THE WELFARE IMPLICATIONS OF
TRADING BLOCS AMONG COUNTRIES
WITH DIFFERENT ENDOWMENTS

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ABSTRACT

In this paper, we present a model where trade is motivated both by preference for variety

and comparative advantages. We use this framework to analyze the welfare implications of

trading blocs among countries with different endowments with and without transportation costs.

In this framework, we address the following issues: a) the welfare implications of the

consolidation of the world into a few trading blocs; b) the different incentives that rich and poor

countries have in choosing their partners in trade arrangements; c) whether the welfare

consequences of continental preferential trade arrangements depend on the relative endowments.

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1. Introduction

Over the last decade, a large number of bilateral trading arrangements have been created, strengthened, or proposed in nearly every region of the world. NAFTA, the European Union, APEC, and Mercosur are just a few examples of this trend. Furthermore, empirical evidence on bilateral trade flows shows that this phenomenon has been accompanied by increased trade regionalization (Frankel, Stein, and Wei, 1994). Therefore, the study of the welfare implications of trading blocs has become very relevant.

One important contributor to the debate has been Krugman (1991a, 1991b). He uses a model of trade under monopolistic competition to study how welfare of the world depends on the number of blocs into which the world is divided. In Krugman's model, the world is completely symmetrical, so all blocs are exactly the same size. He finds that the number of blocs associated with the lowest possible welfare is three. The fact that welfare declines starting from one bloc (free trade) requires no explanation. The reason for the increase in welfare beyond three blocs, however, is more subtle: the distortions associated with a given tariff level become smaller as the number of blocs becomes larger and consumers buy

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a larger proportion of the varieties they consume from outside the bloc. This happens because a smaller portion of the relative prices are affected by the tariff.[1] The conclusion is that a potential consolidation of the world into three trading blocs would have a negative effect on welfare.

Krugman's model has been criticized by Deardorff and Stern (1992) and by Haveman (1994) on the grounds that it relies too heavily on the Armington assumption: goods that differ in their country of origin are imperfect substitutes. This means that each country will be importing goods from every other country in the world. The critics claim is that this feature of the model increases the likelihood of trade diversion when trading blocs are formed, and therefore results in an overly pessimistic view of the prospects for regionalization.

Deardorff and Stern reach a very different conclusion, using a model in which there are more countries than goods and trade is explained by comparative advantage. In their model, trading with a few countries is enough to realize most of the benefits that trade has to offer. Expected world welfare increases monotonically as the world consolidates into trading blocs, reaching a maximum for the case of a single bloc, or free trade. However, in order to obtain this result, the

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[1]The fact that Krugman assumes that tariffs are set optimally contributes to the increase in welfare beyond three blocs, but is not crucial for this result.

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authors go to the other extreme. This happens because they assume that tariffs between countries that are not members of the same bloc are infinite! In effect, they eliminate any possibility of trade diversion altogether.

By adding optimal tariffs to the basic Deardorff and Stern model, Haveman obtains results that are rather similar to Krugman's: expected world welfare will be reduced with the expansion of blocs except at the last stage when the last barrier falls, resulting in worldwide free trade. However, for the case of exogenous tariffs, his results become consistent with those of Deardorff and Stern: expected world welfare increases monotonically as the number of blocs becomes smaller.[2]

There are a number of reasons why studying the effects of regionalization under the assumption of exogenous tariffs is important. One is that Article 24 in the GATT does not allow increases in tariffs to outside countries when Preferential Trade Agreements (PTAs) are formed. Moreover, the optimal tariff argument does not seem to be what drives governments to impose tariffs. In addition, the optimal tariffs calculated by Krugman and Haveman seem to be too large in comparison to those we see in the real world (even when tariffs are used as shorthand for all protection). We are left, then, with one model that is pessimistic regarding

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[2]Haveman actually restricts the tariff level in the bloc to be smaller or equal to that of the least protectionist member. Since these restrictions are binding, for our purposes they are equivalent to exogenous tariffs.

the prospects of regionalization, partly due to its overstating the extent of trade diversion (product variety model), and with another model that is optimistic and probably understates the extent of trade diversion (comparative advantage).

By adding transportation costs to the differentiated products model, Stein and Frankel (1994) have produced a model that allows the study of how the welfare effects depend on such costs, as well as on the geographical character of trading blocs (natural vs. unnatural). In addition, including transport costs makes the model more realistic regarding the extent of trade diversion, since now natural barriers appear which restrict trade between countries that are far apart, therefore reducing the amount of trade diversion when blocs are formed.

In this paper, we go a step further in the direction of resolving the issue of the likely welfare effects of world regionalization in trade, by using a two-factor model where trade is explained both by product variety and by comparative advantage. In fact, by appropriately setting the values of some parameters, the model can be transformed into either a pure product differentiation model (as in Krugman or Stein and Frankel) or a comparative advantage model.

In addition, introducing two factors of production will enable us to study the welfare implications of the formation of trading blocs among countries at different stages of development (North-South integration), as well as those formed among

similar countries (North-North and South-South integration).[3] Our framework allows us to evaluate the case of Preferential Trade Arrangements as well as that of Free Trade Areas, the effects of transportation costs, and the effects of different countries having different tariff levels.

After setting up the model for the closed economy in the next section, we allow for trade in section 3. In section 4, we study the welfare implications of different types of trade arrangements. Section 5 offers our conclusion.

2. The model for the closed economy

We will work with a model where there are three sectors: agriculture (a), intermediate inputs (v), and manufactures (m); and two factors of production: capital (K) and labor (L).[4] On the demand side, consumers share a Cobb-Douglas utility function given by:

$$U = M^\alpha C_a^{1-\alpha} \text{ where } 0 < \alpha \leq 1, \tag{2.1}$$

[3] Another model that incorporates both product variety and comparative advantage can be found in Bond and Syropoulos (1993). In their work, however, countries are completely symmetric except for the fact that each of them is particularly adept at producing a different variety. Therefore, the problem of blocs when there are differently endowed countries cannot be tackled with their model. Levy (1993) has a two-factor model that combines comparative advantage and product variety with a specification that is different from the one used here. He assumes, as do Deardorff and Stern, that tariffs are either prohibitive or zero.

[4] The basic structure of our model is in the tradition of Dixit and Norman (1980).

and M and C_a are the consumptions of manufactures and agriculture. The Cobb-Douglas specification results in consumers spending a fixed proportion of their income on each type of good.

On the production side, we make the assumption that each factor of production is specific to the production of one good. Agriculture is a homogeneous good produced under constant returns to scale, and labor is the only factor used in its production. The production function is given by $q_a = L$, which means that each unit of labor is transformed into 1 unit of agriculture. Therefore, given perfect competition, $p_a = w$.

There is a very large number of potential varieties of intermediate inputs, which are produced under monopolistic competition and use only capital as a factor of production. Increasing returns to scale are introduced by assuming a fixed cost (γ) and a constant marginal cost (β):

$$x_i = \frac{K_i - \gamma}{\beta} \tag{2.2}$$

where x_i is the production of the i^{th}variety, and K_i the amount of capital used in its production. Each intermediate input enters symmetrically into the production of the final manufactured good, produced under a Dixit-Stiglitz technology with

constant returns to scale:

$$M = \left(\sum x_i^\theta \right)^{\frac{1}{\theta}}, \text{where } 0 < \theta < 1. \tag{2.3}$$

This production function results in preference for variety, which becomes stronger as the parameter θ becomes closer to 0. Note that we use M to denote both consumption and production per capita of the manufactured good, since in this model they are always equal.[5]

We assume that each individual is endowed with one unit of labor and k units of capital. In this way, L represents population size as well as labor, and k is the capital to labor ratio. The total capital in the economy is, therefore, $K = kL$. Since every individual is equally endowed, we can set aside distributive considerations and work with a representative agent. Equilibrium in the intermediate input market is given by:

$$x_i = L c_i. \tag{2.4}$$

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[5]In fact, M could alternatively be interpreted as the utility derived from the consumption of the heterogeneous product in a two-good model. In that case, we would have a utility function that is Cobb-Douglas between goods, and Dixit-Stiglitz between varieties. Both specifications are equivalent.

Equilibrium in the capital market is given by:

$$K = \sum_{i=1}^{n} K_i = \sum_{i=1}^{n} (\beta x_i + \gamma).$$ (2.5)

As consumers, the individual maximization problem is:

$$Max \ M^{\alpha} c_a^{1-\alpha} \text{ s.t. } Mp_m + c_a p_a = I$$ (2.6)

where $I = rk + w$ is the per capita income. From the first order conditions we can obtain the inverse demand function:

$$p_m = \frac{\alpha}{1-\alpha} p_a \frac{c_a}{M}.$$ (2.7)

As producers of the final manufactured good, individuals take p_m as given (since manufactures are produced competitively), and solve the following problem:

$$Max \ \left(\sum_{i=1}^{n} c_i^{\theta} \right)^{\frac{1}{\theta}} \text{ s.t. } \sum_{i=1}^{n} p_i c_i = Mp_m.$$ (2.8)

The elasticity of demand for each variety of intermediate inputs can be derived from the inverse demand function, which in turn follows from the first order

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conditions. For a sufficiently large n, it can be approximated by:

$$\epsilon_i \equiv -\frac{\partial c_i}{\partial p_i}\frac{p_i}{c_i} \simeq \frac{1}{1-\theta}. \tag{2.9}$$

Note that the elasticity does not depend on the quantity demanded, but only on the parameter θ. The firms in the intermediate inputs sector are monopolistically competitive and set the price to maximize profits:

$$\pi_i = p_i x_i - (\gamma + \beta x_i)\, r. \tag{2.10}$$

Using equation (2.9) and the first order condition for profit maximization, we obtain the profit maximizing price:

$$p_i = \frac{\beta r}{\theta}. \tag{2.11}$$

Since β is the same for all the intermediate inputs, the price of each variety will be the same. Note that the price in equilibrium does not depend on output.

Free entry condition combined with equation (2.11) yields the output per variety:

$$x_i = \frac{\theta \gamma}{\beta\,(1-\theta)}. \tag{2.12}$$

Introducing (2.12) into the capital market equilibrium condition (2.5), we get the number of varieties:

$$n = \frac{K(1-\theta)}{\gamma}.$$

(2.13)

Note that the production of each variety in equilibrium depends only on the cost parameters and on the substitution parameter θ. On the other hand, the number of varieties depends on the capital endowment of the economy. The fact that production of each variety in equilibrium is fixed is the result of the assumptions made about the production and utility functions, and will be used later when solving for the effects of trading blocs.

Using the zero-profit condition in the final manufactured good sector, and plugging in the equations for n, p_i, and x_i, we obtain the price of the final manufactured good as a function of r:

$$p_m = \frac{\sum_{i=1}^{n} p_i c_i}{M} = \frac{n p_i c_i}{\left(n c_i^\theta\right)^{\frac{1}{\theta}}} = \left(\frac{K(1-\theta)}{\gamma}\right)^{1-\frac{1}{\theta}} \frac{\beta r}{\theta}.$$

(2.14)

Plugging equation (2.14) into the inverse demand function (2.7), substituting for M and p_m, and using $w = p_a$ and $C_a = L$, we obtain the relative returns to the

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factors of production:

$$\frac{r}{w} = \frac{\alpha}{1 - \alpha} \frac{L}{K}.$$ (2.15)

Note that the relative price of the factors of production depends only on the relative endowments (L and K), while the relative price ($\frac{p_m}{p_a}$) has a scale effect that depends on the capital endowment of the economy: the bigger K is, the lower p_m is, as can be verified by dividing the left hand side of equation (2.14) by p_a, and the right hand side by w.

3. Allowing for trade

We assume that countries have similar tastes, technologies, and population size.[6] We will proceed in steps. First, we allow for tariffs in a world formed by N countries, assuming for the moment that they have the same factor proportions. In this first step, gains from trade only arise due to increased variety. Next, we introduce capital-rich and capital-poor countries. In this case, there are gains due to both comparative advantage and product variety. Note that if the parameter α in the utility function (2.1) were equal to 1, all gains would come from increase in variety, as in Stein and Frankel (1994). On the other hand, if the parameter θ

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[6]A recent model that addresses the consequences of trade between North and South when preferences are different is Spilimbergo (1995).

were equal to 1, there would be no preference for variety, and all gains would arise from comparative advantage. Finally, we will allow, in turn, for the formation of trading blocs, and for transportation costs.

3.1. Allowing for tariffs in a world with N identical countries

We introduce ad valorem tariffs, uniform across countries, and for the moment nondiscriminatory. The tariff revenue is redistributed equally to all consumers as a lump-sum transfer.[7] Now, the producer of the manufactured good faces different prices for different varieties of the intermediate inputs, depending on whether they are produced at home or abroad. The price of a foreign variety in terms of a domestic one is:

$$p_f = p_h \left(1 + t\right). \tag{3.1}$$

The producer of the final good now faces the following problem:

$$\max M = \left(\sum c_i^\theta\right)^{\frac{1}{\theta}} \text{ subject to } \sum c_h p_h + \sum c_f p_f \leq M p_m. \tag{3.2}$$

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[7] We assume that the number of consumers is sufficiently large that they view this transfer as exogenous.

The first order conditions yield:

$$c_f = c_h \left(\frac{p_h}{p_f}\right)^{\frac{1}{1-\theta}} = c_h \left(\frac{1}{1+t}\right)^{\frac{1}{1-\theta}} \tag{3.3}$$

In equilibrium, the per capita production of the manufactured good will be:

$$M = c_h n^{\frac{1}{\theta}} \left[1 + (N-1) \left(\frac{1}{1+t}\right)^{\frac{\theta}{1-\theta}}\right]^{\frac{1}{\theta}} = c_h n^{\frac{1}{\theta}} \Psi^{\frac{1}{\theta}} \tag{3.4}$$

$$\text{where } \Psi = 1 + (N-1) \left(\frac{1}{1+t}\right)^{\frac{\theta}{1-\theta}}. \tag{3.5}$$

The zero-profit condition in the production of manufactures yields the price of final manufactured goods in terms of the intermediate home variety:

$$p_m = p_h n^{\frac{\theta-1}{\theta}} \left(\frac{1}{\Psi}\right)^{\frac{1-\theta}{\theta}} = \underbrace{\frac{\beta r}{\theta}}_{p_h} \left[\underbrace{\frac{K(1-\theta)}{\gamma}}_{n}\right]^{\frac{\theta-1}{\theta}} \left(\frac{1}{\Psi}\right)^{\frac{1-\theta}{\theta}}. \tag{3.6}$$

We can interpret $\left(\frac{1}{\Psi}\right)^{\frac{1-\theta}{\theta}}$ can be interpreted as the price index of the intermediate inputs in terms of the price of the domestic variety. We can see that the price of manufactures is proportional to the price of the home varieties. As expected, it

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depends negatively on n, the number of varieties produced in each country, due to preference for variety in the production function.

We have solved the problem of the manufacturer of final goods, who takes p_m as given. Now we need to solve the problem of the consumer. We can express this problem as:

$$\max M^\alpha c_a^{1-\alpha} \text{ subject to } p_m M + p_a c_a \leq rk + w + T \tag{3.7}$$

where T is the per capita tariff receipts that are handed back to consumers as a lump-sum transfer:

$$T = tp_h \underbrace{n\left(N-1\right)}_{\text{\# of foreign varieties}} \underbrace{c_h \left(\frac{1}{1+t}\right)^{\frac{1}{1-\theta}}}_{\text{consume per variety}}. \tag{3.8}$$

The first order conditions yield:

$$\frac{c_a}{M} = \frac{(1-\alpha)}{\alpha} \frac{p_m}{p_a}. \tag{3.9}$$

Substituting p_m, p_a, C_a, w, and M and in (3.9), we can obtain the consumption

of the home variety in terms of exogenous parameters:

$$c_h = \frac{\theta k}{\beta n} \frac{1}{\left[1 + (N - 1) \left(\frac{1}{1+t} \right)^{\frac{1}{1-\theta}} \right]}.$$ (3.10)

Plugging c_h in expression (3.4) we can find the production of manufactures in terms of exogenous variables. Plugging c_m, and c_a into (3.9), we obtain:

$$\frac{r}{w} = \frac{\alpha}{(1 - \alpha)} \left(\frac{1 + (N - 1) \left(\frac{1}{1+t} \right)^{\frac{1}{1-\theta}}}{1 + (N - 1) \left(\frac{1}{1+t} \right)^{\frac{\theta}{1-\theta}}} \right) \frac{1}{k}$$ (3.11)

A comparison with expression (2.15) shows that, in the absence of tariffs, the relative return to the factors of production are the same as in the case of the closed economy. As the tariff rate increases, the relative return to capital falls. Note that this effect disappears in the case where the intermediate inputs are perfect substitutes ($\theta = 1$).

3.2. Trade when countries have different factor proportions

We now introduce two types of countries, which differ only in their capital endowment. In poor countries, each individual is endowed with one unit of capital, as well as one unit of labor ($k_p = 1$). In rich countries, each individual owns one

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unit of labor and k_r units of capital (where $k_r > 1$). Since the capital-to-labor ratio in the poor country is 1, we will drop the subscript for the case of the rich country, and denote its capital to labor ratio simply as k. From equation (2.13), the number of varieties produced in rich countries will be larger than that in poor countries by a factor of k. We make the assumption that k is sufficiently large relative to the tariff rate to ensure that there is trade in agriculture.[8]

The solution of the model involves solving for the prices of the factors of production (w_r, w_p, r_r, r_p); the equilibrium conditions in trade in an intermediate input and agriculture, together with a normalization and the law of one price for agriculture give us the conditions to solve the system.

We first find the demand for intermediate inputs. The relative price of capital in rich and poor countries will be denoted as ρ. Note from equation (2.11) that ρ is also equal to the price of the home varieties in a rich country (p_{hr}) relative to that of the home varieties in a poor country (p_{hp}):

$$\frac{r_r}{r_p} = \frac{p_{hr}}{p_{hp}} = \rho. \tag{3.12}$$

We can now write the prices of intermediate inputs faced by producers of manu-

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[8]The condition for trade in agriculture to occur is $\frac{(1-\alpha)I_r(k)}{w_r(k)} > 1$, where $I_r(k)$ and $w_r(k)$ are the income and wage in the rich country.

factures in a rich country, in terms of the ones produced at home:

$$\frac{p_{fr}}{p_{hr}} = 1 + t \tag{3.13}$$

$$\frac{p_{fp}}{p_{hr}} = \frac{1 + t}{\rho}$$

where the subscript f denotes foreign variety. Likewise, in a poor country, the prices are:

$$\frac{p_{fp}}{p_{hp}} = 1 + t \tag{3.14}$$

$$\frac{p_{fr}}{p_{hr}} = (1 + t)\rho.$$

The producers of manufactures facing these relative prices will demand the following relative quantities of intermediate inputs. In rich countries:

$$\frac{c_{fr}}{c_{hr}} = \left(\frac{p_{hr}}{p_{fr}}\right)^{\frac{1}{1-\theta}} = \left(\frac{1}{1+t}\right)^{\frac{1}{1-\theta}} \tag{3.15}$$

$$\frac{c_{fp}}{c_{hr}} = \left(\frac{p_{hr}}{p_{fp}}\right)^{\frac{1}{1-\theta}} = \left(\frac{\rho}{1+t}\right)^{\frac{1}{1-\theta}}.$$

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In poor countries:

$$\frac{c_{fp}}{c_{hp}} = \left(\frac{p_{hp}}{p_{fp}}\right)^{\frac{1}{1-\theta}} = \left(\frac{1}{1+t}\right)^{\frac{1}{1-\theta}} \tag{3.16}$$

$$\frac{c_{fr}}{c_{hp}} = \left(\frac{p_{hp}}{p_{fr}}\right)^{\frac{1}{1-\theta}} = \left(\frac{1}{(1+t)\rho}\right)^{\frac{1}{1-\theta}}.$$

We use these relative consumptions to write the equation for equilibrium in the market for a variety produced in a rich country:

$$\underbrace{\frac{\theta\gamma}{\beta(1-\theta)}}_{\text{supply}} = L\left[\underbrace{c_{hr}}_{\text{dem. from home}} + \underbrace{(N_r - 1)c_{hr}\left(\frac{1}{1+t}\right)^{\frac{1}{1-\theta}}}_{\text{from other rich countries}} + \underbrace{N_p c_{hp}\left(\frac{1}{(1+t)\rho}\right)^{\frac{1}{1-\theta}}}_{\text{from poor countries}}\right] \tag{3.17}$$

where N_r and N_p are the number of rich and poor countries, respectively. Notice that the supply for each variety is constant, as given by equation (2.12); c_{hr} and c_{hp}, on the other hand, depend on the respective prices of factors in rich and poor countries respectively.[9]

Now we find the equilibrium condition in agriculture. Since agriculture is a homogeneous good, the law of one price requires that the price at home be the

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[9]The results are derived following the same procedure of the previous section. c_{hr} is equal to $\frac{\theta\alpha}{\beta n}\frac{\frac{w_r}{r_r}L+k(t+1)}{\Psi_r+\alpha tk}$, where $\Psi_r \equiv k + k(N_r - 1)\left(\frac{p_{hr}}{p_{fr}}\right)^{\frac{\theta}{1-\theta}} + N_p\left(\frac{p_{hr}}{p_{fp}}\right)^{\frac{\theta}{1-\theta}}$ is analogous to 3.5. The detailed derivations are available upon request.

same whether the good is imported or produced domestically. Therefore, we can write $p_{ar} = p_{ap}(1 + t)$. The relative wage in rich and poor countries, then, is:

$$\frac{w_r}{w_p} = 1 + t. \tag{3.18}$$

The equilibrium in the agriculture sector is given by:

$$NL = N_r \frac{(1 - \alpha)}{p_{ar}} I_r + N_p \frac{(1 - \alpha)}{p_{ap}} I_p. \tag{3.19}$$

The system formed by equations (3.17), (3.19), and (3.18), together with the normalization $w_p = 1$ determines the prices of factors of production (r_p, w_p, r_r, w_r). Since the equations in the system above are nonlinear, an analytical solution is not possible, so the model will be solved through simulations.

3.3. Introducing trade arrangements

The framework outlined in the previous section can be used to examine the welfare implications of different types of trading blocs. Their formation simply introduces changes in the set of relative prices faced in each type of country. For the case of a rich country, the set of relative prices faced by the producers of manufactures

will now be:

$$\frac{p_{frb}}{p_{hr}} = 1 \qquad (3.20)$$

$$\frac{p_{fr}}{p_{hr}} = 1+t$$

$$\frac{p_{fpb}}{p_{hr}} = \frac{1}{\rho}$$

$$\frac{p_{fp}}{p_{hr}} = \frac{1+t}{\rho}$$

where the subscript b denotes members of the bloc. Likewise, in the poor country:

$$\frac{p_{fpb}}{p_{hp}} = 1 \qquad (3.21)$$

$$\frac{p_{fp}}{p_{hp}} = 1+t$$

$$\frac{p_{frb}}{p_{hp}} = \rho$$

$$\frac{p_{fr}}{p_{hp}} = (1+t)\rho.$$

In addition, whenever rich and poor countries are joined together in a bloc, the price of agriculture in both countries becomes equal, except in the case of transportation costs, which will be introduced below. With this new set of relative prices, it is possible to solve for the utility in both types of countries following the same procedure used in Section 3.2.

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3.4. Introducing transportation costs

We will think of the world as being divided into C continents, each of them equidistant from one another. Each of these continents is formed by an equal number of rich and poor countries (Nr, Np). The transportation system within each continent is assumed to be a hub-and-spoke network.[10] In each continent there is a hub, through which all trade involving that continent must pass. Each hub has N spokes (where $N = Nr + Np$), all assumed to be of equal length, connecting it to the N countries on the continent. Note that this is a completely symmetric world, except for the fact that some countries are rich and some are poor. Transport costs will be assumed, following Krugman (1980), to be of Samuelson's iceberg type, which means that only a fraction of the good shipped arrives; the rest is lost along the way. The cost of transport from spoke to hub to spoke will be represented as a, while that of transport from hub to hub (across the ocean), is given by b, where $0 \leq a, b \leq 1$. Trade involving two countries belonging to the same continent will have to be transported from the exporting country to the hub, and from the hub to the importing country. This involves two spokes, and therefore the transport cost within a continent is a, so the fraction of a good shipped that arrives to the market is $1 - a$. Similarly, the fraction of a good that arrives in the

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[10]In this, we follow Stein and Frankel (1994).

case of trade between countries in different continents, which involves two spokes and a hub-to-hub section, is $(1-a)(1-b)$.

We assume that tariffs are levied on the total price paid for the good in the country of origin, which includes what is lost in transportation. An important thing to keep in mind is that once transport costs are allowed, there is a gap between consumption and quantity demanded. For example, in the case of a poor country, the relative price of a variety produced in a rich extra-continental country in the absence of blocs will be:

$$\frac{p_{frx}}{p_{hp}} = \frac{(1+t)\,\rho}{(1-a)\,(1-b)} \tag{3.22}$$

where the subscript x stands for extra-continental. The relative consumption will be:

$$\frac{c_{frx}}{c_{hp}} = \left(\frac{(1-a)\,(1-b)}{(1+t)\,\rho}\right)^{\frac{1}{1-\theta}} \tag{3.23}$$

and the relative demand will be:

$$\frac{d_{frx}}{d_{hp}} = \left(\frac{(1-a)\,(1-b)}{(1+t)\,\rho}\right)^{\frac{1}{1-\theta}} \frac{1}{(1-a)\,(1-b)}. \tag{3.24}$$

The rest of the relative prices, consumptions, and demands are determined ac-

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cordingly. In particular, the relative wage between the rich and poor country will be $\frac{1}{(1-a)(1-b)}$, if they belong to the same bloc, and $\frac{1+t}{(1-a)(1-b)}$ otherwise.

4. Welfare implications of trade agreements

In this section, we will use our model to analyze the welfare implications of different types of trade arrangements. First, we will come back to the question of the welfare effects of the consolidation of the world trading system into a few trading blocs. By changing the substitution parameters in the model, we will be able to see how these effects change as we move from the case where trade is explained mostly by product variety considerations to one where comparative advantages play a large role in explaining trade. Second, in a simple world of four countries (two rich and two poor), we will ask what is the optimal type of arrangement for each type of country, and how the answer changes for different values of the parameters. Finally, we will introduce the possibility of preferential trade arrangements (rather than just free trade areas), and study the optimal level of intra-bloc tariffs when continental trading blocs are formed.

4.1. Does welfare increase as the world consolidates into blocs?

We now address the Krugman vs. Deardorff and Stern debate. As discussed in the introduction, Krugman's product variety model finds that, in the absence of transport costs, a world of a few large blocs results in the lowest level of welfare. In contrast, Deardorff and Stern suggest, using a comparative advantage model, that welfare increases monotonically as the number of blocs becomes smaller, reaching maximum welfare under free trade. In Figure 1, we present the results of simulations using our model, which incorporates both product variety and comparative advantage as motives for trade.

Each curve represents the welfare of the world under different parameter values, as a function of the number of symmetrical blocs into which the world is divided. We work with a world of sixty countries, thirty rich and thirty poor. World welfare is obtained simply by averaging the welfare in rich and poor countries. All countries are assumed to levy the same tariff level on imports from outside the bloc (we use 30 percent in our simulations). Tariffs within the bloc are completely eliminated, as in free trade areas.[11] We use a value of $\alpha = 0.5$, which means that half of the consumer's income is spent in agriculture and the

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[11]Since the tariff for the case of trade with countries outside the bloc is uniform, we do not distinguish here between free trade areas and customs unions.

other half in manufactures, and a value of $k = 3$, meaning that each individual in the rich country is endowed with three units of capital. The highest curve corresponds to a value of $\theta = 0.75$. In this case, the elasticity of substitution among varieties is 4. The rest of the curves correspond to higher values of θ. As θ increases in value, preference for variety decreases, increasing the relative importance of comparative advantage as a source of gains from trade. As θ approaches 1, preference for variety disappears, and only differences in factor proportions explain trade. Intra-industry trade is eliminated, and only inter-industry trade remains.

For $\theta = 0.75$, the number of blocs associated with minimum welfare is three. This suggests that adding different factor proportions to a model with product variety does not change the implications in any significant way. It is only for extremely low preference for variety (high θ) that the model yields results similar to those in Haveman and in Deardorff and Stern.[12] Krugman's conclusion, then, is more robust to the inclusion of comparative advantage in his model than Deardorff and Stern's is to the introduction of preference for variety in one of the goods. The reason for this result is that the elasticity of substitution among varieties

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[12]The values of θ for which Krugman's result goes away correspond to elasticities of substitution that seem unreasonably high.

(given in our model by $\frac{1}{1-\theta}$) is much higher than that between goods (which is 1 under our Cobb-Douglas specification).[13] Thus, the elimination of tariffs when blocs are formed has a substantial effect on trade due to preference for variety (intra-industry trade), but a much smaller effect on trade due to comparative advantage.

There is a sense, however, in which Krugman's critics were right to suggest that he overestimated the extent of trade diversion. If one introduces transportation costs into the picture, the factor proportions motive for trade becomes relatively more important, since transportation costs have a larger effect on intra-industry trade than on inter-industry trade, precisely because of the different elasticities of substitution discussed above. Lower intra-industry trade means that there is less trade to be diverted once trading blocs are formed. Therefore, the effect of increasing transportation costs a is not very different from that of increasing the value of θ, as is shown in Figure 1, where the line with the hollow squares represents welfare as a function of the number of blocs for the case of $\theta = 0.85$ and $a = 0.3$. We also tried different values of k and α, but the results did not change in any significant way.

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[13]This follows from the requirement that θ be a positive number. It is a natural assumption to make, since one would expect the different varieties of intermediate inputs to be closer substitutes than the different goods.

4.2. What type of bloc maximizes welfare for rich and poor countries?

In this section, we work with a simple single-continent world that consists of four countries, two of them rich and two poor. Our model provides an ideal framework for the analysis of the welfare effects of different trade arrangements. For example, what is the effect of North-North integration, on both rich countries and poor ones? Are the rich countries better off by forming blocs with poor countries or among themselves?

We provide a framework to think about these questions. Figures 2 through 5 show how the welfare of the rich (figures 2 and 3) and the poor (figures 4 and 5) depends on the type of trading arrangements that exist in the world, for different combinations of the parameters α and θ. For each set of parameter values, the welfare is normalized to be 1 for the case of non-discriminatory tariffs, as under the Most Favored Nation clause.

Note that an increase in θ results in a higher elasticity of substitution between varieties, and thus in greater changes in the consumption bundles in response to given changes in relative prices. For this reason, the welfare effects of trading blocs generally become more important for higher values of θ. However, as θ approaches 1, the taste for variety disappears, and so does the intra-industry trade, thus reducing the effects of trading blocs. This is the explanation for the

shape of the curves in figures 2 through 5.

As can be seen in figures 2 and 3, it is always the case that a bloc among the rich countries (RB in the figure) makes the rich better off than MFN, while a bloc among the poor (PB) always hurts them. For parameter values that increase the relative importance of product variety as a source of gains from trade (high values of α and low values of θ), welfare in the case of a bloc among the rich is even higher than under free trade. In the case of the poor countries, a similar pattern can be observed in figures 4 and 5: their own bloc improves their welfare, while a bloc among the rich countries lowers it. This confirms the results obtained in Stein (1994) and in Goto and Hamada (1994) for the case of blocs among similar countries: those countries that are left behind when blocs are formed are always worse off. This happens because those that form the bloc experience an improvement in their terms of trade, as each member of the bloc diverts demand from nonmembers toward fellow members. As expected, the effects of a rich bloc on the poor is larger than that of a poor bloc on the rich.

In the case of North-South integration (represented by NS/NS), we did not allow for the formation of a single bloc between two countries.[14] For this reason,

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[14]The reason is that doing so would force us to consider four types of countries: rich in the bloc and outside the bloc, and poor in the bloc and outside the bloc. One does not gain too much insight by doing so, and the model would get much more complicated.

we compare each country's welfare under the North-South blocs with that under the North-North/South-South blocs (NN/SS). Figures 2 through 5 suggest the following: poor countries will always prefer North-South integration. This is true for both comparative advantage and product variety considerations. The rich, however, would prefer to join another rich rather than a poor when product variety plays a large role. This preference becomes weaker for high values of θ and low values of α, when trade occurs mainly due to comparative advantage. Under comparative advantage, the rich would obviously prefer to join a poor. This, however, is not reflected in the figure due to the considerations discussed in the previous footnote.

So far, we have worked under the assumption that tariffs are the same in rich and poor countries. However, developed countries typically have lower rates of protection than developing countries. For this reason, in what follows we will allow the tariff in the rich country (t_r) to differ from that in the poor country (t_p). In figures 6 and 7, t_p is set at thirty percent, while t_r varies between 0 and 40 percent. For high levels of t_r, the results are qualitatively similar to the ones presented above. However, for low tariff levels in the rich country, the implications are very different: a rich country would rather join a poor than another rich country (figure 6); and, as figure 7 shows, the poor would rather integrate among themselves than

join the rich![15] The key to these results is the effect of the formation of blocs on the terms of trade. These effects are very different when the countries start from different tariff levels. We will present a simple example to provide the intuition for this result.

Take a world of three symmetric countries, A, B, and C, where tariffs are non discriminatory, and uniform across countries. What are the effects on the terms of trade of the formation of a *FTA* between A and B? As explained above, both countries deviate trade away from C, and in favor of their partners. As a result, relative world demand for goods produced in C declines, and so do its terms of trade, while those in A and B improve. In addition to the trade diversion effect, there is a trade creation effect: both A and B will demand more goods from each other, at the expense of the demand for home goods. In this symmetric setting, this trade creation effect has no consequences for the terms of trade of A and B, since the effects in both countries cancel out, leaving demand unchanged. However, this changes when tariffs in A and B are not the same.

Take now the extreme example where tariffs in A are zero, while those in B are positive. The following effects will take place if A forms an FTA with B: country B will deviate trade away from C in favor of A; B will also shift demand

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[15]We performed simulations for different values of t_p. The results are qualitatively similar.

from itself to A (trade creation effect). However, A will neither create nor deviate trade, since its tariff structure has not changed at all. The resulting effect is a fall in the demand for the goods produced in country B. Therefore, the terms of trade of country B may actually fall when it enters into a bloc with A. In contrast, the improvement in country A's terms of trade is even larger than in the case where the tariff levels in A and B are similar. We chose a tariff level in A of zero for simplicity, but the result goes through for any tariff in A sufficiently low.

In the case where tariffs in the rich countries are sufficiently lower than those in the poor countries, this example helps us understand why both rich and poor countries might prefer to integrate with the poor.

This type of analysis helps us understand some of the issues involved when a country like Chile has to decide whether to join *NAFTA* or Mercosur. We use this only as an illustrative example since our framework leaves out a number of other important considerations in making this decision.

Under which conditions, then, will Chile prefer to join Mercosur rather than *NAFTA*?[16] The passage above suggests that the larger the tariff in the rich country (*NAFTA*) relative to the poor (Mercosur and Chile), the more inclined

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[16]In what follows we treat Mercosur as a single poor country, and *NAFTA* as a single rich country.

Chile will be to join Mercosur.

Another factor that plays a role in such a decision is the importance of intercontinental transport costs. To address this question, we use a simulation in which the world consists of two continents with four countries each, and compare the poor's welfare under two different arrangements: one where each poor joins the other poor on their continent, and another where each poor country joins a rich country on a different continent.

The results for the case of $tr = tp$ are shown in figure 8. Under these parameter values, only for very high transportation costs across continents would Chile choose Mercosur instead of $NAFTA$.

Figure 9 shows how much things can change when tariffs in rich and poor countries are different. In this case, $tr = 0.1$. The effects of joining Mercosur are qualitatively similar to those in Figure 8. But now the effects of joining $NAFTA$ are completely different. Notice that for $b = 0$, joining $NAFTA$ reduces welfare with respect to MFN, as it does in Figure 7 for the case of low tariffs in the rich countries. The reason is the same: when a high tariff country joins a low tariff country, its terms of trade will fall provided the tariff differential is sufficiently high. What Figure 9 clearly illustrates is that transportation costs can have surprising effects. In this case, the negative effect on Chile's terms of

trade becomes smaller as trade with *NAFTA* decreases due to the increase in transportation costs. When transport costs are sufficiently high, Chile prefers *NAFTA* to Mercosur.

In fact, this analysis suggests a reason why *NAFTA* itself might result in welfare losses for Mexico: it represents a trading bloc with a large proximate country (so terms of trade effects are large) which has much lower tariffs than they did (so terms of trade effects can be negative). This suggests that the association between "natural" (meaning proximate) blocs and increases in welfare is valid only when the countries involved have tariff levels of the same order of magnitude.

4.3. Product variety, comparative advantage, and supernatural blocs

Several authors, among them Krugman (1991) and Summers (1991), have argued that if trading blocs are formed along "natural" lines of geographical proximity, they are likely to be good. Stein and Frankel (1994) and Frankel, Stein, and Wei (1994) have shown, in a model based on product variety, that it is possible for regionalization to go too far, even when blocs are formed along natural geographical lines.

To reach this conclusion, they allowed for continental preferential trade arrangements, where tariffs within the bloc are reduced but not necessarily elimi-

nated, as in the case of *FTAs*. Starting from a non-discrimination situation as under MFN, a small reduction in intra-bloc tariffs always improves welfare: there are positive returns to regionalization. However, as intra-bloc tariffs continue to fall, welfare reaches a maximum level and starts to decline. This maximum level occurs at lower intra-bloc tariff when intercontinental transport costs are high. Beyond the preference margin that maximizes welfare, there are negative returns to further regionalization. If the intra-bloc tariff level continues to decline, welfare might become even lower than at the starting point, under MFN. In this case, the authors suggested that blocs were supernatural: regionalization is much deeper than what would be warranted by "natural" geographical considerations.

In this section, we verify whether the conclusion that continental blocs could become supernatural is robust to the inclusion of comparative advantages in the model. To allow for preferential trade arrangements, the model has to be modified slightly. The intra-bloc tariff level, instead of zero, will now be $(1 - \pi) * t$, where π represents the preference margin within the bloc. We considered a world of 4 continents of 8 countries each, four of them poor and four rich. Since the capital endowment in the rich countries was set at $k = 3$, this setting closely matches that in Stein and Frankel, where a world of four continents with 16 countries each was considered.

Figure 10 shows the effects of increasing the preference margin π on the welfare of the world, both the rich and the poor countries, for a value of intercontinental transport costs $b = 0.35$. In the figure, the welfare of each type is normalized to be 1 under MFN. We can see that the inclusion of comparative advantage does not change the pattern reported by Stein and Frankel. For this set of parameter values used in the simulation ($\theta = 0.75; \alpha = 0.5; t = 0.3$), the optimal preference margin is 43 percent, which corresponds to a level of intra-bloc tariffs of around 17 percent. Blocs become supernatural for $\pi = 0.82$ or when intra-bloc tariffs are reduced below 6 percent.[17]

Keep in mind that throughout this exercise, we ask about the welfare effects of symmetrical trading blocs. As shown in Stein (1994) for the case of similar countries, in a noncooperative game each bloc would in fact benefit from completely eliminating intra-bloc tariffs, since doing so improves their terms of trade. However, this would result in lower welfare in each country as a result of a coordination failure in determining the margin of preference.

In contrast, here we are focusing on the perspective of an organization such as the World Trade Organization (WTO), asking what would be the preference

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[17]Our results are consistent with the implication in Meade (1955) that preferential trade arrangements are in general better than free trade areas.

margin that, if adopted in every continent, would lead to the highest possible world welfare, assuming that free trade is not attainable and that tariff levels outside the bloc cannot be lowered rapidly. Figure 10 highlights an interesting issue that was not captured before: the margin of preference that maximizes the welfare of the world does not maximize the welfare of either the rich or the poor. In general, the poor will benefit from a greater preference margin. If WTO ever abandons Article 24 of the $GATT$, which allows for $FTAs$ but not for $PTAs$ as exceptions to the MFN rule, and instead imposes the level of intra-bloc preference margin allowed, the determination of this preference margin would depend on the relative political power of rich and poor countries in the WTO.

Figure 11 shows how the optimal preference margin depends on inter-continental transportation costs. As they become larger, welfare maximization requires a greater degree of continental integration. This result is similar to that obtained in Stein and Frankel and in Frankel, Stein, and Wei. In the limit, if transport costs are prohibitive across continents, welfare will be maximized under continental $FTAs$, which in this case would represent the ideal of free trade in each relevant world.[18]

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[18]This extreme of prohibitive transport costs across continents was used by Krugman (1991) as an example of how natural trading blocs would be beneficial.

4.4. Conclusions

Previous models that analyzed the welfare effects of trading arrangements were based either on product variety or on comparative advantage. The use of these models provided contradictory answers to some important questions. In this paper, we have presented a framework that encompasses both types of models. We used our framework to address a number of important questions, and reached the following conclusions:

1. In the absence of transportation costs, the consolidation of the world into a few trading blocs reduces welfare, as predicted by Krugman's product variety model. When transportation costs are considered, a move towards free trade zones is more likely to improve welfare, as suggested by the models based on pure comparative advantage.

2. As long as all countries have similar tariff levels, poor countries will always prefer to integrate with rich countries, due to both product variety and comparative advantages considerations. The rich will maximizes welfare by joining other rich, except in the cases where product variety does not play a large role. A poor country would only consider joining another poor rather than a rich if the two poor countries are proximate, and transportation costs

are sufficiently high.

3. However, differentiated tariff levels between rich and poor countries have important consequences for the welfare effects of trading arrangements. In the case of FTA's, joining a high-tariff country will enhance welfare more than joining a low-tariff country, other things being equal. Therefore, if rich countries have lower tariffs, the poor might choose to integrate among themselves.

4. The association between "natural" (meaning proximate) blocs and increases in welfare is valid only when the countries involved have tariff levels of the same order of magnitude.

5. The result that integration can be too deep, even if drawn along natural geographical lines, is not affected by the inclusion of comparative advantages into a model where there is preference for variety. The level of intra-bloc preference margin that maximizes welfare is different for the rich and for the poor. In general, poor countries would prefer deeper integration.

FIGURE 1: PRODUCT VARIETY VS COMPARATIVE ADVANTAGES

$\alpha=0.5$; $t=0.3$; $k=3$; $a=b=0$; $C=1$; $N=60$
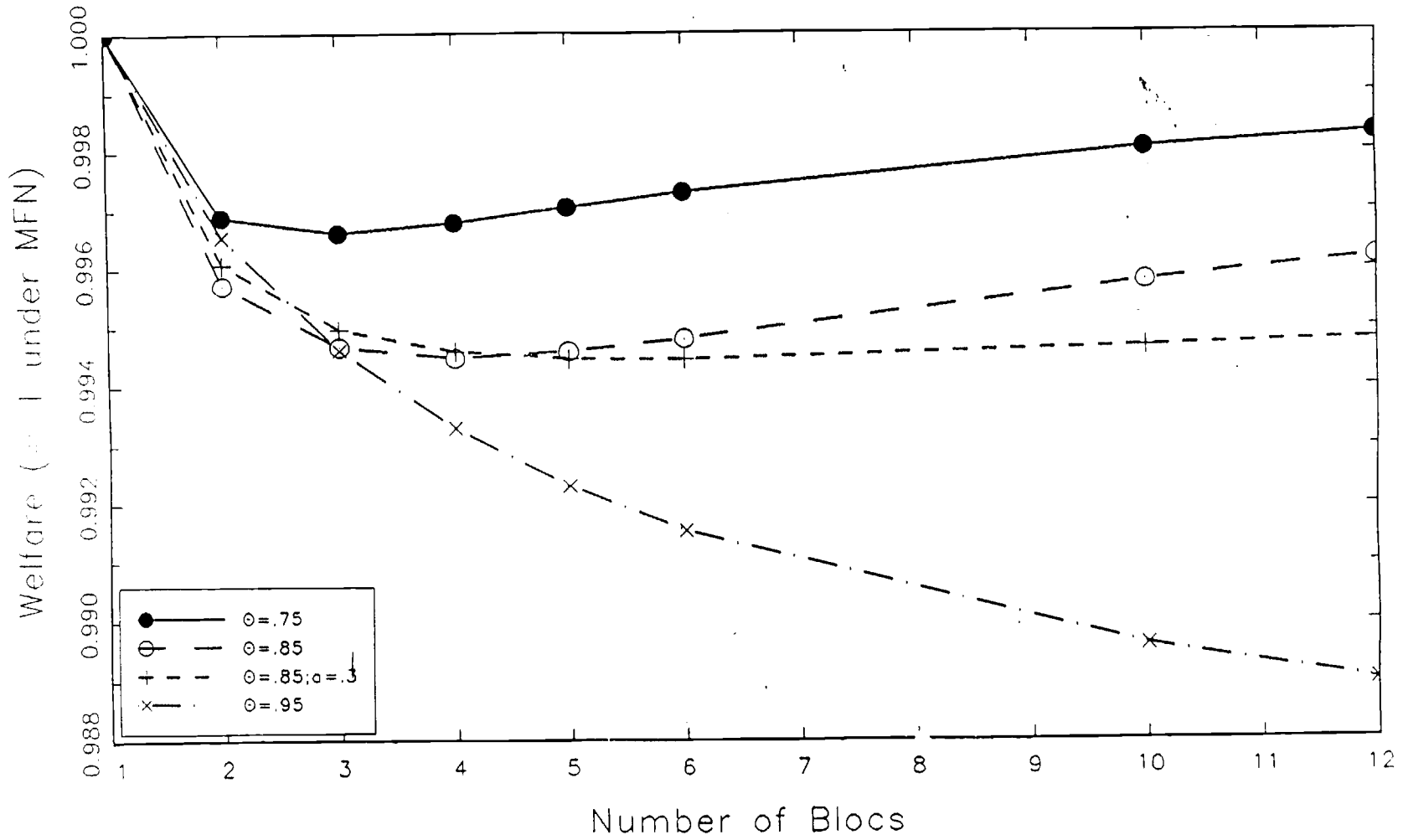
FIGURE 2. WHICH ARRANGEMENT SHOULD THE RICH COUNTRY SEEK?

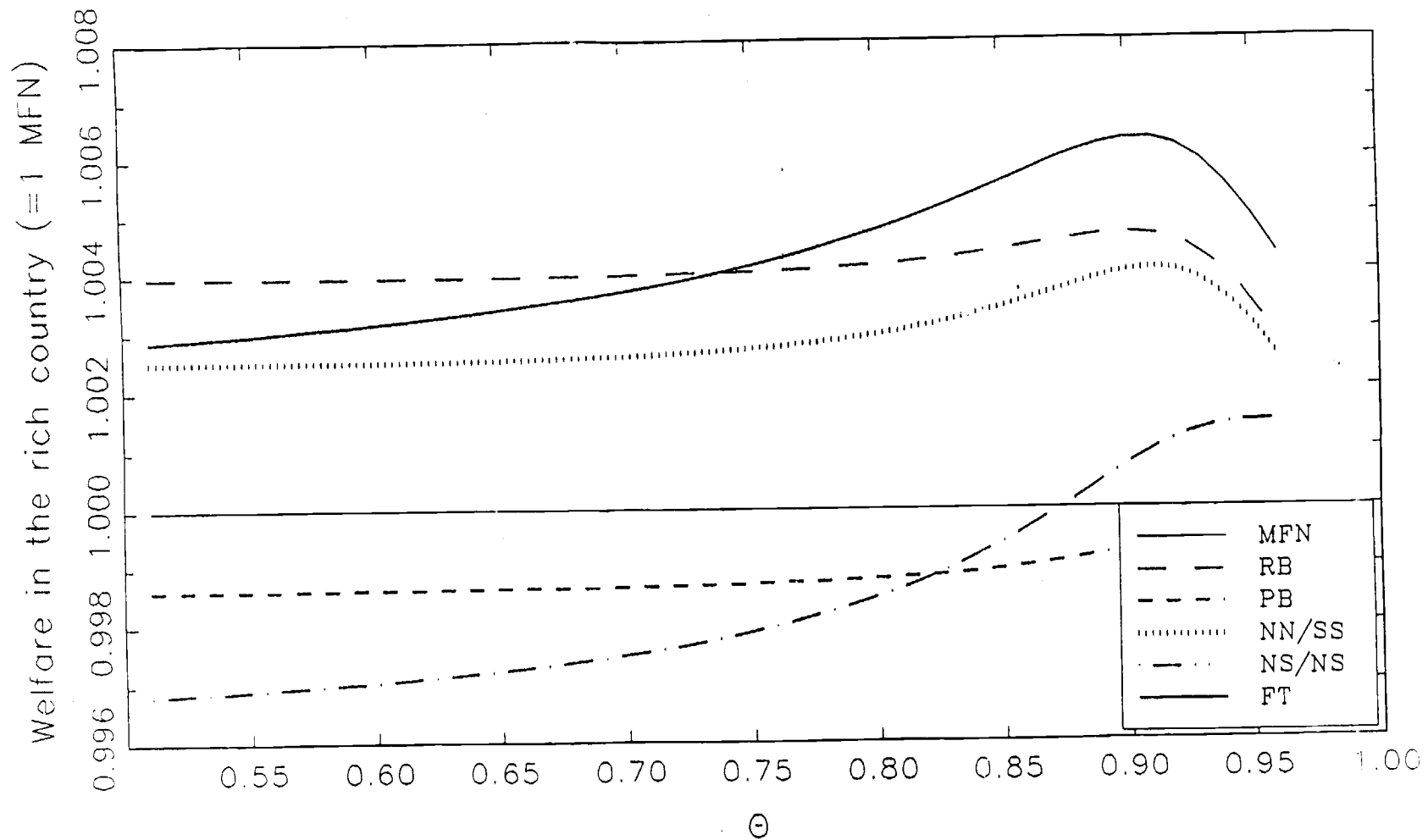$\alpha = 0.9$; $t = 0.3$; $k = 3$; $a = b = 0$; $C = 1$; $N = 4$
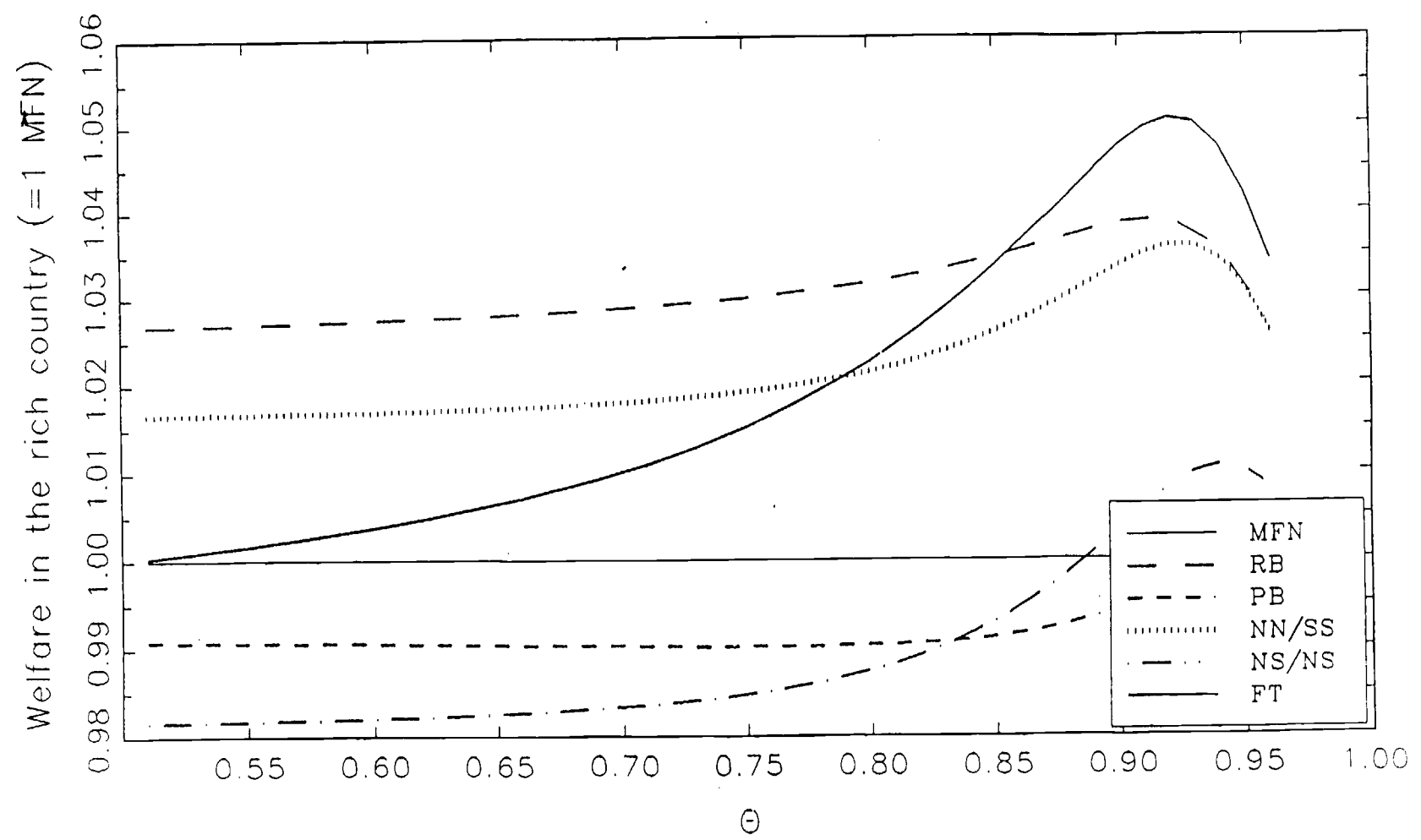
FIGURE 3. WHICH ARRANGEMENT SHOULD THE RICH COUNTRY SEEK?

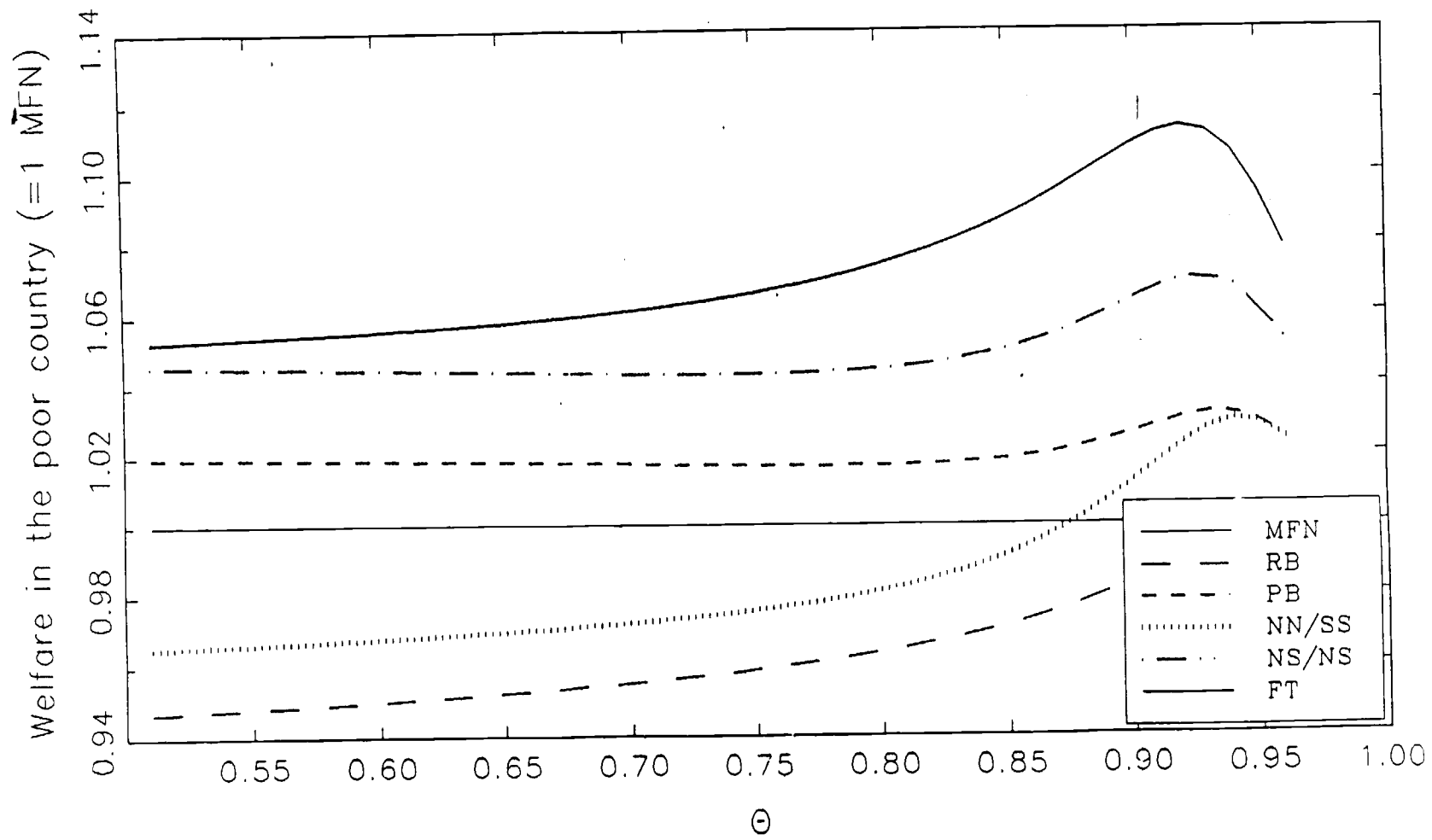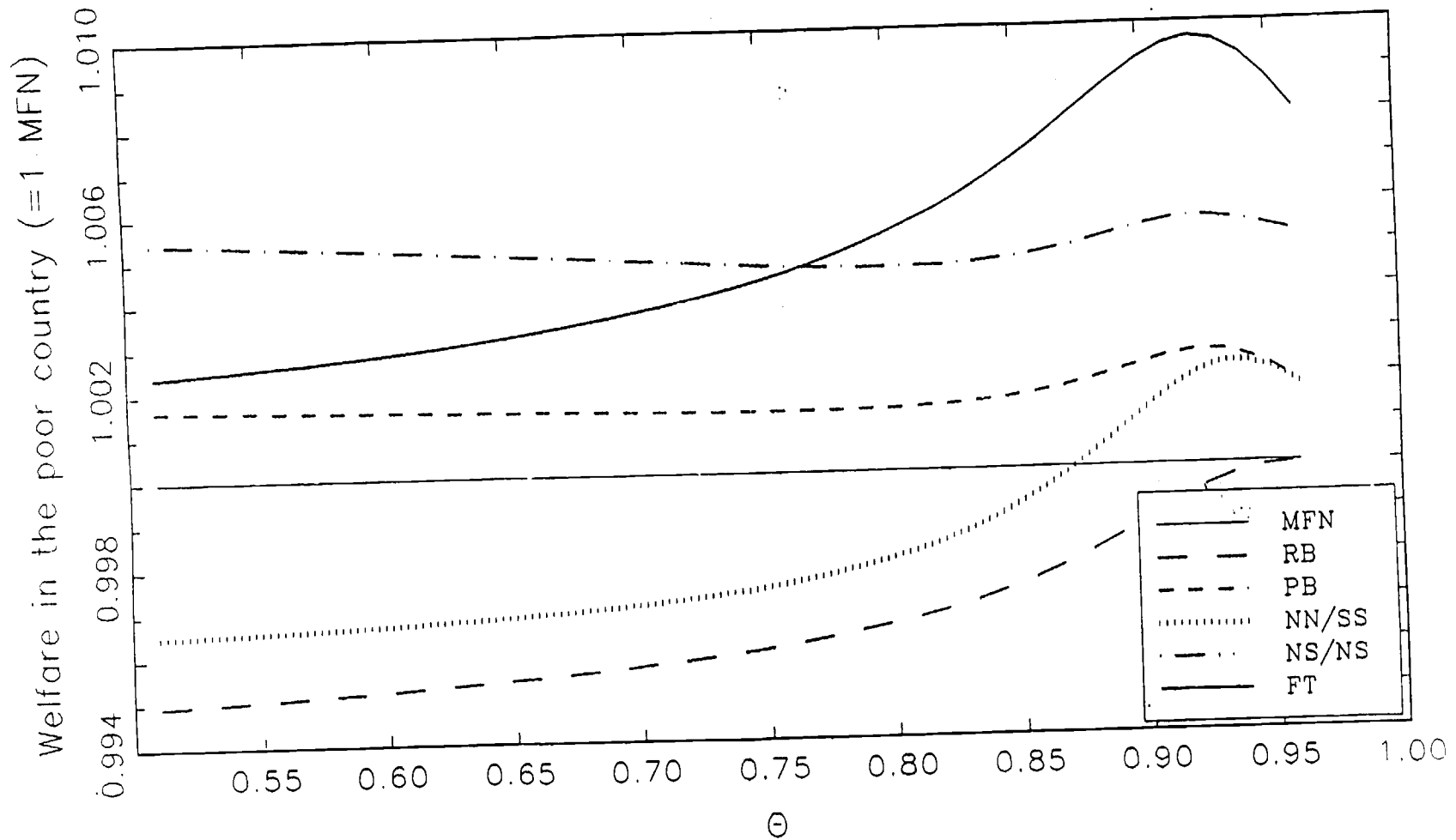$\alpha=0.1$; $t=0.3$; $k=3$; $a=b=0$; $C=1$; $N=4$

FIGURE 4. WHICH ARRANGEMENT SHOULD THE POOR COUNTRY SEEK?

$\alpha = 0.9$; $t = 0.3$; $k = 3$; $a = b = 0$; $C = 1$; $N = 4$

FIGURE 5. WHICH ARRANGEMENT SHOULD THE POOR COUNTRY SEEK?

$\alpha = 0.1; \quad t = 0.3; \quad k = 3; \quad a = b = 0; \quad C = 1; \quad N = 4$

FIGURE 6. DIFFERENTIATED TARIFFS: THE EFFECTS ON THE RICH

$\alpha = 0.5$; $\Theta = 0.75$; tp=0.3; k=3; a=b=0; C=1; N=4
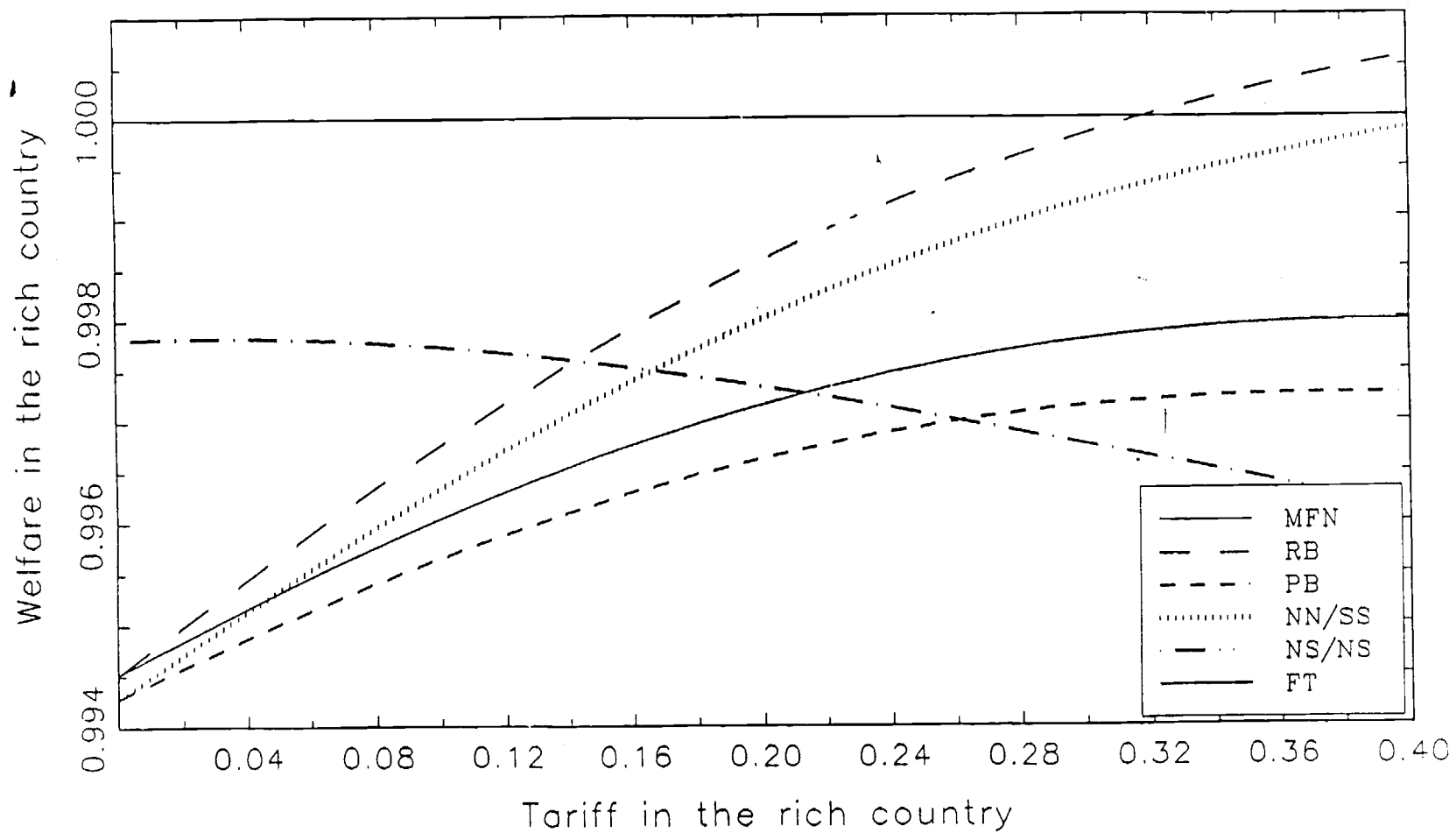
FIGURE 7. DIFFERENTIATED TARIFFS: THE EFFECTS ON THE POOR

$\alpha=0.5$; $\Theta=0.75$; $tp=0.3$; $k=3$; $a=b=0$; $C=1$; $N=4$
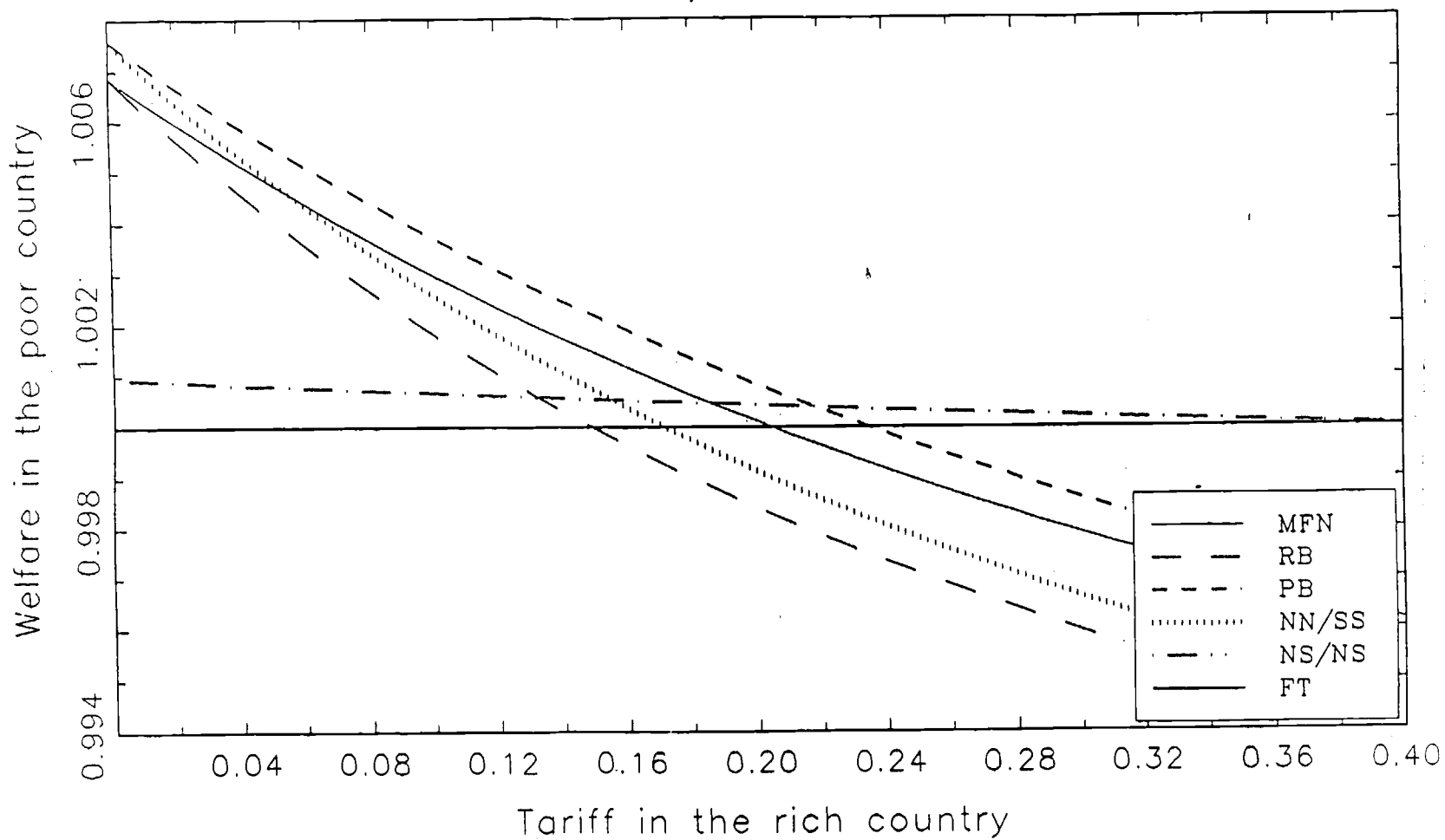
FIGURE 8. SHOULD CHILE JOIN NAFTA OR MERCOSUR?

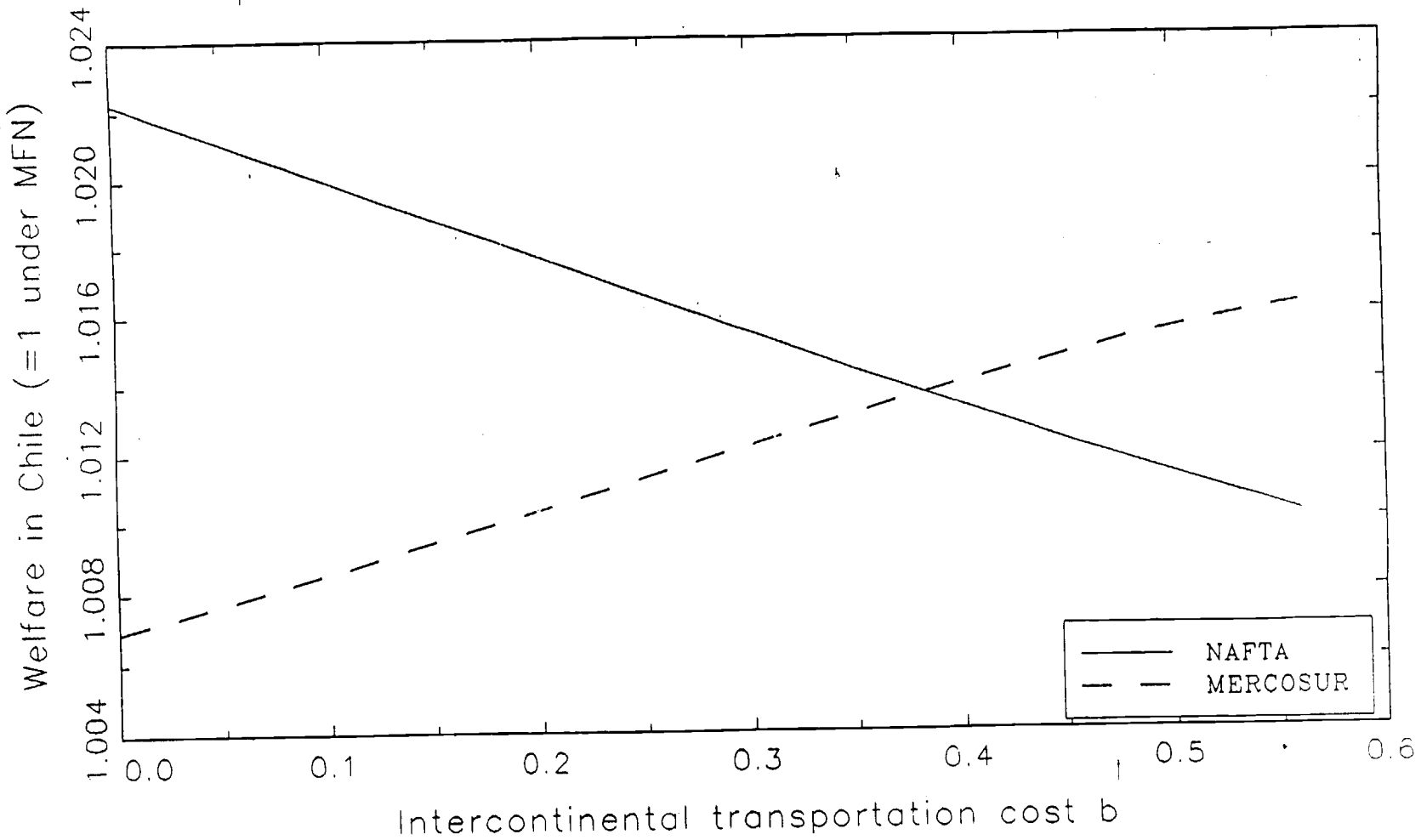$\alpha = 0.9$; tr$=0.3$; tp$=0.3$; k$=3$; a$=0$; C$=2$; N$=4$; $\Theta=.75$

Welfare in Chile ($=1$ under MFN)

Intercontinental transportation cost b

FIGURE 9. SHOULD CHILE JOIN NAFTA OR MERCOSUR?

$\alpha=0.5$; $tr=0.1$; $tp=0.3$; $k=3$; $a=0$; $C=2$; $N=4$; $\Theta=.75$

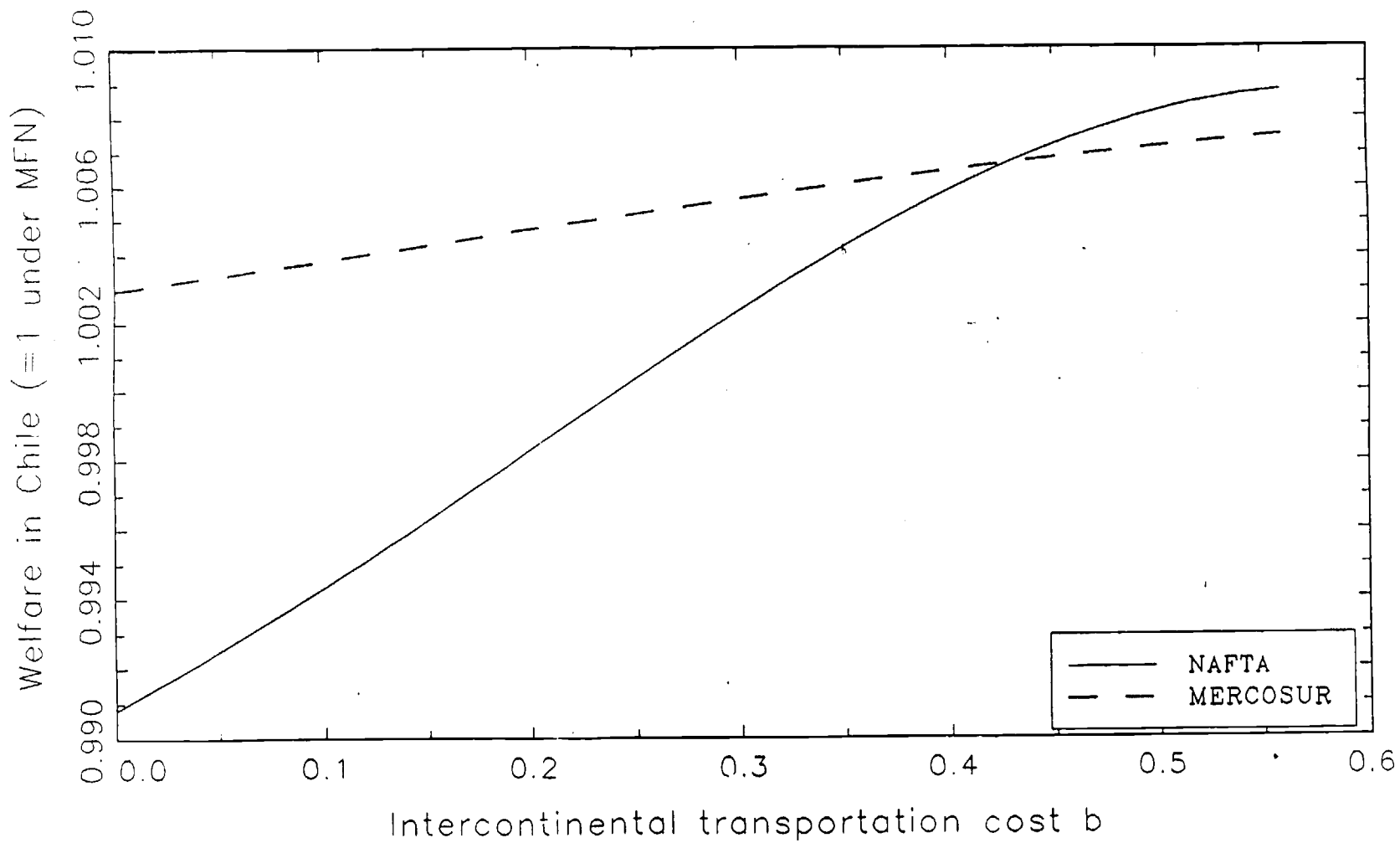# FIGURE 10. INTRA-BLOC PREFERENCE MARGIN AND WELFARE

$\alpha = 0.5$; $\Theta = .85$; $t = 0.3$; $k = 3$; $a = 0$; $b = .35$; $C = 4$; $Nr = Np = 4$

Welfare ($= 1$ MFN)

Intra bloc preference margin

RICH
POOR
WORLD

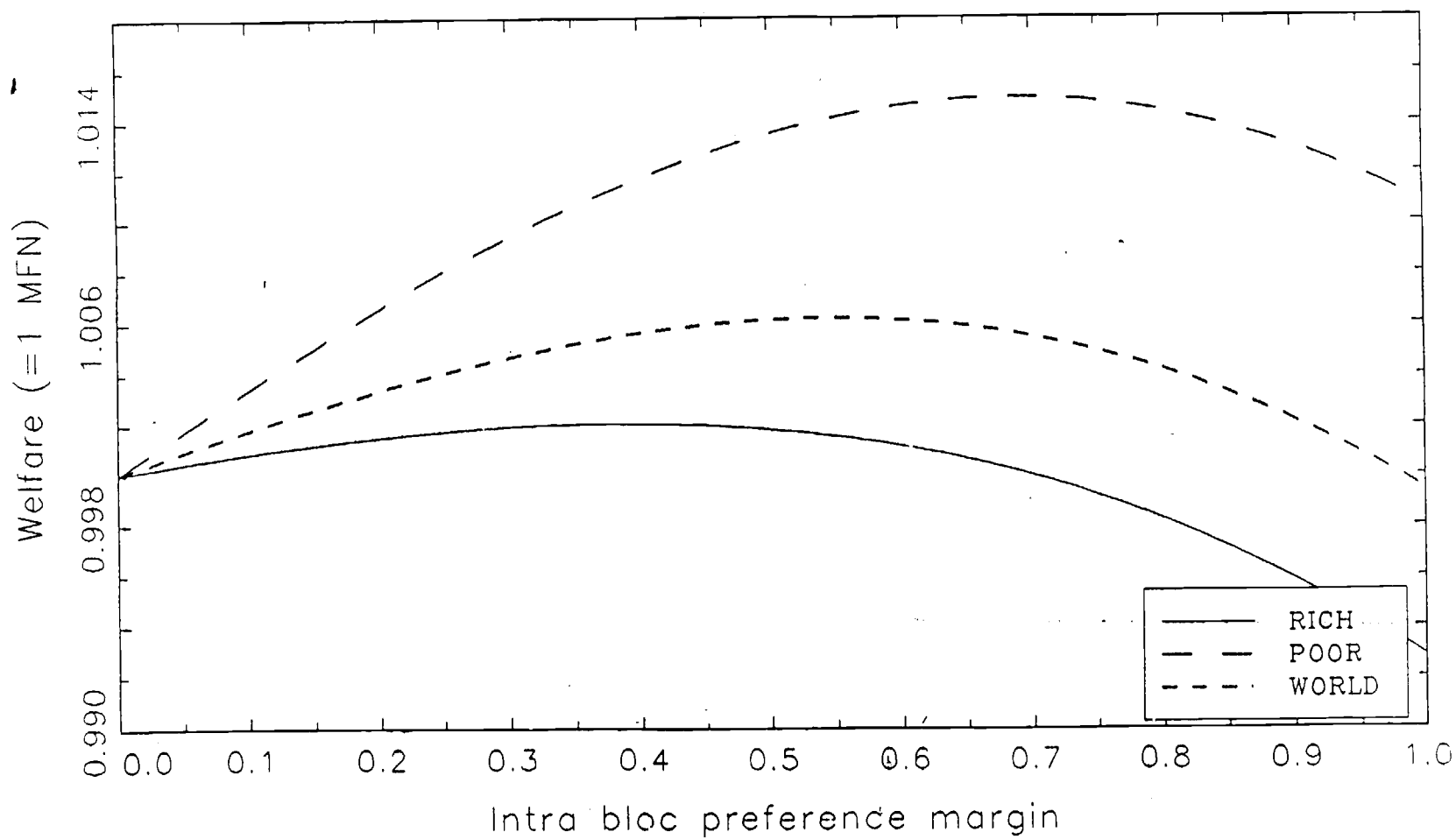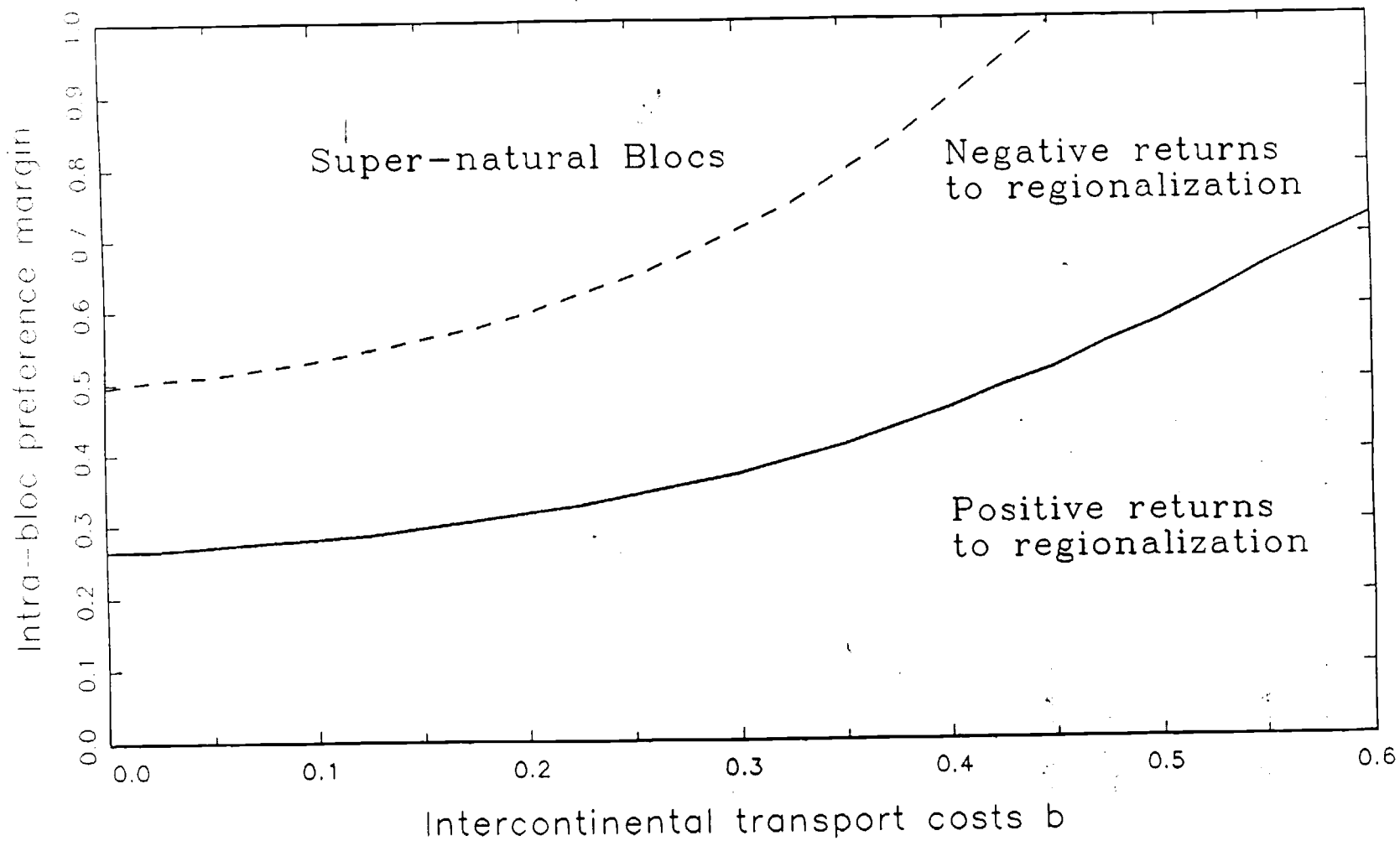# FIGURE 11. RETURNS TO REGIONALIZATION

$\alpha=0.5$; $\Theta=0.75$; $t=0.3$; $k=3$; $a=0$; $C=4$; $Nr=Np=4$

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