economic size. Large countries will tend to have higher relative wages, influencing the relative gains and losses from natural FTAs. For even modest differences in size, intracontinental FTAs are welfare-enhancing for larger countries, regardless of strong preferences for diversity or low intercontinental transport costs.

1. Introduction

Of the many changes in the international economic and business landscape over the past fifty years, two prominent features are the *globalization* of the world's output as depicted by the enormous growth of international trade—both in absolute terms as well as relative to the growth of the world's output—and the *regionalization* of international trade into what are increasingly termed "regional trading blocs."

Regarding the first feature, there is seemingly widespread acknowledgment that the world's economies have become more globalized; this is generally supported by noting higher shares of countries' gross domestic outputs that are imported and exported. The growth of world trade, relative to world output, has been attributed to both the dissolution of artificial barriers to trade, such as multilateral tariff reductions under GATT as well as regional free trade agreements, as well as the dissolution of natural barriers to trade, such as technology advances that have reduced transportation and communications costs.

Regarding the second issue, until 1990 international economists somewhat complacently accepted in the post-1945 era the simultaneous multilateral tariff reductions proposed and implemented under the auspices of several rounds of trade negotiations of members of the General Agreement on Tariffs and Trade (GATT) and the creation of numerous "bilateral" free trade agreements between GATT members in various regions of the globe, such as the European Community (EC), European Free Trade Association (EFTA), the Latin America Free Trade Association (LAFTA), and the Central American Common Market (CACM). However, since 1990 a tension has developed among international economists. Some (such as Jagdish Bhagwati) argue that the proliferation of regional free trade pacts has been diverting energy, resources, and incentives from multilateral trade policy negotiations, diminishing the ability of the GATT to further liberalize trade policies multilaterally. On the other hand, some (such as Paul Krugman) argue that the creation of new regional free trade pacts are often "natural" and augment world economic integration, and not at the cost of multilateral trade liberalization efforts.

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Along these lines, recent papers, including Krugman (1991a,b), Frankel et al. (1995), Nitsch (1996), Wei and Frankel (1996), and Spilimbergo and Stein (1997), have simulated general equilibrium models to demonstrate whether regional free trade agreements (FTAs) are welfare-enhancing or welfare-reducing. Spurring this debate, Krugman (1991a) developed a general equilibrium model to illustrate the potential welfare-reducing effects of regional free trade pacts when trade is generated under conditions of increasing returns to scale in production of differentiated goods with monopolistically competitive markets. Krugman showed that with zero transport costs regional FTAs are unambiguously welfare-reducing, but with prohibitive intercontinental transport costs regional FTAs are unambiguously welfare-enhancing. Using Krugman (1980) as their analytical foundation, Frankel, Stein and Wei (1995)—henceforth FSW—constructed a world economy with numerous symmetric economies on different continents and transport costs that can vary between zero and infinity. FSW demonstrate that there exist "natural" FTAs that are welfare-improving (though not as welfare-enhancing as multilateral tariff reductions). However, there are also "supernatural" FTAs, such that with low transport costs FTAs among economies on the same continent may be welfare-reducing. The FSW framework has been criticized by Deardorff and Stern (1994) who argue that the imperfect-substitutes model may overemphasize the utility from consuming a large number of varieties that may, realistically, only differ in brand name. They argue that the "assumptions of complete product differentiation . . . may introduce a bias against the possibility that an FTA will be beneficial" (p. 58).

In this paper, we shed light on the role of falling transport costs and tariffs, and the increasing regionalization of FTAs, in influencing economic behavior and welfare in developing countries relative to developed countries. To address this asymmetry among countries, we generalize the model of FSW to allow for countries of different economic size and (per capita) incomes. As Krugman (1980) noted, in the context of these imperfectly-competitive-markets models the introduction of transport costs alters relative wages. Differences in relative wages will allow the gains to welfare from falling transport costs, lower multilateral tariffs, and increased regional FTAs to differ between developing and developed countries. At low transport costs, large countries have higher relative wages (as Krugman noted), which enhances such countries' welfare gains from FTAs. Interestingly, we find that, even in the absence of traditional determinants of trade (such as relative factor endowments) *and* for very low transport costs, natural FTAs among large wealthy countries will virtually *always* be welfare-improving, even with strong preferences for variety. For even modest differences in economic size, natural FTAs will be welfare-enhancing for large countries regardless of the levels of transport costs and tariffs and of the taste for diversity. Developing countries, however, may face welfare improvement or reduction depending upon parameter values. For developing countries, regional FTAs are likely to be welfare-enhancing only if the love for variety is low.

The plan of the remainder of this paper is as follows. Section 2 overviews the basics of the Krugman and FSW analytical frameworks to motivate key issues. In section 3, the basic analytical model is described to generate the FSW framework with asymmetry; differing labor endowments among countries introduce asymmetric benefits and costs of reductions in transport costs and tariffs, even in the absence of traditional relative factor endowment comparative advantages. Section 4 simulates the model to show that technological advances increase welfare faster among developing countries relative to developed ones, narrowing the relative wage between such countries. Section 5 shows, however, that regional FTAs have greater benefits to welfare for

economically large economies and disadvantage small economies. In fact, for certain parameter values, FSW's result of "supernatural" regional FTAs disappears for even *marginally* more wealthy large economies.

2. Motivation and Overview

The analytical foundation for the model of international trade without transport costs and tariffs is Krugman (1980). In Krugman's model, international trade is generated by the interaction of consumers having tastes for diversity and production characterized by economies of scale; monopolistic competition is the market structure, characteristic of numerous manufacturing industries in the world. In this framework, there is one imperfectly competitive industry (manufactures) in each country producing output (x), with the representative firm in the industry facing some fixed setup costs (denoted α) and a constant marginal cost of production (denoted β) for adding the variable input, labor (l); the cost function is represented by $l_i = \alpha + \beta x_i$. Each country has a representative consumer whose taste for diversity is captured formally by a constant-elasticity-of-substitution (CES) utility function:

$$U = \sum_i^n c_i^\theta, \quad 0 < \theta < 1. \tag{1}$$

Firms maximize profits in each country subject to the technology, given the downward-sloping demand curves of the consumers worldwide.[1] In equilibrium, the price of each (symmetrically identical) firm is a gross markup ($1/\theta$) over marginal costs (βw_i):

$$p_i = \theta^{-1}\beta w_i, \tag{2}$$

where w_i is the wage rate of labor in each country. The equilibrium output of each firm is a function of the elasticity of substitution in consumption and technology parameters:

$$x_i = \theta\alpha/\beta(1-\theta). \tag{3}$$

The equilibrium number of goods (n_i) produced in each country is proportional to its absolute endowment of the single factor of production, labor (L_i):

$$n_i = L_i\left[(1-\theta)/\alpha\right]. \tag{4}$$

Frankel et al. (1995) extend this model to allow for positive tariffs (t is the *ad valorem* net tariff rate) and transportation costs (a, b). Transportation costs, moreover, can be within a continent as well as between continents; a (b) denotes the fraction of output exported by a country that is "consumed (or lost)" due to intra (inter) continental transport. The FSW model assumes the world consists of C continents with N identically sized (in terms of labor endowment and national income) countries on each continent. In the presence of positive tariffs and transport costs, the price level of the good of another country on the *same* continent (p_i^{C}) is a function of the home country's price level (p_i):

$$p_i^{\mathrm{C}} = p_i/(1-a) + p_i t. \tag{5}$$

The price level of the good of another country on a *different* continent (p_i^{NC}) is also a function of p_i:

$$p_i^{\mathrm{NC}} = p_i/(1-a)(1-b) + p_i t. \tag{6}$$

In the FSW model, the first-order conditions for the representative consumer's maximization problem yield the consumption level of this consumer from another country on the same continent (c_i^C):

$$c_i^C = c_i^H \left(p_i / p_i^C \right)^{1/(1-\theta)}, \tag{7}$$

and the consumption level of this consumer from another country on a different continent (c_i^{NC}):

$$c_i^{NC} = c_i^H \left(p_i / p_i^{NC} \right)^{1/(1-\theta)}, \tag{8}$$

where c_i^H is the consumption of the consumer in country i of his or her own output. In order to find the utility of the representative consumer, consumption of the consumer of his own product needs to be obtained. This value is obtained by solving the budget constraint of consumer i (first normalizing $p_i = 1$) below for c_i^H:

$$w_i + \sum_{i}^{N-1} t c_i^C + \sum_{j}^{C-1} \sum_{i}^{N} t c_{ij}^{NC} = c_i^H + \sum_{i}^{N-1} p_i^C c_i^C + \sum_{j}^{C-1} \sum_{i}^{N} p_{ij}^{NC} c_{ij}^{NC}. \tag{9}$$

The solution for c_i^H is substituted into equations (7) and (8) to obtain values for c_i^C and c_i^{NC}. The values for c_i^H, c_i^C and c_i^{NC} are substituted into utility function (1) to obtain

$$U_i = \left[w_i \Big/ \left\{ 1 + (N-1) \left[(1-a)^{\theta} \Big/ (1+t-ta) \right]^{1/(1-\theta)} + (C-1) N \left\{ \left[(1-a) \right. \right. \right. \right.$$
$$\left. \left. \left. \left. (1-b) \right]^{\theta} \Big/ \left[1 + (1-a)(1-b)t \right] \right\}^{1/(1-\theta)} \right\} \right]^{\theta} \times \left[1 + (N-1) \left\{ 1 \Big/ \left[(1-a)^{-1} + t \right] \right\}^{\theta/(1-\theta)} \right.$$
$$\left. + (C-1) N \left\{ 1 \Big/ \left[(1-a)^{-1} (1-b)^{-1} + t \right] \right\}^{\theta/(1-\theta)} \right]. \tag{10}$$

This utility function, $U = f(w, N, C-1, a, b, t, \theta)$, holds for the representative consumer in any country, since countries are perfectly symmetric. Since income (wage rate, w) and the labor stock (L) are the same in all countries here, w may be normalized to 1 (as FSW employ).

The basic model above can be used to illustrate many conceptual aspects of *regionalism*—the notion of specific regional "policies" enacted by governments to promote trade and economic integration, such as the EC, NAFTA, and APEC—and of *regionalization*—the notion of an increasing share of intraregional international trade arising due to "natural" economic and market forces. Figure 1(a) illustrates the potential welfare decline from regional free trade agreements (FTAs) in a world with identical consumers and country endowments, and zero transportation costs, as shown in Krugman (1991a,b) and Frankel et al. (1995). Each line represents the decline in welfare for a specific level of the tariff rate as a world of 60 countries are "carved up" into differently sized trading "blocs." The top, middle, and bottom lines represent welfare at a world tariff rate of 10, 20, and 30%, respectively. Regardless of the tariff rate, if all countries are members of one trading bloc there are no tariffs on any trade (i.e. world free trade) and welfare of the representative consumer is maximized (and normalized here to 1). With a tariff rate of 10% and the 60 countries divided into two trading blocs, world welfare falls because the division of countries into two blocs

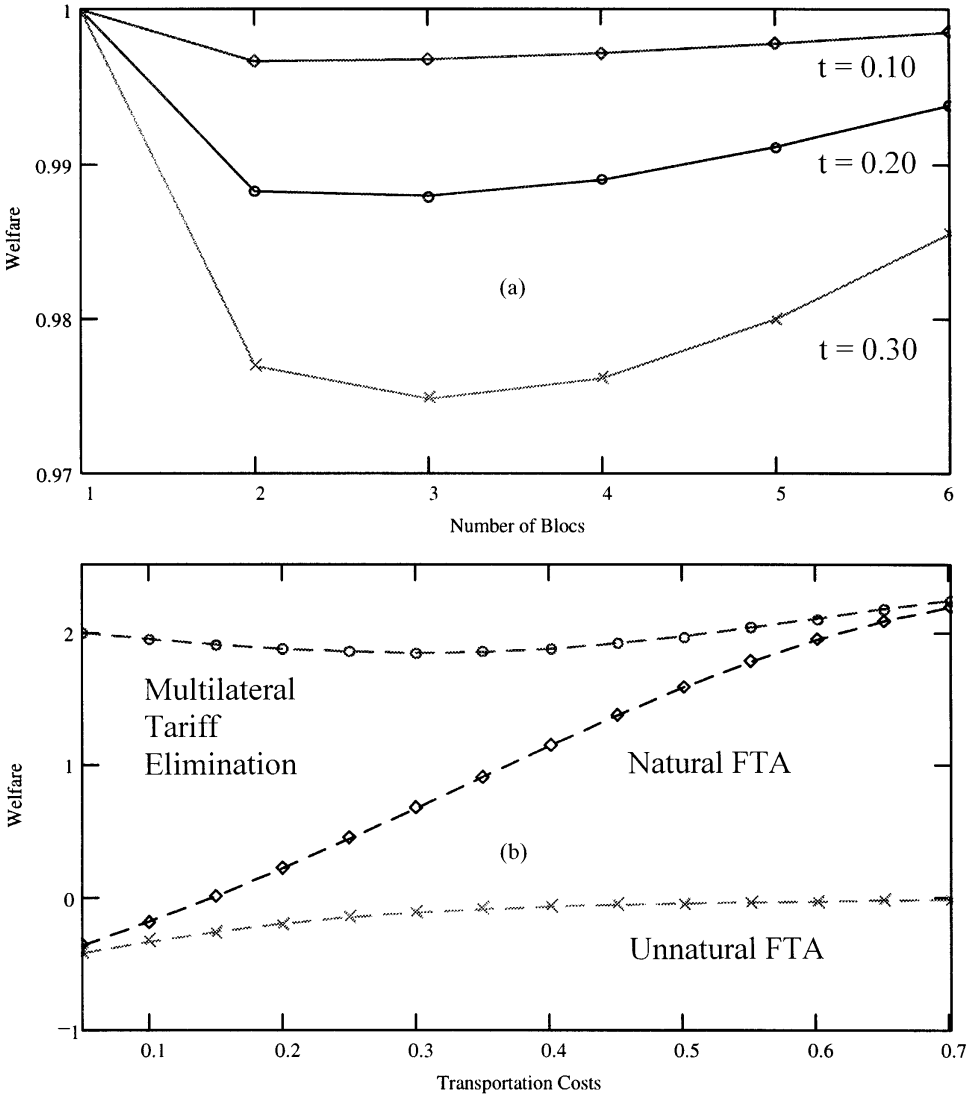

Figure 1. Alternative Trade Policies and Welfare

implies that tariffs will be applied on products supplied from outside the bloc. World welfare is minimized with two blocs because, as in Krugman (1991a), each commands large market power relative to the other, raising the optimal tariff. Moreover, the distortionary effect of a tariff wedge between bloc and non-bloc prices is maximized (as tariffs do not drive a wedge *between* non-bloc prices). For a given tariff rate (exogenous in FSW), world welfare improves as the number of blocs increases because the distortionary effect of tariffs diminishes owing to the larger number of varieties from non-bloc countries relative to bloc countries. For tariff rates of 20% and 30%, world welfare is minimized with three trading blocs.[2]

However, this characterization that trading blocs are necessarily welfare-reducing ignores—as Krugman (1991b) points out—the reality that, for geographical reasons, some countries are "natural" trading partners. The presence of intercontinental

and intracontinental transportation costs raises the possibility that free trade arrangements among "natural" (regional) trading partners may be welfare-increasing, although never as welfare-enhancing as multilateral free trade, while free trade arrangements among "unnatural" (globally dispersed) trading partners may be welfare-decreasing.

Figure 1(b) illustrates that multilateral free trade is optimal for the representative consumer in any country over any range of transport costs (similar to Figure 2 in FSW). In this case, there are three (identical) continents with two (identical) countries in each. The CES utility function parameter, θ, is set equal to 0.75 (representing a very modest "love of variety"). The top line in this figure represents the improvement of welfare (percentage change in utility) for the representative consumer, at various levels of intercontinental transport costs (and zero intracontinental transport costs), of reducing the tariff rate from 30% to zero. In the absence of transport costs, multilateral elimination of tariffs raises welfare as the distortionary wedge between domestic and foreign prices is eliminated. With positive transport cost levels ($b > 0$), utility is lower with either positive or zero tariffs. However, utility falls *less* in the absence of distortionary tariffs (as transport costs increase), yielding the top line in Figure 1(b). This policy is unambiguously welfare-improving; the convexity of this line will be addressed later in the paper.

The middle line in Figure 1(b) illustrates the improvement in welfare for the representative consumer, at various intercontinental transport cost levels, of reducing the tariff rate from 30% to zero for the trading partner within the same continent; that is, *regionalism*. If the portion of goods lost in transit exceeds 15%, "natural" free trade agreements (FTAs within the continent) improve welfare. That is, at higher levels of transport costs, welfare declines, but it declines faster without the FTA than with the FTA. In the special case of Krugman (1991b), prohibitive intercontinental transport costs ($b = 1$) imply that regional and multilateral trade policies have identical welfare effects.

However, if the transport-cost factor is less than 15%, welfare is diminished by creating a "natural" FTA. The reason is that with low intercontinental transport costs much of the variety of goods is coming from other continents. By eliminating tariffs on intracontinental international trade alone, the welfare reduction from losing varieties from abroad offsets the gain in varieties from within the continent; in the context of this framework, trade diversion exceeds trade creation.[3] In the special case of Krugman (1991a), zero transport costs suggest that welfare declines with regional FTAs, as trade diversion exceeds trade creation.

The bottom line represents the decline in welfare from introducing a FTA with a country on another continent; that is, an "unnatural" FTA. The substitution of varieties bearing transport costs for varieties with no transport costs is unambiguously welfare-diminishing, as the bottom line is always below zero. Only in the case of no intercontinental trade ($b = 1$) is there no welfare loss from an "unnatural" FTA.

However, there are limitations in these frameworks. The previous analyses treat all countries as *identical* in terms of economic size and wealth. While this is certainly a restrictive assumption for any international economic analysis, it is even more restrictive here since, as Krugman (1980) noted, the "only way" the presence of transport costs modifies models like this is by altering relative wages. In the next section, we show how the Krugman and FSW frameworks can be extended to allow for differences in economic size and wealth, without introducing differences in relative factor endowments.

3. Relative Incomes, Transport Costs, and International Trade

Krugman (1980) pointed out that, "The only way in which introducing transportation costs modifies (his) results . . . is in allowing the possibility that wages may not be equal in the two countries; the number and size of firms are not affected" (p. 954). His model suggested that "larger countries will have higher wages." The intuition is that, if production costs (α and β) are the same in two countries, it would be more profitable to produce in the larger country to minimize transportation costs. Hence, to maintain labor market equilibrium in both countries, the larger country would have to have a higher wage rate. However, wage differentials feed back into supply and demand, and consequently can influence the relative gains to welfare of a regional FTA. We show in this paper that welfare gains and losses of regionalism are influenced by these factors.

We address this issue by considering first three countries (1, 2, 3) on three separate continents (numbered the same) which are identical in all respects, *except* for their endowment of the single factor of production, labor (L). Hence, the economies share the same α, β, θ and t (with one country per continent, a is assumed zero[4]). The differences in L give rise to differences in per capita income and wealth (owing to increasing returns to scale), and consequently differences in consumption and welfare. Consequently, we can no longer discuss the representative agent for the world; rather, a representative agent exists for each of three continents.[5]

We note that the only paper in this literature that has attempted to introduce differences between countries is Spilimbergo and Stein (1997). Their paper considers the relative impacts of interindustry trade (generated by relative factor endowment differences) versus intraindustry trade (generated by scale and product diversity effects). An important purpose of their study was to address a concern suggested in Deardorff and Stern (1994) that, if traditional comparative advantages are accounted for, supernatural FTA effects do not surface. A prominent conclusion from the Spilimbergo and Stein paper is that the inclusion of traditional comparative advantages (owing to differing relative factor endowments in a two-good two-factor model) does not alter the FSW conclusion that, for low transport costs and even a modest love of variety, supernatural FTAs exist. By contrast, we show that, even without introducing traditional comparative advantages and even for strong tastes for product diversity, small differences between countries in relative economic size will ensure that natural FTAs are *always* welfare improving for large countries and that supernatural FTAs would be more likely for developing countries.[6]

We begin by specifying the balance-of-payments (BOP) constraints that must be satisfied for the three countries (continents), as suggested in Krugman (1980, p. 954):

$$\begin{aligned}\text{BOP}_1\text{:}\ & \Sigma_{L2}\Sigma_{n1}\left[p_1/(1-b)\right]c_{12}+\Sigma_{L3}\Sigma_{n1}\left[p_1/(1-b)\right]c_{13}\\ & -\Sigma_{L1}\Sigma_{n2}\left[p_2/(1-b)\right]c_{21}+\Sigma_{L1}\Sigma_{n3}\left[p_3/(1-b)\right]c_{31}=0\end{aligned}\tag{11}$$

$$\begin{aligned}\text{BOP}_2\text{:}\ & \Sigma_{L1}\Sigma_{n2}\left[p_2/(1-b)\right]c_{21}+\Sigma_{L3}\Sigma_{n2}\left[p_2/(1-b)\right]c_{23}\\ & -\Sigma_{L2}\Sigma_{n1}\left[p_1/(1-b)\right]c_{12}+\Sigma_{L2}\Sigma_{n3}\left[p_3/(1-b)\right]c_{32}=0\end{aligned}\tag{12}$$

$$\begin{aligned}\text{BOP}_3\text{:}\ & \Sigma_{L1}\Sigma_{n3}\left[p_3/(1-b)\right]c_{31}+\Sigma_{L2}\Sigma_{n3}\left[p_3/(1-b)\right]c_{32}\\ & -\Sigma_{L3}\Sigma_{n1}\left[p_1/(1-b)\right]c_{13}+\Sigma_{L3}\Sigma_{n2}\left[p_2/(1-b)\right]c_{23}=0,\end{aligned}\tag{13}$$

where L_i is the labor stock in country i, n_i is the number of varieties of the good produced in i, p_i is the producer's price in i, t_{ij} is the tariff rate on country i's goods imported by country j, b is the intercontinental transport cost factor, and c_{ij} is the consumption per household (or laborer) of country i's product in country j. The key to solving the model is to express these three conditions in terms of each country's wealth (w_i), and solve the three equations for w_1, w_2, and w_3. The utility of each country's consumer can then be expressed in terms of relative wealth.

Maximizing the CES utility function for country 1's consumer yields first-order conditions

$$c_{21} = \left(p_1 \Big/ \left[p_2 \Big/ \left(1-b\right) + p_2 t_{21}\right]\right)^{1/(1-\theta)} c_{11} \tag{14a}$$

$$c_{31} = \left(p_1 \Big/ \left[p_3 \Big/ \left(1-b\right) + p_3 t_{31}\right]\right)^{1/(1-\theta)} c_{11}. \tag{14b}$$

It will be useful to follow Krugman (1980) by defining terms σ_{21} and σ_{31} as

$$\sigma_{21} = \left[p_1 \Big/ \left\{p_2 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{21}\right]\right)\right\}\right]^{1/(1-\theta)} \left[\left(1-b\right) \Big/ \left[1+\left(1-b\right)t_{21}\right]\right]^{-1} \tag{15a}$$

$$\sigma_{31} = \left[p_1 \Big/ \left\{p_3 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{31}\right]\right)\right\}\right]^{1/(1-\theta)} \left[\left(1-b\right) \Big/ \left[1+\left(1-b\right)t_{31}\right]\right]^{-1}. \tag{15b}$$

Combining equations (14) and (15) with the wealth (or budget) constraint for consumer 1 yields

$$\begin{aligned} w_1 + tr_1 &= n_1 p_1 c_{11} + n_2 \left[p_2 \Big/ \left\{\left(1-b\right) \Big/ \left[1+\left(1-b\right)t_{21}\right]\right\}\right] c_{21} \\ &\quad + n_3 \left[p_3 \Big/ \left\{\left(1-b\right) \Big/ \left[1+\left(1-b\right)t_{31}\right]\right\}\right] c_{31} \\ &= \left(n_1 p_1 + \sigma_{21} n_2 p_2 + \sigma_{31} n_3 p_3\right) c_{11} = \Omega_1^{-1} c_{11} \end{aligned} \tag{16}$$

or

$$c_{11} = \Omega_1 \left(w_1 + tr_1\right), \tag{17}$$

where $\Omega = (n_1 p_1 + \sigma_{21} n_2 p_2 + \sigma_{31} n_3 p_3)^{-1}$ and $tr_1 = t_{21} n_2 p_2 c_{21} + t_{31} n_3 p_3 c_{31}$. The term tr denotes the tariff revenue of that country's consumer. Through appropriate substitutions, we can then solve for

$$c_{21} = \left[p_1 \Big/ \left\{p_2 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{21}\right]\right)\right\}\right]^{1/(1-\theta)} \Omega_1 \left(w_1 + tr_1\right) \tag{18}$$

$$c_{31} = \left[p_1 \Big/ \left\{p_3 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{31}\right]\right)\right\}\right]^{1/(1-\theta)} \Omega_1 \left(w_1 + tr_1\right). \tag{19}$$

In a similar manner, we can solve for consumption of the representative consumer in country 2, (c_{12}, c_{22}, c_{32}), as a function of this consumer's income, w_2:

$$c_{22} = \Omega_2 \left(w_2 + tr_2\right), \tag{20}$$

where $\Omega_2 = (\sigma_{12} n_1 p_1 + n_2 p_2 + \sigma_{32} n_3 p_3)^{-1}$, $\sigma_{12} = [p_2/\{[p_1/([1-b]/[1+(1-b)t_{12}])\}]^{1/(1-\theta)}$ $[[1-b]/[1+(1-b)t_{12}]]^{-1}$, and $\sigma_{32} = [p_2/\{[p_3/([1-b]/[1+(1-b)t_{32}])\}]^{1/(1-\theta)}[[1-b]/[1+(1-b)t_{32}]]^{-1}$. Through appropriate substitutions, we can then solve for

$$c_{12} = \left[p_2 \Big/ \left\{p_1 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{12}\right]\right)\right\}\right]^{1/(1-\theta)} \Omega_2 \left(w_2 + tr_2\right) \tag{21}$$

$$c_{32} = \left[p_2 \Big/ \left\{ p_3 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{32}\right] \right) \right\} \right]^{1/(1-\theta)} \Omega_2 \left(w_2 + tr_2 \right). \tag{22}$$

Similarly, consumption of the representative consumer in country 3, (c_{13}, c_{23}, c_{33}), is a function of this consumer's income, w_3:

$$c_{33} = \Omega_3 \left(w_3 + tr_3 \right), \tag{23}$$

where $\Omega_3 = (\sigma_{13} n_1 p_1 + \sigma_{23} n_2 p_2 + n_3 p_3)^{-1}$, $\sigma_{13} = [p_3/\{[p_1/([1-b]/[1+(1-b)t_{13}])\}]^{1/(1-\theta)}[[1-b]/[1+(1-b)t_{13}]]^{-1}$, and $\sigma_{23} = [p_3/\{[p_2/([1-b]/[1+(1-b)t_{23}])\}]^{1/(1-\theta)}[[1-b]/[1+(1-b)t_{23}]]^{-1}$. Through appropriate substitutions, we can then solve for

$$c_{13} = \left[p_3 \Big/ \left\{ p_1 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{13}\right] \right) \right\} \right]^{1/(1-\theta)} \Omega_3 \left(w_3 + tr_3 \right) \tag{24}$$

$$c_{23} = \left[p_3 \Big/ \left\{ p_2 \Big/ \left(\left[1-b\right] \Big/ \left[1+\left(1-b\right)t_{23}\right] \right) \right\} \right]^{1/(1-\theta)} \Omega_3 \left(w_3 + tr_3 \right). \tag{25}$$

The model can now be solved for utility of the representative consumer in each of the different countries (and continents). Recalling that $n_i = L_i(1-\theta)/\alpha$ and $p_i = \theta^{-1}\beta w_i$ (for $i = 1, 2, 3$), the solutions above can be substituted into the three BOP conditions (11)–(13) to yield three nonlinear equations in three unknown variables (w_1, w_2, w_3).[7]

Each consumer's utility can be expressed in terms of the three countries incomes' (w_1, w_2, and w_3) and the exogenous values of the three countries' labor stocks (L_1, L_2, L_3), the intercontinental transport cost parameter (b), and the elasticity of substitution in consumption (preference parameter θ). Consumer 1's utility is given by

$$\begin{aligned} U_1 = \left[\left(1-\theta\right)/\alpha\right] \Big\{ & L_1 + \left[\left(1-b\right)/\left(1+\left(1-b\right)t_{21}\right)\right] L_2 \left(w_1/w_2\right)^{\theta/(1-\theta)} \\ & + \left[\left(1-b\right)/\left(1+\left(1-b\right)t_{31}\right)\right] L_3 \left(w_1/w_3\right)^{\theta/(1-\theta)} \Big\} c_{11}^{\theta} \end{aligned} \tag{26}$$

Consumer 2's utility is given by

$$\begin{aligned} U_2 = \left[\left(1-\theta\right)/\alpha\right] \Big\{ & \left[\left(1-b\right)/\left(1+\left(1-b\right)t_{12}\right)\right] L_1 \left(w_2/w_1\right)^{\theta/(1-\theta)} \\ & + L_2 + \left[\left(1-b\right)/\left(1+\left(1-b\right)t_{32}\right)\right] L_3 \left(w_2/w_3\right)^{\theta/(1-\theta)} \Big\} c_{22}^{\theta} \end{aligned} \tag{27}$$

Finally, consumer 3's utility is given by

$$\begin{aligned} U_3 = \left[\left(1-\theta\right)/\alpha\right] \Big\{ & \left[\left(1-b\right)/\left(1+\left(1-b\right)t_{13}\right)\right] L_1 \left(w_3/w_1\right)^{\theta/(1-\theta)} \\ & + \left[\left(1-b\right)/\left(1+\left(1-b\right)t_{23}\right)\right] L_2 \left(w_3/w_2\right)^{\theta/(1-\theta)} + L_3 \Big\} c_{33}^{\theta} \end{aligned} \tag{28}$$

Equations (26)–(28) show the potential effects of relative wealth on the utilities of the representative continents' consumers. The next section discusses how the benefits of transportation cost declines differ according to economic size.

4. Simulations of Utility and Incomes

The model is simulated first to see the implications for welfare of three countries with differing labor endowments, and consequently differing per capita incomes, as techno-

logical advance lowers the cost of transportation of goods. This section discusses three principal results. First, Krugman's (1980) proposition that larger countries will have higher wage rates holds. Second, transport cost increases reduce welfare and wages in every country; however, as transport costs increase, the wage of larger countries increases *relative* to that of smaller countries. Third, the effect of transport costs on relative wages is very sensitive to the degree of product substitutability; at low transport costs and low preference for diversity, falling transport costs improve the relative wages of poor countries sharply, while they improve the relative wages of poor countries modestly if preference for diversity is high. By contrast, at high transport costs and high preference for diversity, falling transport costs improve the relative wages of poor countries sharply, while they improve the relative wages of poor countries modestly if preference for diversity is low. Relative wages are shown to be a nonmonotonic function of the taste for diversity; that is, for given transport costs and labor endowments, wage differentials will be low for very low preferences for diversity, increase as the taste for diversity increases, but then fall again as the preference for diversity becomes very strong.

Symmetric and Identical Country Sizes

To provide a baseline for comparison, we first simulate the model for countries of *identical* labor endowment. Figure 2(a) confirms that relative wages, or relative per capita incomes (w_1/w_2 and w_3/w_2) remain at unity, regardless of the level of the transportation cost factor (b, on the horizontal axis, $0 < b < 1$). This is consistent with our expectation; with perfectly symmetric countries in terms of factors, tastes and policies, relative incomes should be invariant to changes in transportation costs. Figure 2(b) confirms that all three countries' levels of welfare are (identically) lower the higher is the transportation cost factor (b). The key insight to draw from Figure 2(b) is that—given the popular belief that technological improvements have lowered transportation and communication costs (cf. Krugman, 1995)—the model here suggests that technological improvements improve countries' welfares.

Symmetric, but Nonidentical, Country Sizes

Consider now the case when country 1's and country 3's labor stocks are symmetrically less than and greater than, respectively, country 2's labor stock. Let country 1's labor stock be 10% less than country 2's labor stock ($L_1 = 90$ and $L_2 = 100$) and let country 3's labor stock be 10% greater than country 2's labor stock ($L_3 = 110$). Figure 2(c) illustrates two results. First, as in the identical countries case, utility falls monotonically for countries as transportation costs increase. Thus, technology-induced transportation cost reductions over recent decades seem to have improved countries' welfares. Second, as transport costs rise (b increases), welfare falls faster in the smallest country (1); this is shown by line 1 in Figure 2(c). Perhaps the more relevant way to express this, as transport costs decline welfare improves *faster in smaller countries than in larger countries*.

The reason for welfare improving faster in smaller countries is suggested in Figure 2(d). This depicts the wage of the representative consumer in each country relative to consumer 2. The bottom line in Figure 2(d) shows per capita income rising for poorer household 1 relative to household 2 as the transportation cost factor falls, while per capita income is falling for richer household 3 relative to household 2 (and

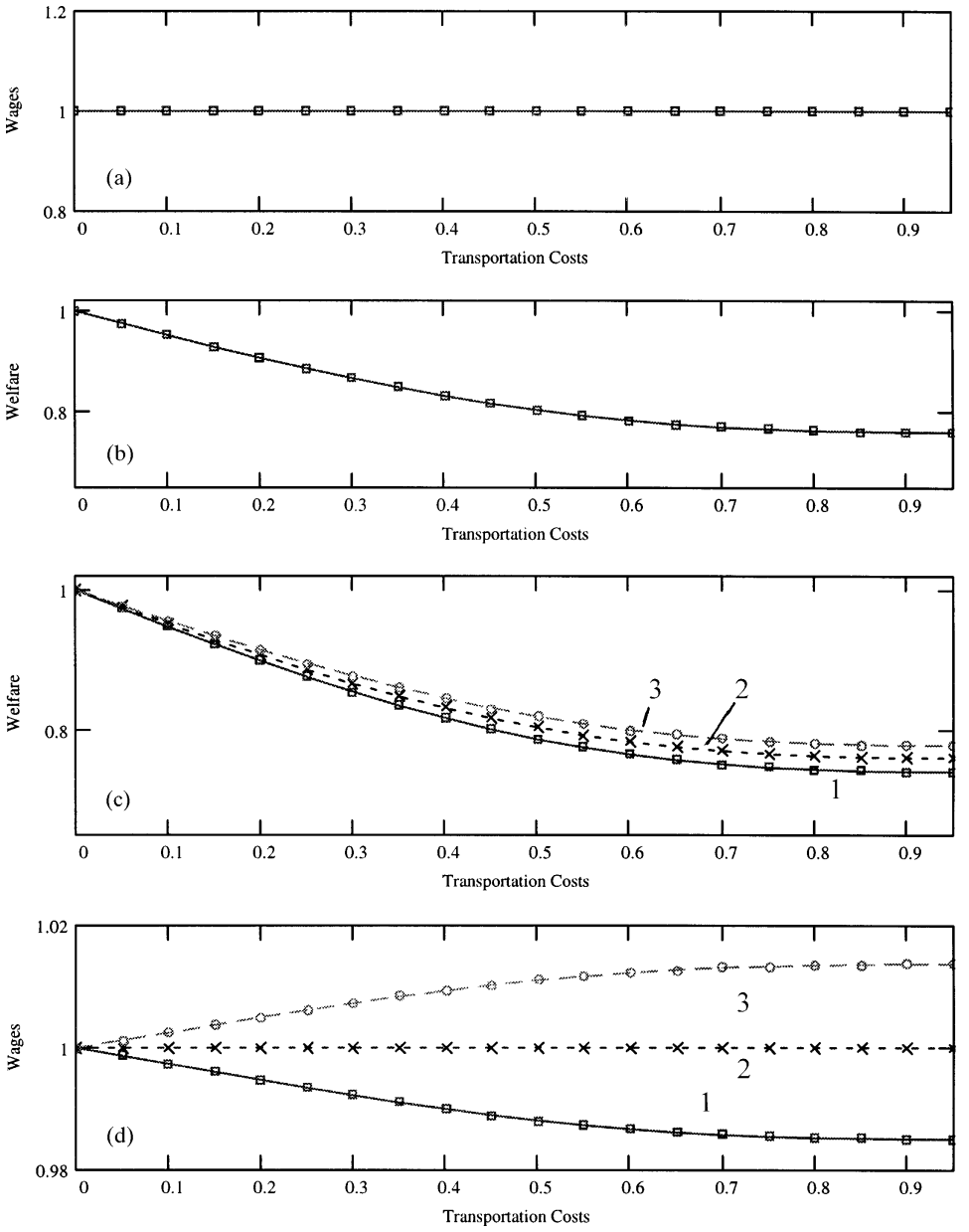

Figure 2. Welfare and Relative Wages Under Various Tranportation Costs

the straight line simply illustrates household 2's income relative to itself, obviously unity).

The intuition for this is the following. At any positive level of transport costs ($b > 0$), larger country 3's consumer is wealthier than country 2's (and 1's). Since fixed and marginal production costs (α and β, respectively) are the same in all three countries here, it is potentially more profitable to produce in a larger market owing to increasing returns to scale in production. Because of the general equilibrium assumption that

labor is fully employed in both countries, labor must earn a higher relative wage in the relatively larger country. This is consistent with the two-economy model discussed in Krugman (1980). Hence, as transportation costs decline (lower *b*), the relative importance of economic size diminishes. Consequently, the per capita income of the smaller country improves *relative* to the per capita income of the larger country. Thus, while both larger and smaller countries' utilities improve with technology-induced lower transport costs, poorer countries' welfares may have improved faster than richer countries' welfares. Falling transportation costs may have contributed toward less income dispersion in the world.

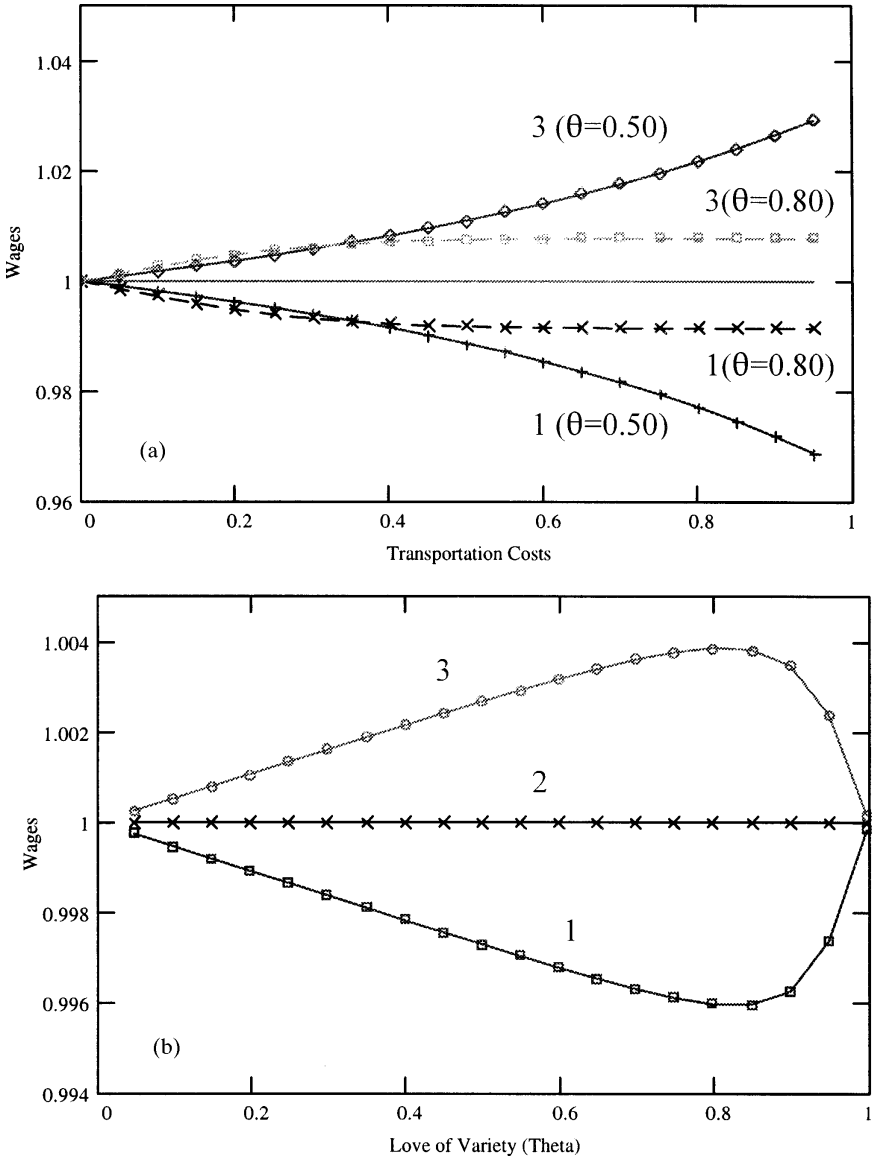

Figure 3. Relative Wages

The Role of Taste for Variety

The degree to which goods are substitutable is important in this analysis. Figure 3(a) illustrates how the comparative advantage of size is influenced by the strength of preference for variety. With zero intercontinental transport costs ($b = 0$) and zero tariffs, countries are indifferent between products at home or abroad, as international trade is frictionless. Suppose the preference for variety is significant ($\theta = 0.50$). As transport costs increase, the smallest country (1) is at a comparative disadvantage because its wage must decline to maintain labor market equilibrium, as the large country shifts demand towards its own continent to minimize transportation costs. As transport costs become prohibitively large, the relative wage of small countries falls sharply; the costs of transportation offset the gains from product variety. With strong love of variety and high transport costs, the comparative advantage of large countries in producing varieties of goods is enhanced.

However, suppose the preference for variety is low ($\theta = 0.80$) and transport costs are zero. As transport costs are introduced, the relative wage of small countries drops more than in the case of strong taste for variety ($\theta = 0.50$). With weak preference for variety, small countries have little market power to ensure demand for their goods, and labor demand falls more sharply. However, as transport costs continue to increase, the relative wage of small countries falls very little. The comparative disadvantage of being small (in producing varieties) has little relevance if there is only modest taste for variety.

Finally, Figure 3(b) illustrates that relative wages are a nonmonotonic function of the taste for variety (for given transport costs). Suppose transport costs are 15% ($b = 0.15$). If goods are perfect substitutes in consumption ($\theta = 1$), the relative economic benefit of being a large country is zero. As the taste for variety becomes positive ($\theta < 1$), the larger country's comparative advantage becomes evident. However, as the taste for variety is further enhanced (say, $\theta = 0.75$), the relative benefit of size for the large country is offset by its demand for the small country's products. The *demand effect* on relative wages from strong preferences for variety starts to offset the *supply effect* on relative wages of economic size. As θ approaches 0, the desire for variety ensures sufficient demand in the small country to maintain parity in wage to the large economy. Thus, for given transport costs, at weak preferences for variety ($\theta = 0.80$) relative wages of small countries are low because the comparative disadvantage of factor endowment size is strong. However, with strong preferences for variety ($\theta = 0.20$) relative wages of small countries are not very low as the strong demand for variety ensures sufficient labor demand in small relative to large countries.

5. Relative Wages, Multilateral Tariff Reductions, and Regional Free Trade Agreements

We use this model to demonstrate how large countries' welfares are affected relative to small countries welfares' with the elimination of all tariffs or the creation of regional free trade agreements. The principal results of this section are the following. First, different factor endowment sizes allow for the welfare gains (and losses) of multilateral and regional FTAs to differ according to economic size. Second, large countries' welfare gains from regional trade liberalization are enhanced relative to small countries' gains. Third, the likelihood of "supernatural" FTAs occurring is diminished for large countries, and enhanced for small countries. Fourth, for even modest differences in factor endowment sizes, supernatural FTAs will not exist for large coun-

tries *regardless* of the strength of the taste for diversity and the level of transport costs and tariffs.

Baseline Model: Positive Tariffs

The model in section 3 can be extended readily to consider three continents with two identical countries on each. Assume zero intracontinental transport costs and a tariff rate of 30% initially for each of the six countries on imported goods. Assume that the two countries on any continent are identical.[8] Assume each of the two continent 1 countries (1 and 1′) has a labor stock 10% less than each of the two continent 2 countries (2 and 2′); i.e. $L_1 = 90$ and $L_2 = 100$. Let each of the two continent 3 countries (3 and 3′) have a labor stock 10% more than each of the two continent 2 countries; i.e. $L_3 = 110$.

Figure 4(a) illustrates the effect on relative wages of introducing multilateral tariffs of 30%. Figure 4(a) is similar, but not identical, to Figure 2(d). Even at zero transport costs, the larger country now has a higher relative wage rate. The increased demand at home due to tariffs drives up (down) the price and consequently the wage rate in the large (small) country to restore labor market equilibrium to minimize transaction costs.

Multilateral Tariff Reductions

Recalling Figure 1(b) from section 2, multilateral elimination of tariffs (from 30% levels) is unambiguously welfare-improving, in the context of the type of model here and traditional comparative advantage models. However, the top line in Figure 1(b), which depicted the welfare gains from eliminating tariffs multilaterally among countries of identical size, had a seemingly trivial, but curious, convexity. Our discussion above on relative wages can now explain this curiosum.

Figure 4(b) illustrates the gains to welfare from multilateral tariff elimination when countries have different sizes (L = 90, 100, 110). Figure 4(b) reveals that, at high transport costs (say, $b = 0.8$) and a modest love of variety ($\theta = 0.75$), the gains from multilateral free trade are approximately the same for small as for large countries. The intuition is that, with high intercontinental transport costs, there is little intercontinental trade; reducing tariffs multilaterally only enhances intracontinental trade. Since both countries on each continent are identically sized and have no intercountry comparative advantages, both small- and large-country continents share identically from multilateral tariff removal.

However, at low transport costs ($b = 0.15$) there is considerable intercontinental trade. Elimination of tariffs on all trade enhances the comparative advantage of small countries, and raises their gains from trade more than large countries, because the satiation of demand for product variety is enhanced; this is analogous to the effect of lower intercontinental transport costs raising the relative welfare of small countries. This comparative advantage is enhanced the greater the love of variety; simulations with lower θs reveal even larger relative welfare gains to small countries (not shown).

Regional Free Trade Agreements

The relative wage effect explains also the differential in welfare gains between large rich countries and small poor countries from regional FTAs. Figure 4(c) illustrates the

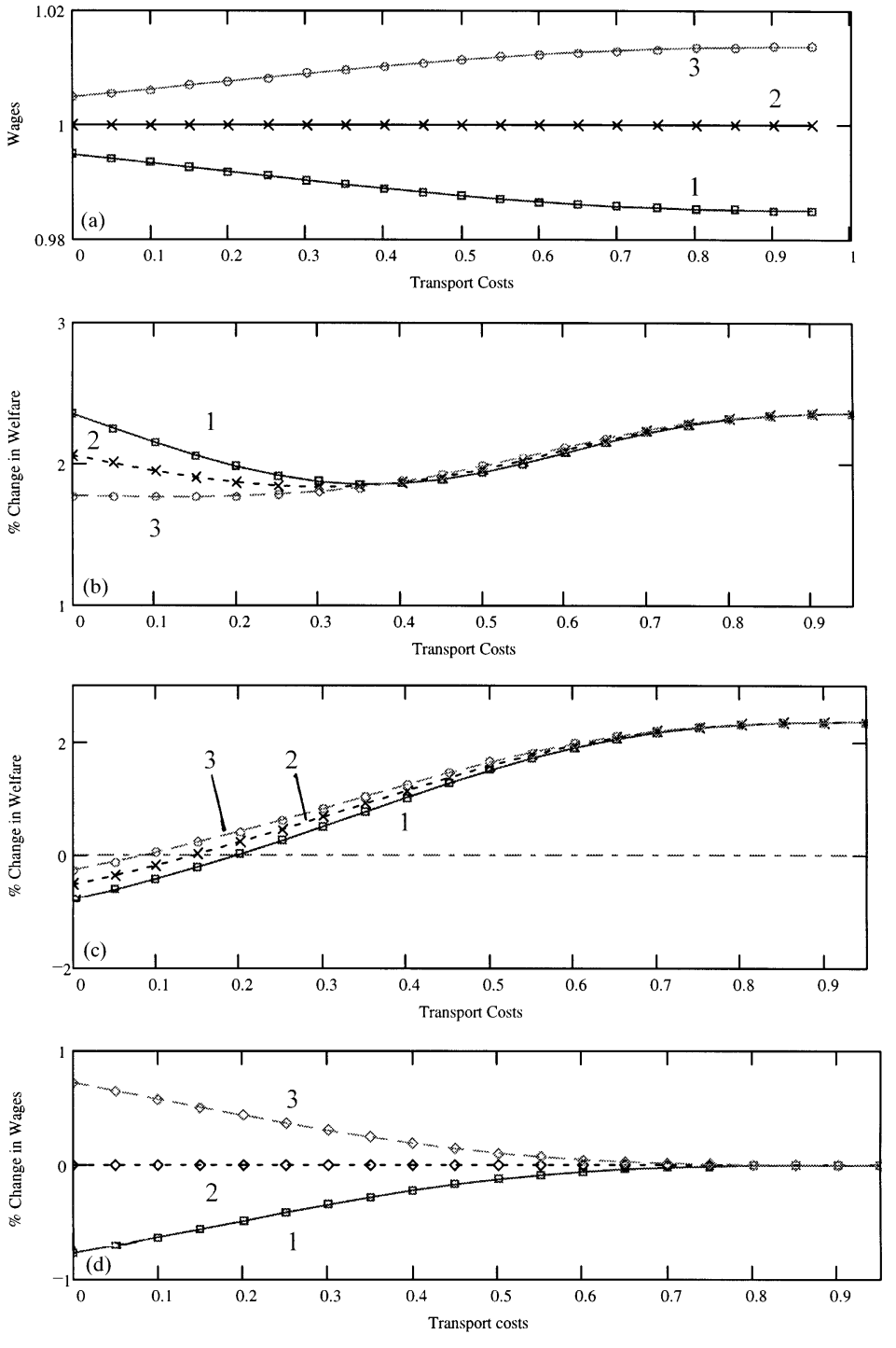

Figure 4. Welfare and Relative Wages

differential gains from tariffs (initially at 30%) being eliminated only *within*, but not between, continents. Similar to multilateral reductions, at high transport costs (b = 0.80) and a modest love for variety ($\theta = 0.75$) there is no difference between multilateral and bilateral tariff reductions; with little intercontinental trade, multilateral tariff eliminations effectively only remove transaction costs to intracontinental trade. Since countries on the same continent are identical, the gains from trade arise solely from transaction cost reductions and no change occurs to the gains from trade owing to size comparative advantage.

For low transport costs (b = 0.15), larger countries gain from regional FTAs, although the gain is less than that from multilateral tariff removal. Smaller countries lose from regional FTAs, while they gained considerably from multilateral tariff elimination. As before, with low intercontinental transport costs much intercontinental trade exists (despite tariff rates initially of 30%). Eliminating tariffs within continents causes considerable trade diversion for large rich economies from small poor economies. The excess relative supply of labor in the small country causes the wage rate to fall in small relative to large countries. Figure 4(d) illustrates the erosion of relative wages of the representative small country from the creation of regional FTAs when transport costs are low.

Similar to the implications of the FSW model, the results in Figure 4(c) suggest that—for even a modest love of variety ($\theta = 0.75$) and low transport costs ($b < 0.15$)—the average country's welfare will decline from a regional FTA; in this case, the intercontinental trade diversion will exceed the intracontinental trade creation. The range of potentially "supernatural" FTAs—where welfare declines with an FTA's inception—declines for large rich countries.

The simulations here have maintained only small disparities in economic size from the norm (the deviations here are 10%). In fact, when the income disparity gets larger—say, 30% deviations—supernatural FTAs do not surface *regardless of the taste for diversity or the level of transport costs.* Figure 5 illustrates—for labor stocks of 70,

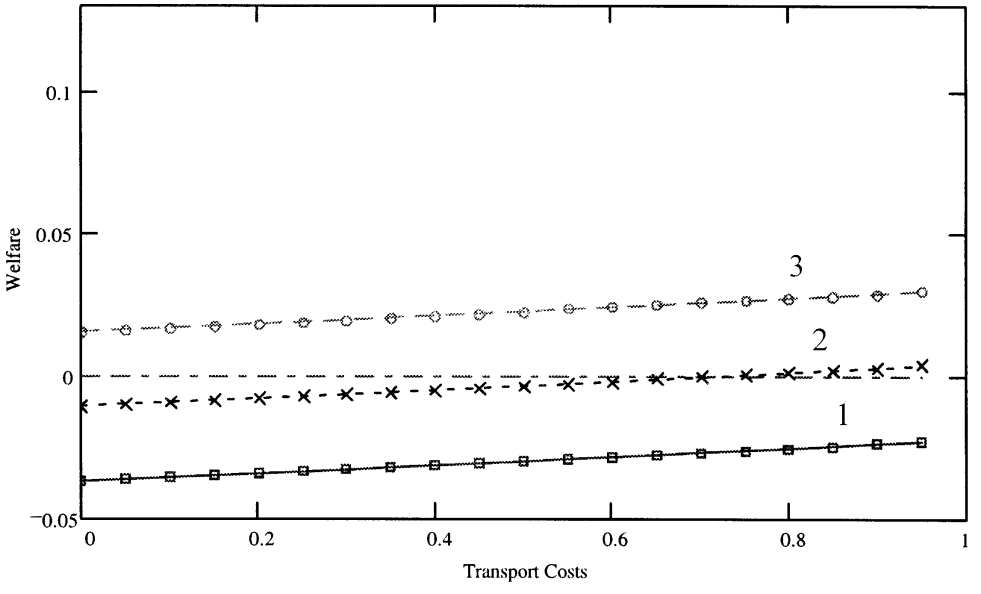

Figure 5. Welfare Gains of Natural FTAs ($\theta = 0.02$)

100, and 130—that large countries elude supernatural effects even if the taste for diversity is extraordinarily strong, say, $\theta = 0.02$.[9]

By contrast, developing countries are at a relative disadvantage if regional FTAs are created on all continents. The degree to which small countries' welfares are increased or decreased depends upon the level of transport costs and preference for diversity. As earlier results suggest, the higher are transport costs and tariff rates and the lower the taste for diversity, the larger are the welfare gains to a small country from a regional FTA.

However, the introduction of a regional FTA *on the small continent only* is welfare-enhancing for small countries, regardless of taste for diversity, tariff levels, or transport costs (not shown). In this case, the trade created within the continent exceeds the trade diverted from other continents. And as to be expected, welfare declines in the larger countries.

6. Conclusions

Deardorff and Stern (1994) eloquently argue the case that regional FTAs are likely to be welfare-enhancing stepping stones to multilateral tariff reductions, formerly under the GATT and now under the auspices of the WTO. Krugman (1991a,b) illustrated, in a model relying upon product diversity and increasing returns to scale, that regional FTAs are welfare-enhancing if intercontinental transport costs are prohibitively high, but are likely to be welfare-reducing if such transport costs are zero. Frankel et al. (1995) extended the analysis to consider positive but not prohibitive transport costs. They find that for levels of intercontinental transport costs as a fraction of output such as 10%, natural FTAs are welfare-reducing; such FTAs are denoted "supernatural." Their results suggest that world welfare may have been lowered owing to regional FTAs.

This paper has extended these works to illustrate that the gains from natural FTAs are related, in the context of these imperfectly competitive trade models, to relative economic size. We have generalized the Krugman (1980) framework to show that relative wages are influenced by the presence of transport costs. In the context of the model, large rich countries tend to be relatively better off from regional FTAs than suggested by Frankel, Stein, and Wei, but small poor countries are worse off. The results suggest that—for even modest differences in economic size among countries—the creation of intracontinental FTAs is welfare-enhancing for larger countries, *regardless* of strong preferences for diversity or of low transport cost or tariff levels; that is, for larger countries supernatural FTAs do not surface. Thus, the assumption of identically sized factor endowments tends to understate (overstate) the relative gains (losses) of regional FTAs to large countries, but overstates (understates) the relative gains (losses) to small countries, with the degree of this bias negatively related to the level of transport costs.

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Notes

1. The demand curve is derived by maximizing utility function (1) subject to a standard income constraint.
2. In Krugman (1991a), optimal tariff policy induced blocs to raise tariffs as bloc size increases. In Krugman (1991b) and FSW (1995), tariffs are assumed exogenous, because the optimal tariff policy will exacerbate the welfare losses from FTAs. Following the latter two studies, we assume exogenous tariffs here. This assumption is consistent with GATT Article XXIV that precludes countries that form preferential trading arrangements from raising tariffs on countries outside the bloc. We note also that Article XXIV precludes preferential trading arrangements other than "free" trade. Following this consideration, we consider in this paper only regional "free" trade agreements.
3. Nitsch (1996) has shown that, with only small intracontinental transport costs ($a = 0.05$), the supernatural effect is eliminated, as the elimination of tariffs on intracontinental trade tends to offset the distortions from intracontinental transport costs.
4. The conclusions found in Nitsch (1996), with $a > 0$, could be incorporated consistently here also.
5. Future research will address other economically relevant differences between countries.
6. We realize, of course, that differences in economic size are not the only source of wealth differences across countries in reality; economically large (small) countries exist that are poor (rich). Addressing these different contexts remains for future research. Our purpose here is to show that the likely existence of "supernatural" FTAs is diminished for rich countries, and enhanced for poor countries, where increasing returns to scale and product differentiation are important.
7. Details of the three equations are available from the authors.
8. There are numerous possible permutations to consider which remain for future research.
9. This result holds regardless of the initial tariff rate level; we considered the traditional values of 0.1, 0.2, and 0.3.