University of California Berkeley

CENTER FOR INTERNATIONAL AND DEVELOPMENT ECONOMICS RESEARCH
Working Paper No. C94-034

Trading Blocs: The Natural, the Unnatural, and the Super-Natural

Jeffrey Frankel, Ernesto Stein and Shang-jin Wei

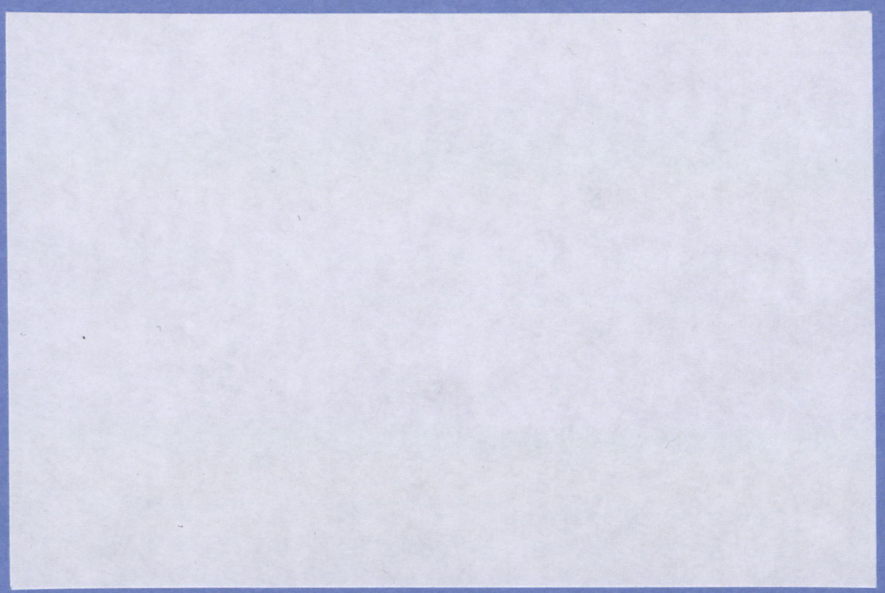
Department of Economics, University of California at Berkeley

April 1994

Department of Economics

CIDER

iber



CIDER

CENTER FOR INTERNATIONAL AND DEVELOPMENT ECONOMICS RESEARCH

The Center for International and Development Economics Research is funded by the Ford Foundation. It is a research unit of the Institute of International Studies which works closely with the Department of Economics and the Institute of Business and Economic Research. CIDER is devoted to promoting research on international economic and development issues among Berkeley faculty and students, and to stimulating collaborative interactions between them and scholars from other developed and developing countries.

INSTITUTE OF BUSINESS AND ECONOMIC RESEARCH

Richard Sutch, Director

The Institute of Business and Economic Research is an organized research unit of the University of California at Berkeley. It exists to promote research in business and economics by University faculty. These working papers are issued to disseminate research results to other scholars.

Individual copies of this paper are available through IBER, 156 Barrows Hall, University of California, Berkeley, CA 94720. Phone (510) 642-1922, fax (510) 642-5018.

UNIVERSITY OF CALIFORNIA AT BERKELEY

Department of Economics

Berkeley, California 94720

CENTER FOR INTERNATIONAL AND DEVELOPMENT ECONOMICS RESEARCH
Working Paper No. C94-034

Trading Blocs: The Natural, the Unnatural, and the Super-Natural

Jeffrey A. Frankel, Ernesto Stein and Shang-Jin Wei

Department of Economics, University of California at Berkeley

April 1994

Key words: Free Trade Area, trading blocs, MFN, gravity model, regional trade preferences, MERCOSUR, Andean Pact
JEL Classification: F15

This paper was written for the Sixth Inter American Seminar in Economics, organized by Sebastian Edwards and Gustavo Marquez, sponsored by the National Bureau of Economic Research, Cambridge, MA., and held in Caracas, Venezuela, May 28-29, 1993. A shortened version is to be published in the *Journal of Development Economics*. The authors would like to thank Benjamin Chui and Xiong Bai Fan for research assistance, and Warwick McKibbin, Gary Saxonhouse and Alan Winters, for supplying data. They would also like to thank for support the Center for International and Development Economics Research, funded at U.C. Berkeley by the Ford Foundation, and the Japan-United States Friendship Commission, a U.S. government agency.

Abstract

Is the world breaking up into three trading blocs, one in the Americas, one in Europe and one in Pacific Asia? If so, is this deviation from the principle of MFN (non-discriminatory trade policies) good or bad? This paper attempts to answer both questions. Using the gravity model to examine bilateral trade patterns throughout the world, we find evidence of trading blocs in the European Community, the Pacific, and the Western Hemisphere, as in earlier work. Intra-regional trade is greater than could be explained by natural determinants: the proximity of a pair of countries, their sizes and GNP/capitas, and whether they share a common border or a common language.

Within the Western Hemisphere, MERCOSUR and the Andean Pact countries appear to function as significantly independent trading areas, but NAFTA much less so (as of 1990). The strongest grouping in most years is APEC (Asia Pacific Economic Cooperation, which includes the U.S. and Canada along with the Asian Pacific countries). The intra-regional trade bias within MERCOSUR increased the most rapidly during the 1980s. In East Asia, on the other hand, increased intra-regional trade can be explained entirely by the rapid growth of the economies.

We then turn from the econometrics to an analysis of economic welfare. Krugman has supplied an argument against a world of three trading blocs (that they would be protectionist), in a model that assumes no transport costs. He has supplied another argument *in favor* of trading blocs, provided the blocs are drawn along the "natural" geographic lines of the continents, in a model that assumes prohibitively high transportation costs between continents. In this paper we attempt to resolve the Krugman vs. Krugman debate. We complete the model of the welfare implications of trading blocs for the realistic case where inter-continental transport costs are neither so high as to be prohibitive nor as low as the costs among neighbors. We consider three applications of the model.

(1) **Continental Free Trade Areas (FTAs).** We show that it is not only Krugman's "unnatural" FTAs that can leave everyone worse off than under MFN, but that under conditions of relatively low intercontinental transport costs, FTAs that are formed along natural continental lines can do so as well. We call such welfare-reducing blocs **super-natural.**

(2) **Partial regionalization.** We find that partial liberalization within a regional Preferential Trading Arrangement (PTA) is better than 100 percent liberalization, in contrast to the Article 24 provision of the GATT. The super-natural zone, where the regional trading arrangement reduces welfare, occurs for combinations of low inter-continental transport costs *and* high intra-bloc preferences, i.e., when the regionalization of trade policy exceeds what is justified by natural factors.

(3) **The formation of several sub-regional PTAs on each continent.** We find that multiple FTAs on each continent could lower welfare, but that multiple PTAs, with partial internal liberalization, would raise welfare.

We conclude the paper with an attempt to extract estimates of transportation costs from the statistics. Estimates suggest that trading blocs on the order of the EC are in fact super-natural.

Trading Blocs: The Natural, the Unnatural, and the Super-Natural

The world has seen a recent upsurge of movements toward Free Trade Areas and other special regional trading arrangements, from the European Union (EU, formerly the EC) to the Association of SouthEast Asian Nations (ASEAN). Currently the momentum for regionalization appears as strong in the Western Hemisphere as anywhere.

Most of the regional trade agreements that were announced in the past did not initially come to much, such as the 1960 Central American Common Market (CACM), the 1960 Latin America Free Trade Association (LAFTA), or the 1969 Andean Pact.[1] But more recent agreements have been more serious. The Canadian-U.S. Free Trade Agreement was successfully concluded in 1988, and went into effect in 1989. MERCOSUR was negotiated between Brazil, Argentina, Uruguay and Paraguay in March 1990, began to go into effect in 1991, and scheduled an elimination of all regional tariffs by the end of 1994 (though it is likely to run slightly behind on time-table). Venezuela and Colombia reinvigorated the Andes Pact in November 1991, agreeing to establish a common market by 1993. (Edwards, 1993, reviews the history of regional economic arrangements in Latin America.) More agreements are in

---

[1] The Latin American Integration Association (LAIA) replaced the LAFTA in 1980. De la Torre and Kelly (1992) and Fieleke (1992) chronicle the lapses between proclamation and practice in these cases [and others, such as ECOWAS in West Africa], in their surveys of the post-war history of regional trading arrangements.

the works, throughout the Western Hemisphere[2] and elsewhere.

In the 1990s, the talk has moved to expansion of the regional Free Trade Agreements within their respective continents. The North American Free Trade Agreement (NAFTA) was negotiated between the U.S., Mexican and Canadian governments in 1992 and went into effect January 1, 1994. There are provisions to add other Western Hemisphere countries;[3] The Clinton Administration has confirmed that negotiations between Chile and NAFTA will begin in 1994. In Europe, negotiations neared completion in March 1994 for four members of the European Free Trade Association (EFTA) to join the EU. Meanwhile the European Economic Area, an arrangement of (relatively) free movement in goods, services and labor comprising 17 countries, came into being in January 1994. Other countries from Central and Eastern Europe hope eventually to join their Western neighbors.

All this regional activity leaves some observers concerned that the world is dividing into three continental trading blocs, one in the Americas centered on the U.S., one in Europe centered on the EC, and one in Pacific Asia, centered on Japan.[4]

Table 1 presents statistics on the intra-regional share of

---

[2] The CACM, comprising six Central American countries, was strengthened in 1991. Central American countries have recently joined Caribbean countries (who have their own arrangement, CARICOM), in asking North America for "parity" with Mexico of access to NAFTA in at least some of their exports.

[3] Consistent with the Enterprise for the Americas Initiative proposed by the Bush Administration in June 1990.

[4] For example, Thurow (1992, pp.16,65).

trade undertaken by members of these groupings. Intra-regional shares increased during the 1980s in each of the three major parts of the world: from 23 per cent to 29 per cent in East Asia, from 27 per cent to 29 per cent in the Western Hemisphere, and from 54 per cent to 60 per cent in Europe. (The greatest increase, from 42 per cent to 53 per cent, took place among the APEC countries, spanning the Pacific.) The table shows that intra-regional trade shares also increased within some specific regional Free Trade Areas: the EC, MERCOSUR, the Andean Pact, and NAFTA.

Is this apparent movement toward regionalization of the world trading system good or bad? Let us begin by reminding ourselves that such a question is an exercise in the "second best."

First-best would be a worldwide regime of free trade, where all countries agree to refrain from erecting barriers and there is a serious international institution to enforce the agreement. Modern trade theory, with its emphasis on imperfect competition and so on, has done little to change this bottom line.[5] But the

---

[5] Modern trade theory has come up with a number of circumstances in which unilateral subsidy or other intervention by one country's government is capable of making that country better off (e.g., certain technological spillovers, and strategic industries). But the models do not undermine standard "free-trade policy," which holds that a world in which governments cooperatively agree to limit subsidies or tariffs is better than a world where all are left free to undertake them. To the contrary, the new models tend to strengthen the case for multilateral agreements, though this is not explicitly recognized as often as it might be. (These models' conclusions also tend to be very sensitive to imperfect knowledge on the part of governments, or vulnerability to political influence by interest

first-best is an ideal that is rather unlikely to be reached in practice. What sort of international trading arrangement is second-best?

Since its founding, the GATT has been predicated on the assumption that second-best is a regime where each member accords others the status of Most-Favored Nation (MFN), i.e., treats its trading partners equally. The MFN system was seen as an antidote to the disaster of the 1930s, when the world was divided up into trading blocs: a Sterling Zone, Gold/Franc Zone, Axis Zone, etc. The GATT incorporated an important exception to the MFN principle in its Article 24: a subset of members could form a Free Trade Area (FTA), provided certain conditions were met, including that barriers within the FTA were removed completely, rather than only partially, and that barriers against non-members not be raised.

Arguments for the merits of the MFN-cum-Article 24 system could take either of two possible tacks. (See Bhagwati, 1992.)[6] First one might try to argue, in a static economic sense, that the formation of FTAs under the conditions specified in Article 24 is likely to raise economic welfare, and that other deviations from the MFN principle are not.[7] Second one could argue, in a

---

groups.)

[6] Bhagwati (1992), Deardorff and Stern (1992), and de Melo, Panagariya, and Rodrik (1992) review the literature. Fieleke (1992) is a useful non-technical review of regional trading arrangements.

[7] Jackson (1993, p.123), for example, has suggested that the goal of the Article 24 exception to the MFN principle is that FTAs would be trade-creating rather than trade-diverting.

dynamic political economy sense, that FTAs can act as stepping stones, which help build the political support necessary to negotiate freer trade worldwide.[8] Neither of these possible arguments is especially clear or well-established. It is the first that we examine critically in this paper.

Paul Krugman has helped to focus the recent debate on whether a global trend toward the formation of trading blocs would be a good thing or a bad thing. But he has supplied equally clever arguments on both sides. In his first contribution (Krugman, 1991a), he focused on the idea that when individual countries form larger groupings, they are liable to become more protectionist, and thus to move farther from the ideal of world free trade. The reasoning was that as a group they would set higher tariff levels vis-a-vis the rest of the world, since they would have more monopoly power to exploit. Units were assumed to set tariffs at a self-maximizing optimal level.[9] He showed that world welfare is lower with a few trading blocs than with the extremes of one or many, and that for specific plausible parameter values, three turned out to be the worst possible number of blocs to have!

---

[8] A good argument for the NAFTA is that it locks into place trade liberalization that Mexico is undertaking anyway, but that future political forces in Mexico might seek to change. Many consider this argument to be as important as the economic gains from the NAFTA provisions in their own right [or as other considerations such as immigration or U.S.-Mexican political relations].

[9] A later contribution, Krugman (1992), dropped the assumption of optimal or endogenous tariffs. The conclusions were similar.

His second contribution, Krugman (1991b), provided a useful review of the whole array of issues and factors involved. But it also included a very simple argument that leads to the diametrically opposite conclusion from the first one, that trading blocs are good. It is observed that even without the formation of regional free trade areas or preferential trading arrangements of any sort, countries trade more with their neighbors than with countries from which they are far removed, presumably because of transportation costs.

Imagine, in the limit, that transoceanic transportation costs were so high that all trade took place within continents. Then it must follow from standard trade theory that removal of trade barriers within each continent, that is, the formation of regional free trade areas, would be a good thing: this move within each area would represent the first-best solution of free trade within its own relevant world. Krugman's conclusion is that, to the extent that trade follows the "natural" lines dictated by proximity, the formation of regional trading blocs is good. Such natural blocs are contrasted with "unnatural blocs", free trade agreements between individual countries in different continents, which are less likely to be welfare-improving.[10]

---

[10] In what the Economist called "the shootout at Jackson Hole," Summers (1991) agreed with Krugman that natural blocs were likely to be beneficial, while Bergsten (1991) was on the other side. It should be noted that the idea of proximity as a desiderata for successful FTAs, on the grounds that it would minimize the amount of trade diversion, was not entirely new with Krugman. (See Balassa 1987, p.44, and Wonnacott and Lutz 1989). The leading opponent is Bhagwati (1992), whose reaction to reports from Jackson Hole was: "The prescription is sufficiently

Each of these two arguments is, of course, valid within its own assumptions. One way to characterize them is as the limiting polar cases of zero inter-continental transportation costs and infinite inter-continental transportation costs, respectively. The analysis, to be complete, cries out for a more general model that can handle the intermediate realistic case where transportation costs between continents are less than infinite, while greater than zero (and greater than transportation costs *within* continents).

One can imagine several possible rules regarding general preferential trading arrangements (PTAs), in addition to the question of whether the FTA deviation from MFN practice should be encouraged or allowed at all. First, should FTAs be restricted to natural trading partners, as Krugman (1991b) suggests? This would mean that FTAs could only be formed among countries that are located in the same part of the world (e.g., the Western Hemisphere, which would exclude the Israel-U.S. FTA) or perhaps only among neighbors located in the same sub-region (e.g., North America, which would exclude even an agreement between NAFTA and Chile). Second, is the rule sensible that technically requires 100 per cent liberalization within a grouping, i.e., that allows only FTAs? Or should partial liberalization be allowed, as <u>de facto</u> prevails in most PTAs? Is there an optimal degree of regionalization that should be encouraged?

---

strange and hard to defend for me to wonder whether these distinguished economists truly expressed these views" (footnote 8).

We shall attempt to do several things in this paper. First, we shall measure the extent to which regionalization is actually taking place, by looking at the magnitude of bilateral trade flows after one adjusts, by means of the gravity model, for such natural determinants of bilateral trade as GNPs and proximity. We consider two alternative possibilities regarding the relevant place to draw the boundaries of the regional groupings: at the level of continental blocs (our continents are The Americas, vs. Europe, vs. Pacific Asia, and perhaps Africa/Mideast as a fourth), or at the level of sub-continental FTAs consisting of a few members each (e.g., NAFTA, MERCOSUR, and the Andean Pact).

That the share of intra-regional trade is increasing within a given grouping, as in Table 1, does not necessarily mean that the members of this grouping are undertaking explicit discriminatory trade policy measures to bring this about. Rapid growth in intra-regional trade could be the result of natural factors, i.e., rapid growth in per capita GNPs. Indeed we find that this is the case for East Asia. In Europe and the Americas, on the other hand, there appears to be a statistically significant role for regional trade policies, even after correcting for natural determinants.

Second, we address welfare implications of different possible rules for the formation of preferential trade groupings. At a theoretical level, we shall attempt to complete the Krugman model of the welfare implications of trading blocs for the realistic case where transportation costs between continents are

neither so high as to be prohibitive nor so low as to be the same as costs among neighbors. We consider three applications of the model in turn.

We start with continental FTAs. We shall see that it is not only unnatural FTAs that can leave everyone worse off than under MFN, but that under certain conditions FTAs that are formed along natural intra-continental lines can do so as well. We call such welfare-reducing blocs super-natural.[11] We shall see in simulations that this possibility may obtain, in particular, when intercontinental transportation costs, while not necessarily as low as intracontinental costs, are as low as 10 or 20 per cent.

Next we apply the model to the issue of partial preferential treatment within regional trade groupings. We find that partial liberalization within a regional trade grouping is better than 100 per cent liberalization, in contrast to the Article 24 provision. The super-natural zone, where the regional trading arrangement reduces welfare, occurs for combinations of low intercontinental transport costs and high intra-bloc preferences.

The third application of the model is to the question of sub-regional FTAs, i.e., the formation of several FTAs on each continent. We have in mind, for example, the regionalization of trade within the Americas into four FTAs consisting of NAFTA, Central America, the Andean Pact and MERCOSUR. (The Caribbean countries might be included in Central America, and Chile in the Andean Pact as it used to be; or perhaps all of them would join

---

[11] The term was introduced in Frankel (1992).

NAFTA.) We find that such an arrangement, like continental FTAs, would be worse than the status quo of MFN. If the constraint of Article 24 is relaxed however, and partial liberalization within each regional trading arrangement is allowed, then the formation of several PTAs within each continent is a good thing, although continent-wide PTAs are even better.

In the final part of the paper, we attempt to get a better idea of which of the theoretical welfare possibilities is actually most likely in practice by adopting estimates of the parameters from the 1980-1990 data on bilateral trade that are used in the first part of the paper. An estimate of intra-continental transport costs based on the ratio of c.i.f. to f.o.b. values (and trade shares) is 10 per cent, suggesting that super-natural blocs are a real danger. Distance may generate costs beyond the freight and insurance required by physical transport of goods. An alternative to the c.i.f./f..o.b. calculation is to use the gravity model estimates of the effect of distance on trade. [Unlike simple statistics drawn from trade shares, these estimates are able to hold constant for membership in regional groupings and other variables.] A tentative estimate of the intra-continental parameter, based on the gravity model, is 16 per cent. Such an estimate, combined with our other simulation parameter values, would imply that negative returns to regionalization begin to set in when regional preferences reach about 23 per cent.

Most of our conclusions regarding economic welfare presume

worldwide symmetry. In other words, we look at the consequences of a worldwide regime of allowing continental blocs or regional FTAs to form; the consequences of the unilateral formation of a single bloc or FTA in one part of the world is not addressed in this paper.[12] It should be noted from the outset that many of the conclusions are tentative, and that many possible considerations are omitted from the analysis. For example, we focus only on the static economic effects.

2. Are Regional Trade Blocs Forming?

Frankel (1992) applied to the trading bloc question the natural framework for studying bilateral trade, the gravity model. The gravity model says that trade between two countries is proportionate to the product of their GNPs and inversely related to the distance between them, by analogy to the formula for gravitational attraction between two masses. It has a fairly long history and fits the data remarkably well empirically, though its theoretical foundations are limited.[13] There are not many recent applications of the gravity model to a large cross-section of countries throughout the world. Three others are Wang and Winters (1991), Hamilton and Winters (1992), and Havrylyshyn

---

[12] Saxonhouse (1993) considers this question.

[13] The results of one extensive early project along these lines were reported in Tinbergen (1962, Appendix VI, pp.262-293) and Linneman (1967). Foundations for the gravity model are offered in papers surveyed by Deardorff (1984, pp.503-06) and Wang and Winters (1992), such as Linnemann (1966) and Anderson (1979).

and Pritchett (1991).[14]

Frankel (1992) and Frankel and Wei (1992), looking at the period 1980-1990, found that: (1) there are indeed intra-regional trade biases in the EC and the Western Hemisphere, and perhaps in East Asia; but (2) the greatest intra-regional bias was in none of these three, but in the APEC grouping, which includes the U.S. and Canada with the Pacific countries; and (3) the bias in the East Asia and Pacific groupings did not increase in the 1980s, contrary to the impression that many have drawn from intra-regional trade statistics such as are reported in Table 1.

Frankel and Wei (1993a, 1993b) extend those results in a number of directions. The papers consider various econometric extensions of the original gravity model estimation: the inclusion of pairs of countries that are reported as undertaking zero trade, and a correction for heteroscedasticity based on the size of the countries. The time period is extended 15 years farther back. The results turn out to be robust to these extensions. The papers also considered some economic extensions, in particular testing whether stabilization of bilateral exchange rates has been a factor in promoting intra-regional trade.

Here we attempt to take some additional factors into account

---

[14] The focus of these papers was on potential Eastern European trade patterns. The Winters papers report statistically significant within-region biases to the following groupings: EC, Latin America, ASEAN, former British colonies, GSP, and EC preferences under the Lome convention. Havrylyshyn and Pritchett (1991) report significant effects for the EC, LAFTA and CACM.

in the equation. Separate results are reported for manufactured products, to see if the patterns differ from those in aggregate trade. We test for trade-diversion. We test whether customs unions have different effects from preferential trading arrangements. We add factor-endowment terms to reflect more traditional theories of trade.

The earlier results were incapable of distinguishing between regional biases reflecting discriminatory trade policies, and those that might derive from historical, political, cultural and linguistic ties. Here we include terms representing pairs of countries that speak a common language or have other historical ties. We also focus more on Western Hemisphere groupings (including the sub-regional groupings, NAFTA, MERCOSUR, and the Andean Pact).

2.1 The Gravity Model of Bilateral Trade

One cannot meaningfully investigate the extent to which regional policy initiatives are influencing trade patterns without holding constant for natural economic determinants. The gravity model offers a systematic framework for measuring what patterns of bilateral trade are normal around the world. A dummy variable can then be added to represent when both countries in a given pair belong to the same regional grouping. The goal, again, is to see how much of the high level of trade within each region can be explained by simple economic factors common to bilateral trade throughout the world, and how much is left over

to be attributed to a special regional effect.

The dependent variable is trade (exports plus imports), in log form, between pairs of countries in a given year. We have 63 countries in our data set, so that there are 1,953 data points (=63x62/2) for a given year.[15]

The two most important factors in explaining bilateral trade flows are the geographical distance between the two countries, and their economic size.

A large part of the apparent bias toward intra-regional trade is certainly due to simple geographical proximity. Indeed Krugman (1991b) suggests that most of it may be due to proximity, so that the three trading blocs are welfare-improving "natural" groupings. Despite the obvious importance of distance and transportation costs in determining the volume of trade, empirical studies surprisingly often neglect to measure this factor. Our measure is the log of distance between the two major cities (usually the capital) of the respective countries. We also add a dummy "Adjacent" variable to indicate when two countries share a common land border.

Entering GNPs in product form is empirically well-established in bilateral trade regressions. It can be justified

---

[15] The list of countries, and regional groupings, is given in an Appendix to Frankel (1992). The Andes Pact grouping consists of Bolivia, Peru, Ecuador, Colombia and Venezuela, as well as Chile.

by the modern theory of trade under imperfect competition.[16] In addition there is reason to believe that GNP per capita has a positive effect on trade, for a given size: as countries become more developed, they tend to specialize more and to trade more.

The equation to be estimated, in its most basic form, is:

$$(1) \qquad \log(T_{ij}) = \alpha + \beta_1 \log(GNP_i GNP_j) + \beta_2 \log(GNP/pop_i GNP/pop_j)$$

$$+ \beta_3 \log(DISTANCE) + \beta_4 (ADJACENT) + \gamma_1 (EC_{ij}) + \gamma_2 (WH_{ij}) + \gamma_3 (EA_{ij}) + u_{ij}.$$

The last four explanatory factors are dummy variables. *EC*, *WH*, and *EA* are three of the dummy variables we use when testing the effects of membership in a common regional grouping standing for European Community, Western Hemisphere, and East Asia.

Table 2 reports results that extend from 1965 to 1990. We find all four standard variables to be highly significant statistically (> 99% level).

The 1990 coefficient on the log of distance is about -.6, when the adjacency variable (which is also highly significant statistically) is included at the same time. This means that when the distance between two non-adjacent countries is higher by

---

[16] The specification implies that trade between two equal-sized countries (say, of size .5) will be greater than trade between a large and small country (say, of size .9 and .1). This property of models with imperfect competition is not a property of the classical Heckscher-Ohlin theory of comparative advantage. Helpman (1987) and Helpman and Krugman (1985, section 1.5).

1 per cent, the trade between them falls by about .6 per cent.[17] We checked for possible non-linearity in the log-distance term, as it could conceivably be the cause of any apparent bias toward intra-regional trade that is left after controlling linearly for distance, but this did not seem to be an issue.[18] We have also tried distance measures that take into account the greater distances involved in sea voyages around obstacles like the Cape of Good Hope and Cape Horn, generously supplied by Winters and Wang (1992), with little effect on the results.

The coefficient of distance fluctuates some over the earlier observations, but with no clear trend. The disaggregated results show higher distance effects for manufactures than for agricultural products or other raw materials. These findings suggest to us that physical transport costs may not be the most important component of costs associated with distance.

The estimated coefficient on GNP per capita varies in the .3-.4 range from 1965 to 1980, indicating that richer countries do indeed trade more. This term declines during the 1980s, reaching .17 in 1990.[19] The estimated coefficient for the log of the product of the two countries' GNPs holds steady at about .75, indicating that, though trade increases with size, it increases less-than-proportionately (holding GNP per capita constant). This presumably reflects the widely-known pattern that small economies tend to be more open to international trade than

---

[17] The estimate is .8 if one does not hold constant for adjacency at the same time (Frankel, 1993). There is no observable tendency for the effect of distance to fall over time. Linnemann's estimate for 1959 is also .8 (1966, pp. 82-88). Leamer (1993) obtains a similar elasticity: .68 [for West German trade. He is struck by the importance of distance, and concludes that, under NAFTA, Southern California will experience the greatest increase in trade with Mexico.]

[18] The log of distance appears to be sufficient; the level and square of distance add little.

[19] Linnemann (1966) obtains similar estimates for this parameter (in the range .21 to .27) for the year 1959.

larger, more diversified, economies.

2.2 Estimation of trade-bloc effects

If there were nothing to the notion of trading blocs, then these four basic variables might soak up all the explanatory power. There would be nothing left to attribute to a dummy variable representing whether two trading partners are both located in the same region. In this case the level and trend in intra-regional trade would be due solely to the proximity of the countries, and to their rapid rate of overall economic growth.

But we found that dummy variables for intra-regional trade are highly significant statistically.

In earlier results, if two countries were both located in the Western Hemisphere, they traded with each other by an estimated 86 per cent more in 1980 than they would have otherwise [exp(.62) = 1.86], after taking into account distance and the other gravity variables. In Table 2, this estimated effect is slightly stronger (though it temporarily loses significance in 1985). In 1990 the estimated effect is especially strong: two Western Hemisphere countries trade almost three times as much as others [2.75 =exp(1.04)].

As recently as 1980, the EC bloc effect was not statistically significant. The effect in 1985 is highly significant. A 1985 coefficient of 1.14 suggests that if two countries are both located in the European Community, their bilateral trade is three times as high as it would otherwise be [exp(1.14) = 3.13]. (The effect falls in 1990, if one allows for the fact that EC countries are more open in general, as reported in Table 2.) EFTA is never significant.

As in earlier results, the coefficient for the East Asian grouping (including China, not including Australia and New Zealand) is highly significant, but diminishes in the 1980s, rather than increasing as often assumed. The rapid growth of East Asian economies is in itself sufficient to explain the

increase in the intra-regional trade share evident in Table 1. Also as in earlier results, the strongest grouping in the world is APEC, though the Western Hemisphere is equally strong in 1990. The United States and Canada are indeed fortunate to belong to both groupings.

The last five coefficients in Table 2 test for trade-diversion effects, indicated by a negative coefficient on a dummy variable representing when (at least) one country in the pair is a member of the regional grouping in question. EFTA is found to have a significant trade-diversion effect in most years, suggesting that these countries are less open than most in the sample. The EC coefficient is positive, and in the 1980s is significant, suggesting that member countries have opened to the whole world, at the same time that they have removed barriers vis-a-vis each other. This is especially true of East Asia as well, in most years. There is some evidence of trade-diversion among members of APEC. The Western Hemisphere also shows signs of trade-diversion early in the sample, but this changes in 1985 and 1990. The disaggregated results show a slight tendency for the trade-diversion to be concentrated in manufactures.

Table 3 drops the Western Hemisphere bloc variable, in favor of separate dummy variables for three sub-regions: NAFTA, MERCOSUR, and the Andean Pact. Tight standard errors and significant coefficients are not to be expected, in light of the small number of observations: 3 (=3x2/2) for NAFTA, 6 (=4x3/2) for MERCOSUR, and 10 (=5x4/2) for the Andean Pact. But the point estimates are of interest nonetheless, as these are the groupings with explicit trade preferences.

The estimates for MERCOSUR and the Andean Pact turn positive in 1970, the latter significantly so in 1975 and 1980, and both significant in 1990. Remarkably, members of MERCOSUR in 1990 trade with each other eight times as much [exp(2.09)=8.08] as

would similar neighbors elsewhere in the world.[20]

The NAFTA coefficient only turns positive in 1985. As one would certainly expect from the extremely small number of observations, it is not statistically significant.

Tables 4 and 4a drop the specific sub-regional groupings [in the Western Hemisphere] and replace them with one dummy variable to indicate whenever a pair of countries belongs to the same PTA or FTA, regardless which one it is, and another to indicate whenever the pair belongs to the same Customs Union or Common Market. The distinction is that in the latter two arrangements, external tariffs are made uniform. The PTA/FTA variable is often statistically significant, particularly when the tests are run on manufacturing products alone. The CU/CM variable is not.

Next, we added a dummy variable to represent when both countries of a pair spoke a common language or had colonial links earlier in the century. We allowed for English, Spanish, Chinese, Arabic, French, German, Japanese, Dutch, and Portuguese.[21] The results are reported in Table 5b for the case of manufactured goods.[22] Two countries sharing

---

[20] In some cases, e.g., the EC, these results confirm what one might have guessed from looking simply at intra-regional trade shares, as in Table 1. But in other cases, e.g., EFTA and MERCOSUR, the corrections of the gravity model make a big difference. [Wonnacott and Lutz, p.76, show increases in intra-regional trade resulting from the EC, EFTA and the Andes Pact, and not from LAFTA or ASEAN.]

[21] Havrylyshyn and Pritchett (1991) found that three languages are significant in the gravity model -- Portuguese, Spanish and English, in decreasing order of magnitude. In a study of poor countries, Foroutan and Pritchett (1992) find that French, Spanish and English are statistically significant.

[22] The language coefficient is not statistically significant when the test is run as in Table 5b, where the inclusion of five individual major languages create multicollinearity with the general language term. But the coefficient is significant for half the years when the analogous test is run on aggregate trade (Table 6 in Frankel and Wei, 1993b) and is highly significant for all years when the coefficient is constrained to be the same for different languages (Table 1 in Frankel and Wei, 1993a).

linguistic/colonial links tend to trade roughly 65 per cent more than they would otherwise [exp(.5)=1.65]. We tested whether some of the major languages were more important than the others. Chinese is the only one that might qualify. [Two Chinese-speaking countries appear to trade four times as much [exp(1.35+.12=1.47)=4.35] as other countries.[23]]

Somewhat surprisingly, the inclusion of the linguistic/colonial terms has little effect on the other coefficients. The EC, Western Hemisphere, APEC, and East Asia all remain significant trade blocs, with increasing trends over the period 1965-1990 in each case but the last.

Finally, we also tried to capture classic Heckscher-Ohlin effects. First we tried including bilateral absolute differences in GNP/capita figures. The variable did not have the positive effect that one would expect if countries traded capital-intensive products for unskilled-labor-intensive products. Rather, it had a moderately signficant negative effect, as in the Linder hypothesis that similar countries trade more than dissimilar ones.

Next we tried gravity estimates that include more direct measures of factor endowments: the two countries' differences in capital/labor ratios, educational attainment levels, and land/labor ratios (reported in Table 5 of the full working paper version of Frankel and Wei, 1993b). The data (for a subset of 656 of our 1,953 pairs of countries) was generously supplied by Gary Saxonhouse (1989). There is a bit of support for these terms, particularly for capital/labor ratios and educational attainment in 1980. The other coefficients are little affected.

The gravity model results thus show that statistically significant regional trading arrangements are indeed springing up

---

[23] Taiwan-China trade does not appear in the statistics, because it is officially non-existent. Much of it goes through Hong Kong, and is thus counted twice. An attempt to correct for this factor eliminates the extra effect of the Chinese language term (Table 3 of Frankel and Wei, 1993a).

in a number of places. The next question is whether this trend constitutes an undesirable threat to the world trading system.

3. The Theory of Trade with Imperfect Substitutes and Transportation Costs

This and the next parts of the paper attempt to settle the Krugman vs. Krugman controversy regarding the desirability of trading blocs, by constructing a more general model that can handle the intermediate realistic case where transportation costs between continents are less than infinite, while greater than zero (and greater than transportation costs *within* continents). The ultimate goal is to match the theory up with the preceding section's empirical estimates of the effects of transportation costs and regional trading arrangements on the volume of bilateral trade, in order to allow an evaluation of different trade arrangements. But the match-up attempted in the final part of this paper can only be regarded as preliminary.

3.1 The Differentiated Products Model

We work with a model of trade under monopolistic competition due to Krugman (1980)[24]. Our contribution is to extend this model to many countries (and many continents), allowing for tariffs and transportation costs, both within continents and between continents, and to apply it to study the welfare implications of the formation of trading blocs.[25] As often in this literature, the reference to "tariffs" is intended as shorthand for all government-imposed trade barriers.

The Krugman (1980) market structure has the property of ruling out strategic interaction among firms. Goods enter symmetrically into the utility function

$$U = \sum_i c_i^{\theta}; \qquad 0 < \theta < 1 \tag{2}$$

where c_i is the consumption of the i^{th} variety. There is a large number of goods being produced (n), but this number is much smaller than the potential number of goods or varieties.

This utility function results in preference for variety by the consumers. The higher the parameter θ, the lower the love for variety. In the limit of perfect substitutability, θ=1. In the limit of complete love for variety, consumers care only about the number of varieties consumed, and not at all about the quantity:

---

[24] For the sake of comparability, both the notation and the description of the basic model will closely follow Krugman (1980).

[25] Krugman introduced transport costs into his (two country) model but applied it to a different purpose: to explore the "home market effect" on trade patterns (the idea that countries tend to specialize in goods for which the home market is relatively large).

$\theta=0$.[26]

Labor is the only factor of production. The total national supply of labor is L. Increasing returns are introduced by assuming a fixed cost and a constant marginal cost in the production of each of the varieties. We assume that individual consumers maximize their utility, individual firms maximize their profits, and free entry assures a zero-profit equilibrium. Under these simple assumptions, the scale of output of each variety does not depend on the size of the economy. Rather, it is the number of varieties n that increases when the size of the economy (L) increases:

$$n = \frac{L(1-\theta)}{\alpha} \qquad (3)$$

where α is a parameter representing the fixed costs of setting up production of a new variety. Notice that in the extreme special case of zero substitutability ($\theta=0$), the bare minimum (one unit) of each of L/α varieties will be produced, since consumers care only about the number of varieties available. (Details of this derivation, and of others below, are given in Stein and Frankel, 1993.)

To see the gains from international trade, which arise here from the opportunity to consume a greater variety of goods, we assume that countries have similar tastes and technologies. If we have two countries of equal size, allowing for unfettered trade will double the number of available varieties in each

---

[26] Deardorff and Stern (1992, p.22-25) question the realism of this set-up. In their view, the Krugman result that a few large blocks are worse than many small ones can be attributed to excessive emphasis on the utility of consuming a large variety of goods that may differ only in the location of production (i.e., brand name). They suggest that classical theories of comparative advantage would imply that welfare is monotonically increasing in the number of countries per bloc, and that FTAs among a few dissimilar countries may be sufficient to attain most of the gains-from-trade to be had.

country and thus raise utility.

3.2 Introduction of Transport Costs and Tariffs

We will think of the world as being divided into a number of continents (C), each of them equidistant from one another. Each of these continents is composed of a number of countries (N). The transportation system we assume within each continent is a hub-and-spoke network. In each continent there is a hub, through which all trade involving that continent must pass. Each hub has N spokes, all assumed of equal length, connecting it to the N countries in the continent. 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.[27]

The cost of transport through two spokes 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 on 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 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 case of trade between countries in different continents, which involves two spokes and a hub-to-hub section, is **(1-a)(1-b)**.

The tariffs will be treated in a standard way. When a consumer buys a foreign good, the government levies an ad-valorem tariff **t**. [Our basic theoretical model will assume that the tariff is levied as a percent of the value of the good expressed in f.o.b. terms, i.e., not including transportation costs. For some purposes it may be more convenient, as well as more

---

[27] The notion of transportation costs should probably be understood as transactions costs, encompassing not just physical transportation of goods but also costs of communications and the idea that countries tend to have a better understanding of their neighbors and their institutions.

realistic, to assume that it is levied as a proportion of the value of the good in c.i.f. terms, i.e., including transportation costs.[28]] The level of tariffs is exogenous, and assumed to be uniform across countries, representing the MFN principle, until we are ready to examine preferential trading arrangements.

For simplicity, we will assume that each one of the countries is equal in size. The symmetry of the model now assures that the producers' prices are the same in every country, as well as the number of varieties and the quantity of each variety produced in every country. Prices of home and foreign goods faced by home consumers are different due to transportation costs and tariffs. If the producer prices in every country are **p**, then the price the domestic consumer will have to pay for every unit of foreign good consumed will be:

$$p_{c,t} = \frac{p[1+(1-a)\,t]}{1-a} \qquad p_{nc,t} = \frac{p[1+(1-a)\,(1-b)\,t]}{(1-a)\,(1-b)} \qquad (4)$$

where the subscript **c** refers to goods imported from within the continent, and **nc** otherwise (across continents). Notice that import prices depend positively on tariffs and transportation costs. In the absence of tariffs, the prices faced by the home consumers will be $p_c=p/(1-a)$ and $p_{nc}=p/(1-a)(1-b)$.

Since the home consumer will be paying different prices for the consumption of home and foreign products, he or she will be consuming them in different quantities. The next step is to derive, from the utility function, the consumption of each foreign variety (both from neighbor countries and from countries in other continents) relative to the consumption of each home variety. We begin by assuming that tariffs **t** are levied.

From the maximization problem of the consumers it is possible to derive the elasticity of demand for exports faced by

---

[28] The c.i.f.-based assumption is pursued in another working paper.

the producers, which turns out to be $\epsilon_x=1/(1-\theta)$, the same as the elasticity of domestic demand. The equality of these elasticities guarantees that the price that results from the firm's profit maximization is the same as in the case of the closed economy. So are the quantity produced of each variety and the number of varieties n produced in each country. Transport costs and tariffs, thus, introduce no changes in these variables. But the key point is the effect on consumption patterns.

The first order conditions for the consumer's problem yield the relative consumption of each variety:

$$\frac{c_i^c}{c_i^h} = \left(\frac{p}{p_{c,t}}\right)^{\frac{1}{1-\theta}} \qquad (5)$$

$$\frac{c_i^{nc}}{c_i^h} = \left(\frac{p}{p_{nc,t}}\right)^{\frac{1}{1-\theta}} \qquad (6)$$

where c_i^c and c_i^{nc} are the domestic consumer's consumption of foreign varieties, from countries within the continent and across the ocean and c_i^h is the domestic consumer's consumption of the home varieties.

Now we can derive the relative *demand* for varieties by the home consumer. The "demand" for the foreign varieties as defined here (again, following Krugman), is larger than the consumption of those varieties, since it includes what is lost through transportation. We know that in order to consume one unit of a foreign variety, a home consumer will have to demand 1/(1-**a**) in the case of a neighbor country, 1/(1-**a**)(1-**b**) otherwise. Introducing these terms, as well as the prices given by (4) into equations (5 and 6), we obtain the demand for each one of the foreign varieties relative to the demand for the domestic varieties:

$$\sigma_{c,t} = \frac{(1-a)^{\frac{\theta}{1-\theta}}}{[1+(1-a)\,t]^{\frac{1}{1-\theta}}}$$

$$\sigma_{nc,t} = \frac{[(1-a)(1-b)]^{\frac{\theta}{1-\theta}}}{[1+(1-a)(1-b)\,t]^{\frac{1}{1-\theta}}} \qquad (7)$$

We can see that the relative demand for all foreign varieties depends negatively on tariffs. Although the effect of transport costs on consumption of an import good is negative, the effect on the total value of demand (including transport costs themselves) is ambiguous.

From equation (7) it is very simple to obtain the share of demand of the home consumer for the three types of varieties, given the number of continents (C) and the number of countries per continent (N). If we normalize the demand for each home variety to be equal to 1, the share of home goods in total home demand is:

$$S_h = \frac{n}{n+n\sigma_{c,t}(N-1)+n\sigma_{nc,t}(C-1)N} = \frac{1}{1+\sigma_{c,t}(N-1)+\sigma_{nc,t}(C-1)N} \qquad (8)$$

This share depends positively on tariffs and transportation costs, as one would expect.

The share of each neighbor country will be:

$$S_c = \frac{\sigma_{c,t}(N-1)}{1+\sigma_{c,t}(N-1)+\sigma_{nc,t}(C-1)N} \qquad (9)$$

and that of countries in other continents is:

$$S_{nc} = \frac{\sigma_{nc,t}(C-1)N}{1+\sigma_{c,t}(N-1)+\sigma_{nc,t}(C-1)N} \qquad (10)$$

These shares depend negatively on tariffs and (except for cases of extreme love for variety) on transportation costs **a** and **b**.

3.3 The bilateral volume of trade

The bilateral volume of trade is easily identifiable in this model. Since we are dealing with a symmetric situation (with balanced trade), the bilateral volume of trade between two countries A and B will be equal to twice the volume of trade in one direction, which is equal to the share of country B on country A's demand, multiplied by wL (the product of the wage times the labor force being the total demand). As an example, the bilateral volume of trade between two countries that belong to the same continent, with uniform tariffs, will be:

$$BVT_c = 2 \left(\frac{\sigma_{c,t}}{1 + \sigma_{c,t}(N-1) + \sigma_{nc,t}(C-1)N}\right) wL \qquad (11)$$

Likewise, the bilateral volume of trade between countries across the ocean will be :

$$BVT_{nc} = 2 \left(\frac{\sigma_{nc,t}}{1 + \sigma_{c,t}(N-1) + \sigma_{nc,t}(C-1)N}\right) wL \qquad (12)$$

Now, we can look at the consequences of free trade agreements, both of the natural and unnatural type (in Krugman's terminology), on the bilateral volume of trade. Let us assume, for example, that countries eliminate tariffs on their neighbors, in such a way that C regional Free Trade Areas are created, each of them formed by N neighboring countries. This would be an example of natural trading blocs.

In Stein and Frankel (1993), we also examine implications of FTAs for trade diversion and trade creation, which contributes some intuition to the welfare results. But here we proceed directly to derive the bilateral volume of trade (BVT). The new equation for the bilateral volume of trade between countries belonging to the same continent is

$$BVT_c^f = 2 \left(\frac{\sigma_c}{1 + \sigma_c(N-1) + \sigma_{nc,t}(C-1)N}\right) wL \qquad (13)$$

where the *f* supra-script denotes that the trade takes place under a FTA. Compare this equation with (11). Not surprisingly, there is an increase in the bilateral volume of trade within the continent.

In the case of countries across the ocean, the new bilateral volume of trade will be

$$BVT_{nc}^{f} = 2\ \left(\frac{\sigma_{nc,t}}{1 + \sigma_{c}(N-1) + \sigma_{nc,t}(C-1)N}\right)\ wL \qquad (14)$$

Comparing with equation (12), we see that the bilateral volume of trade is reduced between countries which are not part of the same bloc.

The same analysis can be done for any kind of symmetrical arrangements between countries. We could, for example, analyze changes in the bilateral volume of trade that would result if each country struck an agreement with one other country on another continent. This would be an example of unnatural trading blocs. By assigning values to the parameters a, b, t, θ, N and C, we can obtain the exact effect on BVT of any symmetrical arrangement.

In order to explore the desirability of potential trading blocs, we now need to introduce a measure of welfare.

3.4 Welfare implications of trade agreements

Given that we are working with a symmetric model, the natural way to look at world welfare is to derive the utility of a representative individual in any country. To determine the utility of the consumer, we need to know how much he or she is consuming of each good, and introduce these values into the utility function. Equation (6) above gives us the relative consumption of each home and foreign variety, so we only need to determine the consumption of each home variety, c_i^h. We do this by expressing the budget constraint in terms of c_i^h, and taking into account the redistribution of the tariff revenue to consumers.

If we normalize n, p, and w to be 1, we can obtain, after some algebra

$$c_i^h = \frac{1}{1 + (N-1)\left(\frac{1}{p_{c,t}}\right)^{\frac{1}{1-\theta}}(p_{c,t}-t) + (C-1)N\left(\frac{1}{p_{nc,t}}\right)^{\frac{1}{1-\theta}}(p_{nc,t}-t)} \quad (15)$$

Once we have the consumption of domestic varieties, the consumption of foreign varieties can be obtained from the relative consumption equations (6):

$$c_i^c = c_i^h\left(\frac{1}{p_{c,t}}\right)^{\frac{1}{1-\theta}} ; \qquad c_i^{nc} = c_i^h\left(\frac{1}{p_{nc,t}}\right)^{\frac{1}{1-\theta}} \quad (16)$$

Replacing these into the utility function, we obtain the value of the utility of the representative individual:

$$U = c_i^{h\theta}\left[1 + (N-1)\left(\frac{1}{p_{c,t}}\right)^{\frac{\theta}{1-\theta}} + (C-1)N\left(\frac{1}{p_{nc,t}}\right)^{\frac{\theta}{1-\theta}}\right] \quad (17)$$

Given the values of the parameters a, b, t, θ, N and C, we can first obtain the value of c_i^h by plugging the price equations (4) into (15), and then the value of the utility of the representative individual, which is used as a measure of world welfare.

Equation (17) is the expression for utility in the absence of free trade agreements. It is simple to calculate utility under other arrangements in the same manner. When trading blocs are formed, we just introduce the new set of relative prices faced by the home consumers into the model, and we can obtain new results for utility in a similar way.

4. Four Welfare Implications of Regional Trading Arrangements

We have presented a model that allows us to analyze the desirability of different trade arrangements from a world welfare perspective, as well as the changes associated with these

different arrangements in terms of the bilateral volume of trade between countries. We now present some applications.

The first one is a simulation showing that, in the absence of transport costs, our model replicates Krugman's U-shaped welfare curve as a function of the number of blocs, for plausible values of the parameters. In the rest of the applications, we introduce transportation costs and study the welfare implications of forming trading blocs.

In application 2, we consider a world of three continents with two countries per continent (the simplest case), and explore the desirability of forming natural and unnatural trading blocs, as a function of transportation costs. In particular, in this application we look at free trade areas (FTAs), where the intra-bloc tariffs are completely eliminated.

Next, in application 3, we analyze the implications of what could be considered an intermediate degree of regionalization, a partial movement toward the creation of (natural) FTAs, and compare it to the outcome associated with a full movement in that direction. We allow for the formation of Preferential Trade Agreements (PTAs) that differ from the FTAs in that the tariff level is reduced among partners, although not necessarily eliminated. Even though it is technically prohibited by Article 24, many existing regional arrangements are in fact of this partial kind.[29] We will show that a partial movement towards regional integration, as in the case of PTAs with preference below 100%, is usually superior to a complete one, associated with natural FTAs. At the same time, this application illustrates the need for a more complete characterization of trading blocs, one that goes beyond the natural/unnatural distinction.

---

[29] The United States initially opposed discriminatory tariff policies such as the British Commonwealth preferences in the founding of the GATT, but dropped its opposition in the 1950s in the context of European integration, the GATT rules notwithstanding. Irwin (1993) and Finger (1993) review the history.

A different way to look at a partial trend toward regionalization is to recognize that each continent has many countries, and to consider the formation of several sub-blocs within each continent. Obvious examples of this are the existence of more than one bloc in Europe (the EC, EFTA, and the former Eastern European Bloc) or in the Western Hemisphere (NAFTA, the Andean Pact, and MERCOSUR). Application 4 considers the welfare implications of forming more than one FTA or PTA in each continent.

Throughout, we consider only exercises involving symmetric formation of equal-sized blocs around the world. Deardorff and Stern (1992) and Srinivasan (1992) have taken exception to the symmetric logic of Krugman's bloc question. We, like Krugman, do not address the asymmetric partial equilibrium exercise of examining the effects of forming a single bloc in one part of the world, particularly the effects on countries unfortunate enough to be left out of any bloc. The motivation, as we see it, is to address the desirability of the international regime with respect to blocs worldwide, i.e., Article 24. But it is of course true that variation in GNPs across countries, if nothing else, renders the real world an inherently asymmetric place.

4.1: The number of blocs and welfare in the absence of transportation costs

The purpose of this exercise is to see whether our model yields Krugman's U-shaped welfare curve as a function of the number of blocs, in the absence of transportation costs. We assume a world consisting of 60 countries, and study the welfare implications of dividing the trading system equally into different numbers of blocs. Figure 1 shows the results of our simulations for a value of $\theta = 0.75$, and tariffs of ten, twenty

and thirty percent.[30] We can see that welfare is minimized for a small number of blocs, three in the cases of twenty and thirty percent tariffs, and two blocs in the case of a tariff rate of ten percent. Welfare increases gradually beyond the minimum-welfare number of blocs.[31]

In Krugman's model (1991a), there are two reasons for the increase in welfare as the number of blocs becomes larger. One reason is that blocs set tariffs optimally, and become less protectionist as the market power of each one declines. The other reason is that as the number of blocs increases, a larger portion of their demand is satisfied from outside the bloc, and tariffs become less distortionary. Tariffs introduce a wedge between the prices of bloc varieties and those of non-bloc varieties, but not between two non-bloc varieties. The greater the number of non-bloc varieties relative to those from within the bloc, the smaller the distortionary effect of a given tariff level. In our model, where tariffs are assumed exogenous, the shape of the curve is explained completely by this latter reason.[32]

On what does the minimum-welfare number of blocs depend? We have found that it depends positively on the tariff rate t, other things being equal (an example of this can be seen in figure 1). Additionally, we have found (in simulations not shown here) that the minimum-welfare number of blocs increases with θ, other things being equal.

4.2: Transport costs and the effects of free trade agreements on

---

[30] Krugman (1991a) considers for his simulations three different values for the elasticity of substitution: 2, 4 and 10. Since the elasticity of substitution is equal to $1/(1-\theta)$, the middle value of 4 is equivalent to our value of $\theta=0.75$.

[31] In Figure 1 the level of welfare is normalized to be 1 in the case of a single bloc.

[32] Krugman (1992) argues that the optimal tariff argument is not crucial, and shows that the U-shape result goes through even when tariffs are set exogenously.

welfare

In this application, we assume a world that consists of three continents, with two countries in each continent, and we study how the effect of the formation of free trade agreements on welfare depends on intercontinental transportation costs. Thus we are able to fill in the realistic intermediate case between Krugman's polar cases of zero and infinite intercontinental transportation costs. Transportation costs within continents are for simplicity assumed to be zero.

Figure 2 shows the percentage change in welfare associated with the formation of trading blocs, both of the natural and unnatural type, for θ=0.75 and t=0.3.[33] We can see that there is a critical level of intercontinental transportation costs **b**, that governs the welfare effects. For the case of natural trading blocs, where each country forms a bloc with its neighbor, the critical value of **b** is approximately 0.15. For higher values of **b**, the formation of continental trading blocs will result in improvements in welfare. (Remember, in the limit, Krugman's case where **b=1**.) For lower values of b, continental blocs would reduce welfare. (Remember the limit case where **b=0**.) As noted in the introduction, we label such welfare-reducing arrangements "super-natural blocs", to indicate that intercontinental transportation costs are not high enough to justify the formation of blocs even along the lines of geographical proximity. (The benefit of forming trading blocs becomes much larger as t and θ

---

[33] For comparison, the unweighted average tariff rate among the sample of developing countries examined in Pritchett and Sethi (1993, p.12) is .25. [There are two reasons why the true level of protection may be higher than this: we want to include the effect of nontariff barriers in addition to tariffs, and the composition of trade shifts endogenously away from high-tariff goods. There are also two reasons why the true level of average worldwide protection may be lower than this: industrialized countries have lower barriers than developing countries, and statutory tariff rates are in practice subject to many exceptions.]

increase.[34])

Unnatural trading blocs, where each country forms a bloc with one other country outside the continent, result in distinctly lower welfare for small values of **b** (when **b=0** they reduce welfare in precisely the same way as natural blocs). Unnatural blocs then have a steadily smaller effect as **b** tends to 1. The reason for this is intuitive: as **b** gets closer to 1, the bilateral volume of trade between countries in different continents will tend to zero, whether they belong to the same bloc or not. Therefore, the formation of unnatural trading blocs has only negligible effect on welfare when intercontinental transport costs are very high. The limit is the polar case of no intercontinental trade.

Krugman's intuition that the benefits from regional free trade arrangements depends positively on intercontinental transportation costs is confirmed by our results. So is his idea that natural trade arrangements have a better chance of improving welfare than arrangements between unnatural partners (Krugman, 1991a).

4.3: Allowing for Preferential Trade Agreements

In this application, we will have another look at trading blocs of the "natural" kind (among neighbors), but we will allow for the formation of PTAs, i.e., partial liberalization. To do

---

[34] Figure 3 in Stein and Frankel (1993) represents the effects of agreements on welfare for θ=0.85 and t=0.35. In this case, the effect of the formation of natural trading blocs on welfare is substantial, even for low levels of intercontinental transportation costs. Indeed, for these parameter values, blocs are welfare-improving even when **b=0**. [The intuitive explanation is that residents consume so much of the home good, that it is a net gain to realign correctly the relative price of a neighbor's good in terms of the home good, even though this distorts the relative price of the neighbor's good in terms of all goods produced elsewhere in the world.] Thus Krugman's idea that the consolidation of six blocs into three in the absence of transportation costs is bad depends on the values of the parameters t and θ.

this, we need to modify our model slightly. The tariff level between partners, instead of zero, will now be **(1-k)t**, where **0≤k≤1**, and **k** is the degree of preference for intra-bloc trade or intra-bloc liberalization. The price of partner varieties faced by domestic consumers now becomes:

$$p_c = \frac{p[1+(1-a)(1-k)t]}{1-a} \qquad (18)$$

Until now we were only considering the special cases of **k=0** (absence of blocs) and **k=1** (Free Trade Areas). Now the blocs are allowed to set any level of intra-bloc preference. We will begin, as in the previous application, with a world that consists of three continents, each formed by two countries.

What is the level of intra-bloc preference that will maximize welfare? Figure 3 shows the welfare level as a function of k, for t=0.3, θ=0.75, a=0, and several values of b.[35] This figure is closely related to figure 2 above. There, we were comparing the welfare levels associated with the two extremes of k=0 and k=1 for every possible level of inter-continental transportation cost b. For example, for b<0.15, figure 2 indicates that the formation of FTAs along natural regional lines is welfare-reducing (super-natural). In figure 3, this translates into a higher welfare level for the MFN or no-preference extreme (k=0) relative to the opposite endpoint of full continental FTAs (k=1) for b=0.1.

The important thing to notice in Figure 3 is that for every level of intercontinental transport costs, the degree of intra-bloc preference associated with maximum welfare is in between 0 and 1, which implies that, in general, PTAs with less than 100%

---

[35] For each set of parameter values (transport cost and θ) welfare is normalized to be 1 under free trade in the figure.

preference are superior to FTAs.[36] This result is not new in the literature. It was first suggested by Meade (1955). But it is significant if we contrast it with GATT's article 24, which allows for FTAs and Customs Unions as exceptions to the Most Favored Nation (MFN) clause, but not for PTAs with less than 100% preference.[37]

Figure 3 suggests that starting from the absence of trading blocs, a small movement in the direction of increased regionalization (by increasing intra-bloc preference) is always a good thing. We can say that there are positive returns to regionalization up to the point of maximum welfare, and negative returns to regionalization thereafter.

Figure 4 provides another way of looking at this issue. For the set of parameters chosen, it represents all possible combinations of intercontinental transport cost **b** and intra bloc preference **k**. The solid line represents the level of intra-bloc preference that maximizes welfare at each level of transportation cost **b**. Below this line, there are positive returns to regionalization, i.e., increasing the degree of preference will result in higher welfare. Above this line, increases in the preference are welfare-reducing. We call this the area of negative returns to regionalization NRR.

Within the NRR area, the dotted line represents, for every level of intercontinental transportation cost, the intra-bloc preference level that yields the same welfare as k=0 (i.e., the absence of trading blocs). The term "natural" does not seem appropriate to describe trade arrangements which, even when formed along the lines of geographical proximity, represent a movement so deep toward regionalization that welfare is reduced

---

[36] This follows from the fact that the welfare functions are strictly concave to the origin so, in general, the maximization problem will have an interior solution.

[37] Bhagwati (1992) discusses possible reasons for the inclusion of Article 24 in the GATT.

compared to the no-bloc situation. The trade arrangements that lie above this dotted line are the ones we call super-natural trading blocs.[38]

In reality, the world of course consists of more than three continents of two countries each. In Figure 4b we repeat the experiment for the more realistic (if still stylized) case where the world consists of four continents of 16 countries each. (We could get to four continents either by counting North and South America separately, or adding the Mideast/Africa.) This 64-country set-up has the virtue of corresponding roughly to the data set in our gravity model. We see that negative returns to regionalization set in sooner than before. If inter-continental transport costs are .2, then the world reaches the welfare optimum when intra-bloc preferences are as low as 27 per cent, and enters the super-natural zone when they are 51.5 per cent. If inter-continental transport costs are as low as .1, then negative returns to regionalization set in even sooner.

We now look, in Figure 5, at the welfare effects of trade agreements, this time not only allowing for less than 100% preferences, but also assuming the world trade system chooses the preference level optimally.[39] We return (for the moment) to a

---

[38] Note that the "super-natural" bloc area does not always exist. For certain values of the parameters -- for example, (θ=0.85, t=0.35) in the stylized world of three two-country continents -- welfare under Free Trade Areas is better than welfare under the MFN rule for every value of transportation cost b. This eliminates the possibility of "super-natural" blocs. In general, the higher θ and t, the less likely blocs will be "super-natural". In addition, the higher θ and t, the higher the optimal preference level k for every level of transportation cost b, which translates into a smaller area corresponding to negative returns to regionalization.

[39] This "optimal" level is not the result of a Nash non-cooperative equilibrium, where each bloc chooses the optimal preference level given the preference level chosen by the rest of the blocs (and given the tariff level t). It is just the preference level that maximizes welfare in a symmetric world, and

hypothetical world of three continents consisting of two countries each. These arrangements are welfare improving no matter what the intercontinental transport costs are.

As **b** increases, the difference between welfare under optimal PTAs and under FTAs diminishes. The reason for this is that, as can be observed in Figure 4, the optimal preference level approaches 1.0 for high values of **b**, and therefore an FTA becomes closer to being optimal. Recall once again the example of Krugman (1991b): in the limit, as intercontinental transport costs become prohibitive, FTAs become the first best arrangement.

This application, together with the second one, has provided some answers, within the limitations imposed by the structure of our model, to what Bhagwati (1992) calls the static-impact effect question regarding the creation of trading blocs. If intra-bloc preferences are set at the optimal level, regionalism will have an immediate positive effect on world's welfare. If countries are constrained to choose between no preferences and 100% preferences (as in Article 24 in the GATT), the impact of regionalism on welfare will depend on the values of parameters such as transportation costs and consumers' preference for variety. The larger the intercontinental transportation costs, and the lower the preference for variety (or the higher θ), the more likely regionalism will have a positive immediate impact. Furthermore, the closer the trading blocs follow geographical proximity considerations, the more likely they are to increase welfare, as Krugman has suggested.

Does this mean that GATT should eliminate Article 24's requirement that FTAs stipulate complete liberalization (and perhaps substitute a requirement that they be among neighbors)? From the purely static point of view of our model, the answer to this question would be yes. Blocs with less than 100% preference

---

can be interpreted as the cooperative solution (again, given the tariff level t).

formed along the lines of geographical proximity provide the best possible outcome in terms of immediate impact on welfare.

However, two (at least) important caveats should be noted. First, the welfare effects appear to be small. In the simulation results shown in Figure 5, welfare effects have the dimension of real GNP. To focus on the case of b=.2 in a six-country world (three continents of two countries each), the welfare benefit of moving from MFN to a system of optimally-calibrated PTAs is only about 0.6% of real GNP. The welfare gain from forming a system of continental FTAs is about 1/4 per cent. In other words, the difference between the two kinds of regional trading arrangements in less than 0.4% of GNP. These numbers are small, in part, because b=.2 is so close to the borderline case.

Second, Bhagwati's "dynamic time-path" question remains. If the ultimate goal is the achievement of multilateral free trade among all countries, limiting the formation of blocs to geographically proximate countries might not be the best way to go, if it led to the permanent fragmentation of the world's trade rather than to a process of continuous integration. The answers are not clear once we include dynamic political economy considerations in the analysis.[40]

4.4: Welfare Effects of Sub-continental Blocs

Application 3 has shown a sense in which a partial movement towards regionalization may be better than a total one. We now look at another way in which "partial" trends toward regionalization can be understood: the formation of multiple blocs on each continent. We have in mind recent sub-continental FTAs of two countries each, like the Canada-U.S. FTA or the

---

[40] The possible implications of political costs to negotiating with many partners simultaneously are considered briefly below. Political economy considerations like those mentioned in the introduction -- a country that joins an FTA may then experience an increase in political support for further steps toward liberalization -- are modelled by Baldwin (1993), and also in a preliminary way in Wei and Frankel (1993).

customs union between Colombia and Venezuela that was instituted in January 1992 [or the Australia-New Zealand Closer Economic Relationship of 1983]. We also wish to consider somewhat bigger groupings, like the NAFTA, CACM, MERCOSUR, and Andean Pact in the Western Hemisphere.

For this purpose, we run a simulation where the world consists of 4 continents, each of them containing 16 countries. This allows us to compare welfare under the MFN rule with that associated with 8 sub-continental FTAs on each continent of 2 countries each, 4 of 4 each, or 2 of 8 each. The results of this simulation are seen in Figure 6. MFN in this figure is the starting point: 16 sub-continental blocs, each formed by one country.

The Figure shows that the formation of FTAs between regional subsets of countries is not a good idea, and the more countries that participate, the worse the idea. Even at the last stage, when two half-continental blocs of 8 members each are merged into a continental FTA, welfare falls slightly, if **b** is .2 or less.[41] These results seem to bode ill for recent regional agreements.[42]

We have found that the formation of a number of FTAs within each continent, for our parameter values, lowers welfare regardless of the number and size of the FTAs. But we found earlier that partial liberalization in continent-wide PTAs is

---

[41] We have also tried a simulation where the world consists of 3 continents, each of them containing 12 countries. The results are similar to Figure 6. But carving up each continent into two blocs of six countries each, when **b** = .2, turns out to be the welfare minimum: not only worse than MFN or smaller FTAs, but worse also than continental FTAs.

[42] These results do not allow for the fact that transport costs between potential sub-regional Free Trade Areas, such as North and South America [or Australia and East Asia, or Western Europe and Eastern Europe] are greater than between countries within the same sub-region. But estimates similar to those made here for inter-continental transportation costs would be smaller in the case of North-to-South America costs, making regionalization on such a scale more likely to be excessive than on the Asia-Americas-Europe scale.

better than both MFN and fully-liberalized FTAs. Is the same true for the formation of a number of PTAs within each continent?

Figure 7 addresses this question for the case where **b**=.2. The right edge confirms that the formation of eight two-country FTAs on each continent reduces welfare, and larger blocs are even worse. But for partial preferences, ideally in the range of 20 to 25 per cent, the picture for multiple PTAs looks much better. Two-country PTAs are slightly better than the MFN status quo (1-country groupings). Four-country PTAs are better still, and so on until the optimum is reached at a continent-wide grouping of 16 countries (at which point preferences of 27 per cent are the precise optimum in the simulation, as we saw in Figure 4b). In other words, welfare increases monotonically with the size of the PTAs, rather than decreasing monotonically as it did for the case of FTAs. Clearly the distortionary (or trade-diverting) effects are less important when internal tariffs are only reduced partway. The pattern is similar when **b**=.1 or **b**=.3, but the level of preferences that maximizes welfare for each size of PTA becomes approximately 15 per cent and 25-35 per cent, respectively. [Figures omitted to save space.]

Why might countries wish to negotiate small two-country PTAs that would raise welfare only slightly, if larger PTAs would be even better? For the same reason that it seems to be impossible to negotiate worldwide liberalization. Although these political economy considerations lie outside the scope of our model, one could easily posit costs to international negotiation that increase with the number of partners involved.[43] (We have in mind, not so much the salaries or airfares of the negotiators, as the adjustment costs of harmonizing standards and administrative procedures or the difficulty of satisfying adversely affected interest groups.) Two-country PTAs could then be viewed as stepping stones or building-blocks for four-country PTAs, leading to eight and, finally, the continent-wide arrangement.

---

[43] Deardorff and Stern (1992, p.17-20) suggest as much.

The stepping-stone idea would be particularly attractive if there was reason to think it could be sustained across continents. We now turn attention to blocs formed across continents. We consider a world formed by four continents and six countries per continent in order to answer the following question: under what circumstances will it be beneficial for the world to consolidate into two blocs, each formed by two continents?

For the parameters θ=0.75 and t=0.3, we find that the consolidation will be beneficial under any transportation costs **a** and **b**. We could have predicted this: if we look at Figure 1, we can see that, in the absence of transport costs, two blocs are better than four for these parameter values. And we know, from application 2, that consolidation is more likely to improve welfare the higher the transportation costs.

The interesting cases are those that correspond to parameter values such that, in the absence of transport costs, four blocs are better than two. In these cases, our results show that there is a critical value of **b** above which the consolidation becomes beneficial. We ran several simulations for θ=0.6, different values of t (0.2 and 0.3) and different values of **a** (0, 0.2 and 0.5). We found that the critical value of **b** will be lower (and therefore consolidation more likely to be improve welfare) the higher the tariff level and the higher the transportation cost **a**.

This kind of analysis can be useful to study the welfare consequences of potential blocs such as the one proposed by President Bush's Enterprise for the Americas Initiative, which includes both North and South America (here **b** is not much larger than **a** on average), or a trans-Pacific grouping, as often discussed in meetings of such organizations as APEC, PECC, and PAFTAD (where **b** is large).

5. Some Estimates of Intercontinental Costs to Evaluate the Extent of Regionalization

It would be useful to obtain estimates of the parameters,

especially the crucial magnitude of intra-continental transportation costs, **b**, to get a better idea where the world economic system lies in terms of the welfare spaces mapped out above. We can think of four ways of estimating **b**. First is direct data on bilateral shipping costs. One disadvantage here is that the range of variation of actual shipping costs is extremely wide across modes of transport and kinds of goods, especially as a percentage of value, and it would be difficult to know how to aggregate different measures.

Second is the ratio of the c.i.f. value of a country's trade to its f.o.b. value. One disadvantage here is that the data are not available on a bilateral basis [though we plan in the future to infer the bilateral costs from the aggregate c.i.f./f.o.b. ratios and our knowledge of bilateral distances between trading partners, so that we can put bilateral costs into the gravity regressions in place of bilateral distances]. Another disadvantage of using aggregate c.i.f./f.o.b. numbers is that they depend on the composition of trade (which is in turn influenced by the true transportation costs).

The ratio of total worldwide import values, including insurance and freight, to export values is about 1.06.[44] We can infer a rough upper bound on **b** by assuming that 6 per cent is a weighted average of intra-continental costs and inter-continental costs:

$$.06 = ICS\ a + (1-ICS)(a+b-ab), \text{ or}$$

$$b = (.06-a)/[(1-ICS)(1-a)] \leq .06/(1-ICS). \qquad (19)$$

We get our *ICS* estimate from Table 1. Considering only the set of 63 countries examined statistically in the first part of the paper, the intra-continental trade share is about .4. (Somewhat lower in East Asia and the Americas, higher in Europe. The simple average for the three continents is .39 in 1990, up from .35 in 1980. The average of the three weighted by shares in world trade

---

[44] 1.066 in 1980 and 1.053 in 1989. Table 36 from Review of Maritime Transport 1990, UNCTAD, U.N.: New York, 1991.

is .44, up from .40 in 1980.) Thus (19) implies an upper bound on **b** of .06/(1-.4) = .10.

If 10 per cent is a realistic estimate of intra-continental transport costs, then we can see from Figure 2, 3, or 4 that super-natural trading blocs are a real danger. Indeed, for **b**=.10, our base-case parameter values, and a world consisting of three continents of two countries each, negative returns to regionalization set in when preferences are 52.4 per cent; any greater degree of regional preference moves into the zone of negative returns to regionalization (Figures 3 and 4). For this world, 95 per cent preferences are in the super-natural zone. For a world consisting of four 16-country continents, negative returns set in even sooner. The optimum degree of continental preferences is just over 16 per cent, and the super-natural zone begins at 32 per cent (Figure 4b).

It is possible that the c.i.f./f.o.b. ratio substantially understates the costs of trade by focusing solely on the cost of physical transport, and omitting for example costs associated with personal contact between buyer and seller. Within the confines of our theoretical model, the parameter **b** could be estimated in a simple way from the data on intra-regional trade shares, if we were willing to assume that the observed current tendency for countries to trade with neighbors was the result solely of geographical proximity, and not of preferential trading policies.[45] We pursue this logic next.

Given actual data on inter-continental trade, intra-continental trade, and GNP, σ_c and σ_{nc} could be computed, and then equations (7) could be solved for **a** and **b** (given estimates of **t** and θ). An estimate of **b** alone can be had more simply, if we are willing to assume that tariffs are levied on the total

---

[45] Krugman (1991) and Summers (1991), for example, use simple calculations to infer roughly the importance of distance in determining trading patterns, without explicitly distinguishing the effect of existing trade preferences.

c.i.f. value of imports. Then equations (7) become simpler:

$$\sigma_{c_c}=\frac{(1-a)^{\theta/(1-\theta)}}{(1+t)^{1/(1-\theta)}} \text{ and } \sigma_{nc_c}=\frac{[(1-a)(1-b)]^{\theta/(1-\theta)}}{(1+t)^{1/(1-\theta)}}. \quad (7')$$

Taking the ratio of the two, the terms involving **a** and **t** cancel out. Solving for **b**,

$$b = 1 - [\frac{\sigma_{nc}}{\sigma_c}]^{(1-\theta)/\theta}.^{46} \quad (20)$$

Total intra-continental trade on a continent is $\Sigma S_{c_i} GNP_i$. Total trade undertaken by the continent with other continents (including both imports and exports) is $2\Sigma S_{nc_i} GNP_i$. Thus $ICS = \Sigma S_{c_i} GNP_i / [\Sigma S_{c_i} GNP_i + 2\Sigma S_{nc_i} GNP_i]$. In the special case where intra-continental trade as a share of GNP in each country i is the same, and the inter-continental share of each country is the same, the intra-continental trade share becomes

$$ICS = S_c \Sigma GNP_i / [S_c \Sigma GNP_i + 2S_{nc} \Sigma GNP_i] = \frac{S_c}{S_c + 2S_{nc}}. \quad (21)$$

Using equations (9) and (10), it follows that $ICS = \frac{\sigma_c(N-1)}{\sigma_c(N-1)+2\sigma_{nc}(C-1)N}$. Solving for $\frac{\sigma_{nc}}{\sigma_c}$ and substituting into (20),

$$b = 1 - [\frac{(1/ICS)-1}{2(C-1)N/(N-1)}]^{\frac{1-\theta}{\theta}}. \quad (22)$$

The set of countries from which our trade data come can be approximately described as four continents (including

---

[46] We plan to re-run the simulations with tariffs levied on the c.i.f. value of trade, to conform with equations (7') [an alternative would be solving equations (7)]. In the meantime until we finish doing so, our hope is that it will not make much difference to the outcome.

Africa/Mideast along with the other three[47]) consisting of 16 countries each. Substituting C=4, N=16, and θ=.75, into equation (21), we obtain a sample estimate of b = .383. This is quite a high estimate of intra-continental costs, and it would imply a corresponding reduction in the risk of trade policies becoming excessively regionalized.

We know from our gravity estimation, however, that statistically significant tendencies toward regional trade preferences already exist, and thus explain part of the proclivity toward intra-regional trade that shows up in Table 1 and in this estimate of **b**. We thus conclude the paper by using our preferred estimate of **b**, which comes from the gravity estimates in Part II. They hold constant for the effects of regional trading arrangements already in existence, as well as the effect of per capita GNPs, common languages, etc.

Table 6 gives distance in kilometers between some major world capitals. Table 7 gives the average distance between all the pairs of countries in our sample, by continent. European countries tend to be both closer to each other (and closer to the other two continents) than is the case for countries in the Western Hemisphere or East Asia.

Averaging over all countries in the sample, the mean distance between countries on the same continent is 2896 kilometers, and on different continents is 11776 kilometers -- four times as great. The gravity equations estimate the coefficient of the log-distance between a pair of countries at about .56. It follows that trade between two countries on the same continent will on average be twice as great as trade between countries on different continents, other things equal

---

[47] Foroutan and Pritchett (1992) find that the 19 African countries in their sample trade more with each other than the other gravity variables would be predict, though the bloc effect is only of borderline significance.

[.56{log(11776/2896)}=.7855 and exp(.7855)=2.19].

In the algebra in Part 3 of the paper, the elasticity of demand, $\epsilon_x = \frac{d\log(Trade)}{d\log(P)}$, is given by $1/(1-\theta)$. If transport costs show up fully in the price facing the consumer, the percentage change in price associated with being in a different continent is given by $(p_{nc,t}/p_{c,t})-1 = b/(1-b)$ (for the case of tariffs levied on the c.i.f. value). From the data on bilateral trade, this should be approximately equal to $\frac{d\log(P)}{d\log(Distance)}\log(11776/2896) =$

$\frac{d\log(Trade)/d\log(Distance)}{d\log(Trade)/d\log(P)}1.403 = [.56(1-\theta)]\,1.403$. Choosing again our baseline value $\theta=.75$, our sample calculation suggests that the difference between inter-continental transportation costs and intra-continental costs is roughly on the order of 16.4 per cent.

Such an estimate for **b** might still seem a bit high. But recent literature on spillovers and geographic concentration suggests that the effects of proximity on stimulating production are much greater than mere transportation costs. In the classic gravity model of world trade, Linneman (1966) concluded that the effect of distance on trade consisted of three kinds of effects rather than one: (i) transportation costs, (ii) the time element (involving concerns of perishability, adaptability to market conditions, irregularities in supply, in addition to interest costs), and (iii) "psychic" distance (which includes familiarity with laws, institutions and habits).

If taken at face value, the .164 estimate together with Figure 4 suggests that the optimal degree of preferences within a continental grouping is roughly 60 per cent, i.e., intra-regional liberalization to 40 per cent of the level of world-wide trade barriers, in a stylized six-country world. Only if regionalization proceeds past that point, does it enter into the zone of negative returns to liberalization. For the more

realistic 64-country world of Figure 4b, negative returns to regionalization set in as early as at 23.1 per cent preferences and the super-natural zone at 44.2 per cent preferences.

The last step is to try to extract from our gravity estimates of part 2 a measure of **k**, the degree of preferences prevailing in existing regional trading blocs, in order to help evaluate whether the world trading system has in fact entered the super-natural zone. Our gravity estimates in Tables 3-5 suggest that the EC in 1990 operates to increase trade among its members by about 50 per cent. Other parts of the world have weaker or stronger arrangements. But we have found that such FTAs as MERCOSUR and the Andean Pact actually have effects on trade that are considerably greater (proportionally) than the EC. Let us ask the following hypothetical question: what would be the effect on world economic welfare if the trading system settled down to an array of regional blocs that each had the same level of preferences as the EC?

Let the percentage effect on trade of bloc formation be represented by γ.[48] Using our model of part 4, in the modified form where tariffs are assumed to be levied on the price inclusive of transport costs, a bit of algebra reveals that the formation of a bloc with preferences of **k** lowers the prices of goods in intra-bloc trade by $-tk/(1+t)$. The ratio of the change in quantity to the change in price is equal to the elasticity of demand:

$$\frac{\gamma}{tk/(1+t)} = \epsilon_x = 1/(1-\theta).$$

Solving for the parameter we wish to estimate,

$k = \gamma(1+t)(1-\theta)/t.$

Taking $\gamma = 0.5$ from the EC estimate, $\theta = 0.75$, and $t = .30$, the implied estimate of k is .54. In other words, EC preferences operate to reduce trade barriers by 54 per cent for intra-bloc

---

[48] This is actually -1 + exp (the coefficient in the gravity equation).

trade. This parameter value lies within our super-natural zone. It follows, within the assumptions of our model, that if all continents followed the EC example, the regionalization of world trade would be excessive, in the sense that world economic welfare would be reduced relative to the MFN norm.

* * *

The tentative conclusion of this study is that some degree of preferences along natural continental lines, such as an Enterprise for the Americas Initiative, or enlargement of the EC to include EFTA and Eastern Europe, would be a good thing, but that the formation of Free Trade Areas where the preferences approach 100 % would represent an excessive degree of regionalization of world trade. This is especially true if the prospective FTAs consist of entire continents. The overall conclusion is that the world trading system is currently in danger of entering the zone of excessive regionalization.

The optimal path to liberalization appears to feature a sharp departure from Article 24. It entails reducing intra-regional barriers by only 10 per cent or so. Apparently the optimal path concentrates on extending the scope of the Preferential Trading Arrangements from two-country agreements to wider sub-continental agreements, and then to the continental level, and then finally to the worldwide level, <u>before</u> liberalizing completely within any unit. At least, such a path would in our model raise economic welfare at each step of the way.

References

Anderson, James. 1979. "A Theoretical Foundation for the Gravity Equation," American Economic Review 69, 1 (March): 106-116.

Anderson, Kym, and Hege Norheim. 1992. "History, Geography and Regional Economic Integration," GATT Secretariat Conference, Geneva, Oct.; forthcoming in Regionalism and the Global Trading System, K.Anderson and R.Blackhurst, eds., London: Harvester Wheatsheaf, 1993.

Balassa, Bela. 1987. "Economic Integration" in the The New Palgrave Dictionary of Economics, MacMillan Press Reference Books, London: 43-47.

Baldwin, Richard. 1993. "A Domino Theory of Regionalism." NBER Working Paper No. 4465, September.

Bergsten, C.Fred. 1991. "Commentary: The Move Toward Free Trade Zones," in Policy Implications of Trade and Currency Zones, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, (August): 43-57.

Bhagwati, Jagdish. 1971. "Trade-Diverting Customs Unions and Welfare Improvement: A Clarification," Economic Journal, 63.

Bhagwati, Jagdish. 1990. "Regional Accords Be-GATT Trouble For Free Trade," Wall Street Journal, Dec. 5.

Bhagwati, Jagdish. 1992. Regionalism and Multilateralism: An Overview. World Bank and CEPR Conference on New Dimensions in Regional Integration, April, Washington, D.C.

Bhagwati, Jagdish, and T.N. Srinivasan. 1983. Lectures on International Trade, Cambridge: MIT Press, Chapter 27.

Deardorff, Alan. 1984. "Testing Trade Theories and Predicting Trade Flows," in R.Jones and P.Kenen, eds., Handbook of International Economics vol. I. Amsterdam, Elsevier Science Publishers. Ch.10: 467-517.

Deardorff, Alan, and Robert Stern. 1992. "Multilateral Trade Negotiations and Preferential Trading Arrangements," RFIE Discussion Paper No. 307, University of Michigan, July. Forthcoming in Deardorff and Stern, eds., Analytical and Negotiating Issues in the Global Trading System, Ann Arbor: University of Michigan Press.

de la Torre, Augusto, and Margaret Kelly, 1992, Regional Trading Arrangements, Occasional Paper No. 93, Washington, D.C., International Monetary Fund (March).

de Melo, J., A. Panagariya, and D.Rodrik. 1992. Regional Integration: An Analytical and Empirical Overview, World Bank and CEPR Conference on New Dimensions in Regional Integration, April, Washington, D.C.

Edwards, Sebastian. 1993. "Latin American Economic Integration: A New Perspective on an Old Dream," The World Economy, *Basil Blackwell*: 317-338.

Fieleke, Norman. 1992. "One Trading World, or Many: The Issue of Regional Trading Blocs," New England Economic Review, Federal Reserve Bank of Boston, May/June, 3-20.

Finger, J.M. 1993. "GATT's Influence on Regional Arrangements," in J. de Melo and A. Panagariya, New Dimensions in Regional Integration (New York: Cambridge University Press).

Foroutan, Faezeh and Lant Pritchett. 1992. "Intra-Sub-Saharan African Trade: Is It Too Little?" World Bank, December. Forthcoming, Journal of African Studies.

Frankel, Jeffrey. 1991. "Is a Yen Bloc Forming in Pacific Asia?" in Finance and the International Economy, The AMEX Bank Review Prize Essays, edited by R.O'Brien, Oxford Univ. Press, UK, 1991.

Frankel, Jeffrey. 1993. "Is Japan Creating a Yen Bloc in East Asia and the Pacific?" *NBER conference*, April 3-5, 1992, Del Mar, California. NBER working paper no. 4050. Forthcoming in Regionalism and Rivalry: Japan and the U.S. in Pacific Asia, edited by Jeffrey Frankel and Miles Kahler, Chicago, University of Chicago Press, Fall.

Frankel, Jeffrey, and Shang-Jin Wei. 1992. "Yen Bloc or Dollar Bloc: Exchange Rate Policies of the East Asian Economies", in Macroeconomic Linkages, *Third Annual NBER - East Asia Seminar on Economics*, Takatoshi Ito and Anne Krueger, editors, Chicago, University of Chicago Press, forthcoming 1994.

Frankel, Jeffrey, and Shang-Jin Wei. 1993a. "Is There A Currency Bloc in the Pacific?" Kirribilli, Australia, 12-13 July; forthcoming in Exchange Rates, International Trade and Monetary Policy, edited by Adrian Blundell-Wignall and Stephen Grenville; Reserve Bank of Australia, Sydney.

Frankel, Jeffrey, and Shang-Jin Wei. 1993b. "Emerging Currency Blocs." *International Center for Monetary and Banking Studies*, Geneva, Sept. 2-4. [Revised version of NBER Working Paper 4335.] Forthcoming, The Future of the International Monetary System and Its Institutions, edited by Hans Genberg, 1994.

Hamilton, Carl, and L.Alan Winters. 1992. "Opening Up International Trade in Eastern Europe," Economic Policy (April).

Havrylyshyn, Oleg, and Lant Pritchett. 1991. "European Trade Patterns After the Transition." *Policy, Research and External Affairs Working Paper Series* No. 748, August, World Bank.

Helpman, Elhanan. 1987. "Imperfect Competition and International Trade: Evidence from Fourteen Industrial Countries," Journal of the Japanese and International Economies 1: 62-81.

Helpman, Elhanan and Paul Krugman. 1985. Market Structure and Foreign Trade, Cambridge, MA, MIT Press.

Irwin, Douglas. 1993. "The GATT's Contribution to Economic Recovery in Post War Western Europe." International Finance Discussion Paper No. 442, Federal Reserve Board, March. Jackson,

Jackson, John. 1993. "Regional Trade Blocs and the GATT." The World Economy 121-132.

Krugman, Paul. 1980. "Scale Economies, Product Differentiation, and the Pattern of Trade," American Economic Review 70, 950-959.

Krugman, Paul. 1991a. "Is Bilateralism Bad?" in E.Helpman and A.Razin, eds., International Trade and Trade Policy. Cambridge, MA, MIT Press.

Krugman, Paul. 1991b. "The Move Toward Free Trade Zones," in Policy Implications of Trade and Currency Zones, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, (August): 7-42.

Krugman, Paul. 1992. Regionalism vs. Multilateralism: Analytical Notes, World Bank and CEPR Conference on New Dimensions in Regional Integration, April, Washington, D.C.

Lawrence, Robert. 1991. "Emerging Regional Arrangements: Building Blocks or Stumbling Blocks?" in Finance and the International Economy, The AMEX Bank Review Prize Essays, edited by R.O'Brien. United Kingdom: Oxford University Press.

Leamer, Edward. 1993. "California Manufacturing and an Emerging Mexico." School of Management, University of California at Los Angeles.

Linneman, Hans. 1966. An Econometric Study of International Trade Flows, North-Holland, Amsterdam.

Meade, James. 1955. The Theory of Customs Unions. Amsterdam: North-Holland.

Pritchett, Lant, and Geeta Sethi, 1993, "Tariff Rates: What do we know? Why do we care?" June [not to be cited].

Saxonhouse, Gary. 1993. "Pricing Strategies and Trading Blocks in East Asia." Presented at an NBER conference, April 3-5, 1992, Del Mar, California. NBER working paper no. 4050. Forthcoming in Regionalism and Rivalry: Japan and the U.S. in Pacific Asia, edited by Jeffrey Frankel and Miles Kahler.

Srinivasan, T.N., 1992, "'Regionalism vs. Multilateralism: Analytical Notes' Comment," World Bank and CEPR Conference on New Dimensions in Regional Integration, April, Washington, D.C.

Stein, Ernesto, and Jeffrey Frankel, 1993, "Transport Costs and the Welfare Effects of Free Trade Agreements," University of California, Berkeley, February.

Summers, Lawrence. 1991. "Regionalism and the World Trading System," in Policy Implications of Trade and Currency Zones, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, (August): 295-302.

Thurow, Lester. 1992. The Coming Economic Battle among Japan, Europe and America, New York: William Morrow.

Tinbergen, Jan, 1962, Shaping the World Economy, The Twentieth Century Fund: New York.

Wang, Zhen Kun, and L.Alan Winters, 1991, "The Trading Potential of Eastern Europe," Centre for Economic Policy Research Discussion Paper No. 610, November, London, UK.

Wonnacott, Paul, and Mark Lutz, 1989. "Is There a Case for Free Trade Areas?" Chapter 2 in Jeffrey Schott, ed., Free Trade Areas and U.S. Trade Policy, Washington, D.C.: Institute for International Economics, 59-84.

Table 1
Some measures of effectiveness of trade blocs

$$Ratio\ 1 = \frac{Intra\text{-}regional\ trade}{total\ trade\ of\ the\ region}$$

$$Ratio\ 2 = \frac{Intra\text{-}regional\ trade\ /\ total\ trade\ of\ the\ region}{total\ trade\ of\ the\ region\ /\ world\ trade}$$

		1990	1987	1985	1980	1975	1970	1965
EAEC	Ratio 1	0.292902	0.263401	0.255759	0.229132	0.212683	0.197508	0.199352
	Ratio 2	0.930792	0.857816	0.841841	0.913014	0.974123	1.011404	1.218857
APEC	Ratio 1	0.531645	0.535594	0.535615	0.420014	0.428359	0.446138	0.446138
	Ratio 2	1.01488	1.029306	0.967295	0.871695	0.90805	0.910729	0.528965
WH	Ratio 1	0.285275	0.278533	0.310123	0.271797	0.3089	0.311318	0.31456
	Ratio 2	0.847788	0.794082	0.783177	0.794613	0.877711	0.784382	0.78682
EEC	Ratio 1	0.471139	0.465209	0.423585	0.416157	0.402224	0.397312	0.357932
	Ratio 2	0.801713	0.79421	0.790148	0.715522	0.676644	0.639509	0.565919
EFTA	Ratio 1	0.075978	0.084306	0.080335	0.079508	0.104478	0.098885	0.080292
	Ratio 2	0.570921	0.621423	0.682592	0.624318	0.798584	0.683608	0.533408
EUR	Ratio 1	0.601875	0.601315	0.548242	0.537722	0.523725	0.53213	0.501972
	Ratio 2	0.956735	0.95777	0.953394	0.860304	0.815935	0.793801	0.738096
MERCOSUR	Ratio 1	0.061113	0.050118	0.043355	0.056323	0.039933	0.050628	0.061045
	Ratio 2	2.757369	2.041674	1.403869	1.689069	1.075364	1.494153	1.759036
ANDEAN	Ratio 1	0.02583	0.026476	0.034081	0.02395	0.020829	0.011654	0.007762
	Ratio 2	1.727709	1.61231	1.7308	0.88666	0.668761	0.374359	0.181074
NAFTA	Ratio 1	0.245771	0.237858	0.273571	0.214188	0.246031	0.257507	0.236712
	Ratio 2	0.787752	0.733075	0.753755	0.709644	0.79446	0.727786	0.669932

Table 2

Gravity Model of Trade

Disaggregated Data, 1965

	Total	Agricultural	Raw Material	Manufactured Goods
GNP	0.63** (0.02)	0.41** (0.02)	0.45** (0.02)	0.64** (0.02)
GNP/Capita	0.38** (0.03)	0.10* (0.04)	0.14** (0.04)	0.34** (0.03)
Distance	-0.39** (0.06)	-0.25** (0.07)	-0.23** (0.07)	-0.36** (0.06)
Adjacency	0.69** (0.17)	0.85** (0.19)	0.93** (0.19)	0.61** (0.18)
WH2	0.07 (0.17)	-0.30 (0.22)	-0.01 (0.20)	-0.20 (0.17)
EAEC2	1.46** (0.28)	0.54# (0.32)	0.68* (0.32)	1.22** (0.29)
APEC2	0.37# (0.22)	0.82** (0.25)	0.65** (0.25)	0.29 (0.23)
EEC2	-0.13 (0.17)	0.79** (0.19)	-0.36# (0.19)	0.30# (0.17)
EFTA2	0.20 (0.29)	-0.25 (0.33)	-0.10 (0.34)	0.53# (0.29)
WH1	-0.39** (0.10)	0.29* (0.13)	-0.15 (0.12)	-0.30** (0.10)
EAEC1	0.50** (0.14)	-0.36# (0.19)	0.15 (0.16)	0.57** (0.15)
APEC1	-0.29* (0.13)	0.36* (0.17)	0.04 (0.15)	-0.21 (0.14)
EEC1	0.07 (0.09)	0.06 (0.12)	0.21# (0.12)	0.04 (0.10)
EFTA1	-0.58** (0.10)	-0.30* (0.13)	-0.30* (0.14)	-0.36** (0.10)
# obs.	1194	775	798	1007
SEE	1.03	1.07	1.03	1.00
adj. R^2	0.70	0.52	0.51	0.71

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummies are in logarithms

Gravity Model of Trade

Disaggregated Data, 1970

	Total	Agricultural	Raw Material	Manufactured Goods
GNP	0.62** (0.02)	0.43** (0.02)	0.45** (0.02)	0.67** (0.02)
GNP/Capita	0.45** (0.03)	0.12** (0.04)	0.19** (0.04)	0.34** (0.03)
Distance	-0.50** (0.06)	-0.32** (0.07)	-0.36** (0.07)	-0.50** (0.07)
Adjacency	0.68** (0.17)	0.88** (0.19)	0.91** (0.19)	0.87** (0.18)
WH2	0.12 (0.16)	-0.16 (0.19)	-0.10 (0.18)	0.01 (0.17)
EAEC2	1.75** (0.29)	0.45 (0.33)	1.25** (0.29)	1.24** (0.30)
APEC2	0.58** (0.21)	1.12** (0.25)	0.72** (0.22)	0.43# (0.22)
EEC2	-0.23* (0.17)	0.65** (0.19)	-0.04 (0.18)	0.14 (0.18)
EFTA2	0.23 (0.29)	0.22 (0.34)	-0.05 (0.30)	0.70* (0.30)
WH1	-0.24* (0.09)	0.37** (0.12)	-0.02 (0.11)	-0.14 (0.10)
EAEC1	0.42** (0.13)	-0.36* (0.17)	0.18 (0.15)	0.47** (0.15)
APEC1	-0.27* (0.12)	0.28* (0.15)	0.23 (0.14)	-0.17 (0.14)
EEC1	0.10 (0.09)	0.19* (0.11)	0.29** (0.10)	0.16# (0.10)
EFTA1	-0.51** (0.10)	-0.21* (0.12)	-0.35** (0.12)	-0.23* (0.11)
# obs.	1274	887	867	1118
SEE	1.05	1.08	0.99	1.06
adj. R^2	0.72	0.55	0.61	0.72

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummes are in logarithms

Gravity Model of Trade

Disaggregated Data, 1975

	Total	Agricultural	Raw Material	Manufactured Goods
GNP	0.69** (0.02)	0.50** (0.02)	0.46** (0.02)	0.75** (0.02)
GNP/Capita	0.35** (0.03)	-0.005 (0.03)	0.03 (0.03)	0.31** (0.03)
Distance	-0.65** (0.06)	-0.35** (0.07)	-0.51** (0.07)	-0.59** (0.06)
Adjacency	0.57** (0.18)	0.96** (0.20)	0.60** (0.20)	0.69** (0.17)
WH2	0.46** (0.17)	-0.24 (0.19)	-0.03) (0.19)	0.64** (0.16)
EAEC2	0.82** (0.30)	0.32 (0.32)	0.05 (0.32)	0.73** (0.28)
APEC2	0.79** (0.23)	1.14** (0.24)	1.42** (0.24)	0.63** (0.21)
EEC2	-0.40* (0.18)	1.01** (0.19)	0.25 (0.20)	0.01 (0.17)
EFTA2	0.19 (0.31)	0.60# (0.34)	0.37 (0.35)	0.71* (0.29)
WH1	-0.29 (0.09)	0.23* (0.11)	0.23* (0.11)	-0.14 (0.09)
EAEC1	0.42** (0.13)	-0.66** (0.16)	-0.13 (0.16)	0.70** (0.13)
APEC1	-0.19 (0.13)	0.50** (0.15)	0.45** (0.15)	-0.27* (0.13)
EEC1	0.13 (0.08)	0.26* (0.10)	0.32** (0.11)	0.32** (0.08)
EFTA1	-0.57 (0.10)	-0.38** (0.12)	-0.13 (0.13)	-0.11 (0.10)
# obs.	1453	1103	1032	1287
SEE	1.15	1.18	1.18	1.06
adj. R^2	0.73	0.54	0.50	0.76

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummes are in logarithms

Gravity Model of Trade

Disaggregated Data, 1980

	Total	Agricultural	Raw Material	Manufactured Goods
GNP	0.71** (0.02)	0.48** (0.02)	0.48** (0.02)	0.74** (0.02)
GNP/Capita	0.32** (0.23)	0.07* (0.03)	-0.03 (0.03)	0.30** (0.02)
Distance	-0.58** (0.06)	-0.30** (0.07)	-0.57** (0.07)	-0.53** (0.06)
Adjacency	0.72** (0.18)	0.60** (0.20)	0.65** (0.20)	0.66** (0.18)
WH2	0.86** (0.16)	0.60** (0.19)	0.16 (0.19)	1.15** (0.16)
EAEC2	0.64* (0.26)	1.34** (0.29)	-0.25 (0.28)	0.63* (0.26)
APEC2	1.36** (0.19)	0.87** (0.21)	2.05** (0.21)	1.33** (0.19)
EEC2	-0.02 (0.18)	1.26** (0.20)	0.60** (0.20)	0.41* (0.18)
EFTA2	0.34 (0.32)	0.79* (0.36)	0.89* (0.37)	0.79* (0.32)
WH1	-0.11 (0.08)	0.45** (0.10)	0.43** (0.10)	-0.13* (0.09)
EAEC1	0.58** (0.11)	-0.26# (0.13)	-0.28* (0.13)	0.84** (0.11)
APEC1	-0.08 (0.11)	0.21# (0.13)	0.93** (0.14)	-0.15 (0.12)
EEC1	0.38** (0.08)	0.68** (0.09)	0.63** (0.10)	0.53** (0.08)
EFTA1	-0.24* (0.09)	0.04 (0.11)	0.18# (0.12)	0.18# (0.09)
# obs.	1708	1407	1337	1614
SEE	1.17	1.28	1.27	1.16
adj. R^2	0.73	0.52	0.52	0.74

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummes are in logarithms

Gravity Model of Trade

Disaggregated Data, 1985

	Total	Agricultural	Raw Material	Manufactured Goods
GNP	0.49** (0.02)	0.48** (0.02)	0.78** (0.02)	0.73** (0.02)
GNP/Capita	0.07* (0.03)	-0.04 (0.03)	0.28** (0.02)	0.30** (0.02)
Distance	-0.43** (0.06)	-0.44** (0.07)	-0.64** (0.06)	-0.70** (0.06)
Adjacency	0.81** (0.19)	0.89** (0.21)	0.77** (0.17)	0.81** (0.18)
WH2	0.14 (0.20)	0.28 (0.21)	0.91** (0.17)	0.61** (0.17)
EAEC2	-0.34 (0.27)	0.05 (0.29)	0.48* (0.24)	0.53* (0.25)
APEC2	1.86** (0.20)	1.80** (0.21)	1.16** (0.18)	1.17** (0.18)
EEC2	1.14** (0.19)	0.83** (0.20)	0.51** (0.17)	0.13 (0.18)
EFTA2	0.67# (0.34)	0.95* (0.37)	0.63* (0.30)	0.32 (0.31)
WH1	0.28** (0.10)	0.40** (0.11)	-0.14# (0.08)	-0.03 (0.08)
EAEC1	-0.63** (0.12)	-0.21 (0.14)	0.94** (0.11)	0.56** (0.11)
APEC1	0.38** (0.13)	0.64** (0.15)	-0.43** (0.12)	-0.26* (0.12)
EEC1	0.44** (0.09)	0.63** (0.10)	0.60** (0.08)	0.44** (0.08)
EFTA1	-0.62** (0.11)	0.10 (0.12)	0.08 (0.10)	-0.40** (0.09)
# obs.	1343	1234	1526	1647
SEE	1.20	1.26	1.09	1.13
adj. R^2	0.56	0.51	0.78	0.75

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummes are in logarithms

Trade Creation/Diversion

1990

	Total
GNP	0.73** (0.02)
GNP/Capita	0.17** (0.03)
Distance	-0.66** (0.05)
Adjacency	0.71** (0.16)
WH2	1.04** (0.15)
EAEC2	0.59** (0.23)
APEC2	0.99** (0.17)
EEC2	0.17 (0.16)
EFTA2	0.11 (0.28)
WH1	0.16* (0.07)
EAEC1	0.89** (0.10)
APEC1	-0.44** (0.11)
EEC1	0.12## (0.08)
EFTA1	-0.48** (0.09)
# obs.	1573
SEE	1.03
adj. R^2	0.79

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummes are in logarithms

Table 3a: Gravity Model with Western Hemisphere Broken Into Sub-regions

(Aggregate Trade, 1965-1990)

	1965	1970	1975	1980	1985	1990
GNP	0.63** (0.02)	0.64** (0.02)	0.72** (0.18)	0.74** (0.02)	0.53** (0.02)	0.75** (0.01)
GNP per capita	0.26** (0.02)	0.36** (0.02)	0.27** (0.02)	0.29** (0.02)	0.06** (0.02)	0.09** 0.02
Distance	-0.44** (0.04)	-0.53** (0.04)	-0.68** (0.05)	-0.56** (0.04)	-0.35** (0.05)	-0.56** (0.04)
Adjacency	0.62** (0.17)	0.58** (0.17)	0.45* (0.19)	0.68** (0.18)	0.85** (0.20)	0.79** (0.16)
EAEC2	1.40** (0.29)	1.71** (0.29)	0.86** (0.31)	0.78** (0.27)	-0.41# (0.28)	0.63** (0.24)
APEC2	0.61** (0.21)	0.76** (0.21)	0.97** (0.22)	1.49** (0.18)	1.58** (0.20)	1.32** (0.17)
EEC2	0.24## (0.17)	0.11 (0.17)	-0.06 (0.18)	0.21** (0.18)	1.51** (0.19)	0.49** (0.16)
EFTA2	0.04 (0.30)	0.07 (0.30)	0.01 (0.32)	0.58 (0.32)	0.06 (0.36)	-0.05 (0.29)
NAFTA2	-0.12 (0.63)	-0.41 (0.64)	-0.44 (0.70)	0.08 (0.71)	-0.58 (0.75)	0.05 (0.63)
MERCOSUR2	-0.18 (0.46)	0.46 (0.46)	0.43 (0.50)	0.81## (0.51)	0.72 (0.55)	2.09** (0.46)
ANDEAN2	-0.51 (0.39)	-0.13 (0.32)	1.15** (0.35)	1.11** (0.32)	-0.17 (0.59)	0.90** (0.29)
# Observations	1194	1274	1453	1708	1343	1573
SEE	1.07	1.08	1.18	1.20	1.28	1.08
Adjusted R^2	0.68	0.71	0.71	0.71	0.51	0.77

Notes:
(1) Standard errors are in parentheses.
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
denotes significant at 15% level (t=>1.44)
(3) All variables except the dummies are in logarithms.

Table 3b: Gravity Model with Western Hemisphere Broken Into Sub-regions

(Trade in Manufactures, 1965-1985)

	1965	1970	1975	1980	1985
GNP	0.63** (0.02)	0.68** (0.19)	0.77** (0.18)	0.76** (0.02)	-10.46 (0.52)
GNP per capita	0.24** (0.03)	0.29** (0.03)	0.27** (0.02)	0.30** (0.02)	0.25 (0.02)
Distance	-0.36** (0.05)	-0.50** (0.05)	-0.60** (0.04)	-0.52** (0.04)	-0.69 (0.04)
Adjacency	0.57** (0.18)	0.81** (0.18)	0.66** (0.18)	0.61** (0.19)	0.73 (0.18)
EAEC2	1.25** (0.29)	1.26** (0.30)	0.80** (0.29)	0.82** (0.27)	0.57 (0.26)
APEC2	0.55** (0.22)	0.59** (0.21)	0.75** (0.21)	1.42** (0.19)	1.25 (0.18)
EEC2	0.59** (0.17)	0.36* (0.17)	0.19 (0.17)	0.51** (0.18)	0.45 (0.18)
EFTA2	0.49# (0.30)	0.60* (0.30)	0.53# (0.30)	0.58# (0.33)	-0.06 (0.32)
NAFTA2	-0.18 (0.62)	-0.31 (0.64)	-0.39 (0.65)	0.05 (0.72)	-0.39 (0.69)
MERCOSUR2	-0.53 (0.49)	0.05 (0.47)	0.30 (0.47)	0.93# (0.52)	0.97 (0.50)
ANDEAN2	-1.01** (0.37)	-0.24 (0.34)	0.71* (0.33)	1.09** (0.33)	0.83 (0.40)
# Observations	1007	1118	1287	1614	1647
SEE	1.03	1.08	1.09	1.22	1.17
Adjusted R^2	0.69	0.71	0.75	0.71	0.74

Notes:

(1) Standard errors are in parentheses.

(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
denotes significant at 15% level (t=>1.44)

(3) All variables except the dummies are in logarithms.

Table 4: Preferential Trading Arrangements vs. Customs Unions

Forms of Regional Trade Blocs

(Total Trade, 1965-1985)

	1965	1970	1975	1980	1985	1990
GNP	0.63** (0.02)	0.64** (0.02)	0.72** (0.02)	0.74** (0.02)	0.53** (0.02)	0.76** (0.02)
GNP per capita	0.26** (0.02)	0.36** (0.02)	0.27** (0.02)	0.28** (0.02)	0.05# (0.03)	0.08** (0.02)
Distance	-0.44** (0.05)	-0.54** (0.05)	-0.69** (0.05)	-0.54** (0.04)	-0.33** (0.05)	-0.52** (0.04)
Adjacent	0.63** (0.17)	0.62** (0.17)	0.49** (0.19)	0.68** (0.18)	0.79** (0.20)	0.77** (0.16)
WH2	-0.22 (0.02)	-0.10 (0.17)	0.19 (0.18)	0.37* (0.18)	0.40# (0.21)	0.76** (0.17)
EAEC2	1.40** (0.03)	1.71** (0.30)	0.87** (0.31)	0.77** (0.27)	-0.42 (0.28)	0.63** (0.24)
EEC2	0.30 (0.40)	-0.09 (0.37)	-0.34 (0.40)	-0.10 (0.40)	1.52** (0.50)	0.42 (0.34)
EFTA2	0.00 (0.31)	0.07 (0.30)	0.01 (0.33)	-0.07 (0.34)	-0.08 (0.37)	-0.26 (0.30)
PTA/FTA	0.05 (0.13)	-0.02 (0.13)	-0.05 (0.14)	0.20 (0.13)	0.25# (0.15)	0.32** (0.12)
CU/CM	-0.10 (0.37)	0.19 (0.33)	0.32 (0.36)	0.19 (0.35)	-0.15 (0.47)	-0.13 (0.31)
# observations	1194	1274	1453	1708	1343	1573
SEE	1.07	1.08	1.18	1.20	1.27	1.07
Adj. R^2	0.68	0.71	0.71	0.71	0.52	0.77

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummies are in logarithms
(4) "PTA/FTA" -- trade between countries of the same preferential trade agreement (PTA) or free trade area (FTA)
"CU/CM" -- trade between countries of the same customs union (CU) or common market (CM)

Forms of Regional Trade Blocs

(Manufactured Trade, 1965-1985)

	1965	1970	1975	1980	1985
GNP	0.64** (0.02)	-0.68** (0.02)	0.77** (0.02)	0.76** (0.02)	0.76** (0.02)
GNP per capita	0.23** (0.03)	0.27** (0.03)	0.26** (0.02)	0.29** (0.02)	0.24** (0.02)
Distance	-0.31** (0.05)	-0.46** (0.05)	-0.56** (0.05)	-0.48** (0.04)	-0.66** (0.04)
Adjacent	0.60** (0.18)	0.85** (0.18)	0.65** (0.18)	0.55** (0.18)	0.70** (0.18)
WH2	-0.60** (0.18)	-0.38* (0.17)	0.04 (0.17)	0.23 (0.18)	0.10 (0.18)
EAEC2	1.23** (0.29)	1.22** (0.30)	0.77** (0.29)	0.80** (0.27)	0.55* (0.26)
EEC2	0.71# (0.42)	0.24 (0.39)	-0.06 (0.38)	-0.29 (0.40)	-0.06 (0.42)
EFTA2	0.27 (0.30)	0.40 (0.30)	0.35 (0.31)	0.32 (0.34)	-0.28 (0.33)
PTA/FTA	0.34** (0.13)	0.29* (0.13)	0.30* (0.13)	0.42** (0.14)	0.34** (0.13)
CU/CM	-0.35 (0.39)	-0.06 (0.35)	0.08 (0.34)	0.54 (0.36)	0.29 (0.39)
# observations	1007	1118	1287	1614	1647
SEE	1.03	1.08	1.09	1.21	1.17
Adj. R^2	0.69	0.71	0.75	0.71	0.74

Notes: (1) Standard errors are in parentheses

(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)

(3) All variables except the dummies are in logarithms

(4) "PTA/FTA" -- trade between countries of the same preferential trade agreement (PTA) or free trade area (FTA)
"CU/CM" -- trade between countries of the same customs union (CU) or common market (CM)

Linguistic Links in Trade

(Manufactured Goods, 1965-1985)

	1965	1970	1975	1980	1985
GNP	0.64** (0.02)	0.69** (0.02)	0.77** (0.02)	0.76** (0.02)	0.76** (0.02)
GNP per capita	0.27** (0.03)	0.29** (0.03)	0.29** (0.02)	0.31** (0.02)	0.26** (0.02)
Distance	-0.36** (0.05)	-0.52** (0.05)	-0.61** (0.05)	-0.54** (0.04)	-0.70** (0.04)
Adjacent	0.50* (0.18)	0.81** (0.18)	0.64** (0.17)	0.56** (0.18)	0.71** (0.18)
WH2	-0.25 (0.18)	-0.26 (0.18)	0.20 (0.18)	0.66** (0.19)	0.17 (0.18)
EAEC2	1.41** (0.30)	1.14** (0.30)	0.90** (0.30)	0.94** (0.28)	0.56* (0.27)
APEC2	0.17 (0.22)	0.44* (0.21)	0.55** (0.21)	1.07** (0.19)	1.10** (0.18)
EEC2	0.60** (0.16)	0.33# (0.17)	0.19 (0.17)	0.51** (0.18)	0.47** (0.18)
EFTA2	0.48# (0.29)	0.56# (0.29)	0.51# (0.29)	0.57# (0.32)	-0.04 (0.32)
English	0.30 (0.31)	-0.12 (0.32)	0.16 (0.30)	0.42 (0.31)	0.20 (0.31)
Spanish	-0.78* (0.35)	-0.41 (0.35)	-0.28 (0.34)	-0.47 (0.36)	0.30 (0.36)
Chinese	0.84 (0.57)	2.61** (0.83)	1.14 (0.83)	1.12 (0.61)	1.03# (0.60)
Arabic	-0.37 (0.41)	-0.04 (0.44)	-0.34 (0.34)	-0.97** (0.36)	-0.28 (0.36)
French	-0.15 (0.36)	-0.74* (0.36)	-0.44 (0.33)	-0.23 (0.35)	0.06 (0.35)
Common language	0.47 (0.29)	0.52# (0.30)	0.44 (0.28)	0.46 (0.30)	0.16 (0.30)
# observations	1007	1118	1287	1614	1647
SEE	1.01	1.07	1.08	1.19	1.17
adj. R^2	0.71	0.72	0.75	0.72	0.74

Notes: (1) Standard errors are in parentheses
(2) ** denotes significant at 1% level (t=>2.576)
* denotes significant at 5% level (t=>1.96)
\# denotes significant at 10% level (t=>1.645)
(3) All variables except the dummies are in logarithms
(4) "Common" -- dummy for common linguistic link
(German, Japanese, Dutch, Portugese and 5 languages in table)

Table 6: Bilateral Distances for some Major Cities, in kilometers

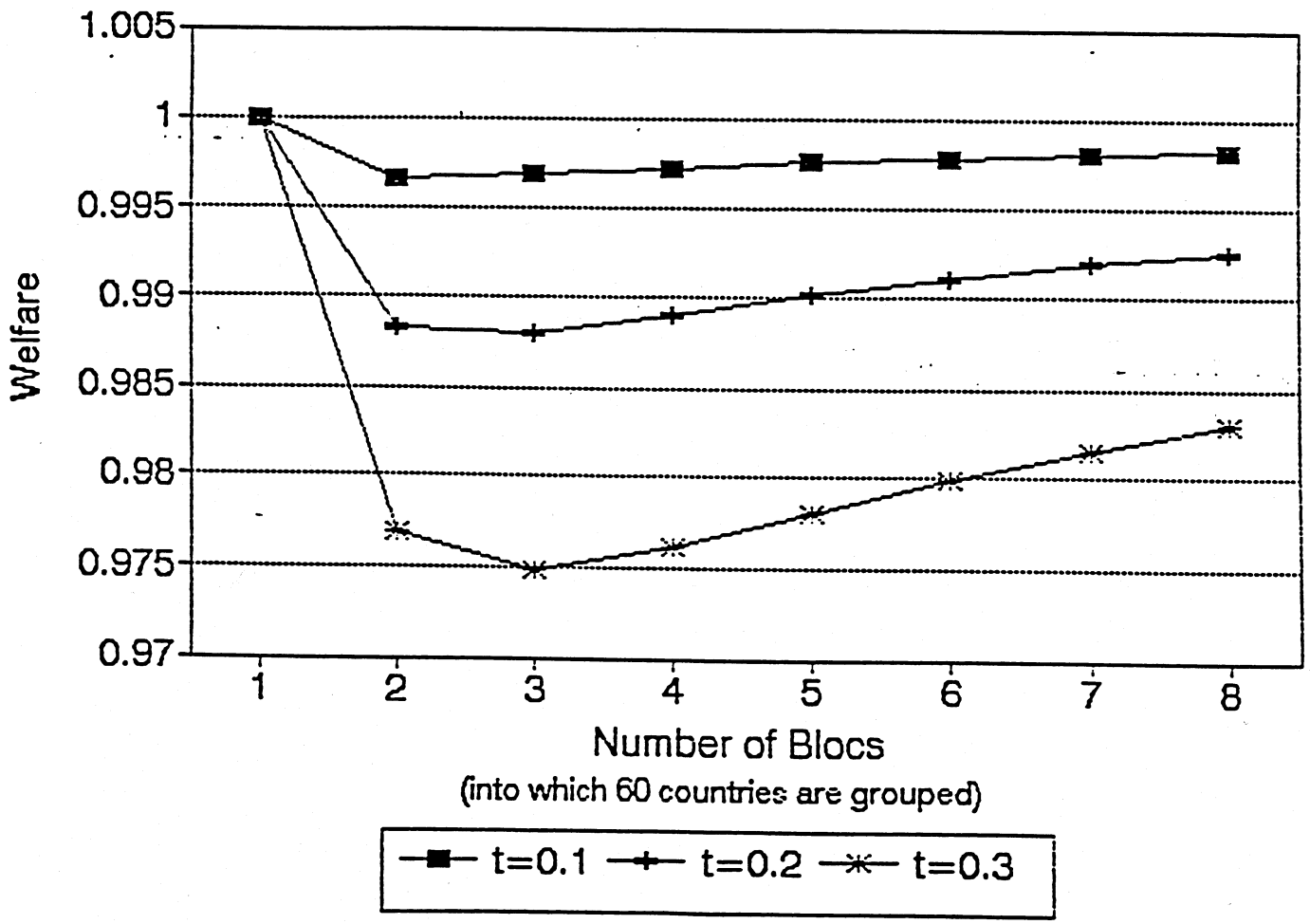
	Tokyo	Chicago	Geneva	Sydney	SaoPaolo
Tokyo					
Chicago	10142.4				
Geneva	9803.0	7056.8			
Sydney	7835.4	14891.3	16788.5		
Sao Paulo	18546.6	8415.8	9406.3	13370.9	
Nairobi	11278.6	12894.0	6078.1	12162.7	9289.96

Table 7: Average Bilateral Distances, in kilometers

	Europe	Western Hemisphere	Pacific Asia
Europe	1491		
Western Hem.	9585	4163	
Pacific Asia	10995	15902	4293

Figure 1: Number of Blocs and Welfare

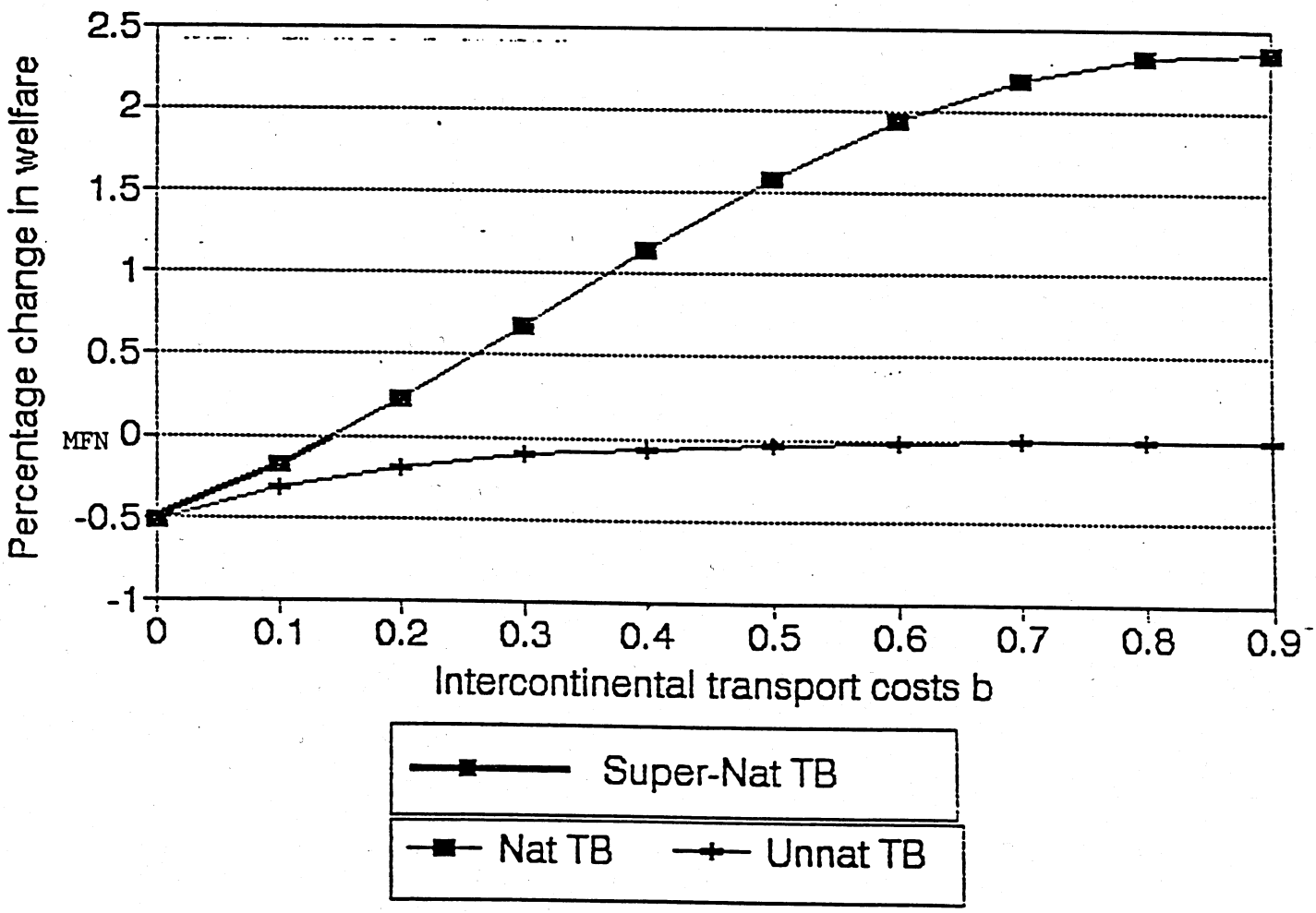
(zero transport costs; theta = 0.75)



Confirmation of Krugman's results

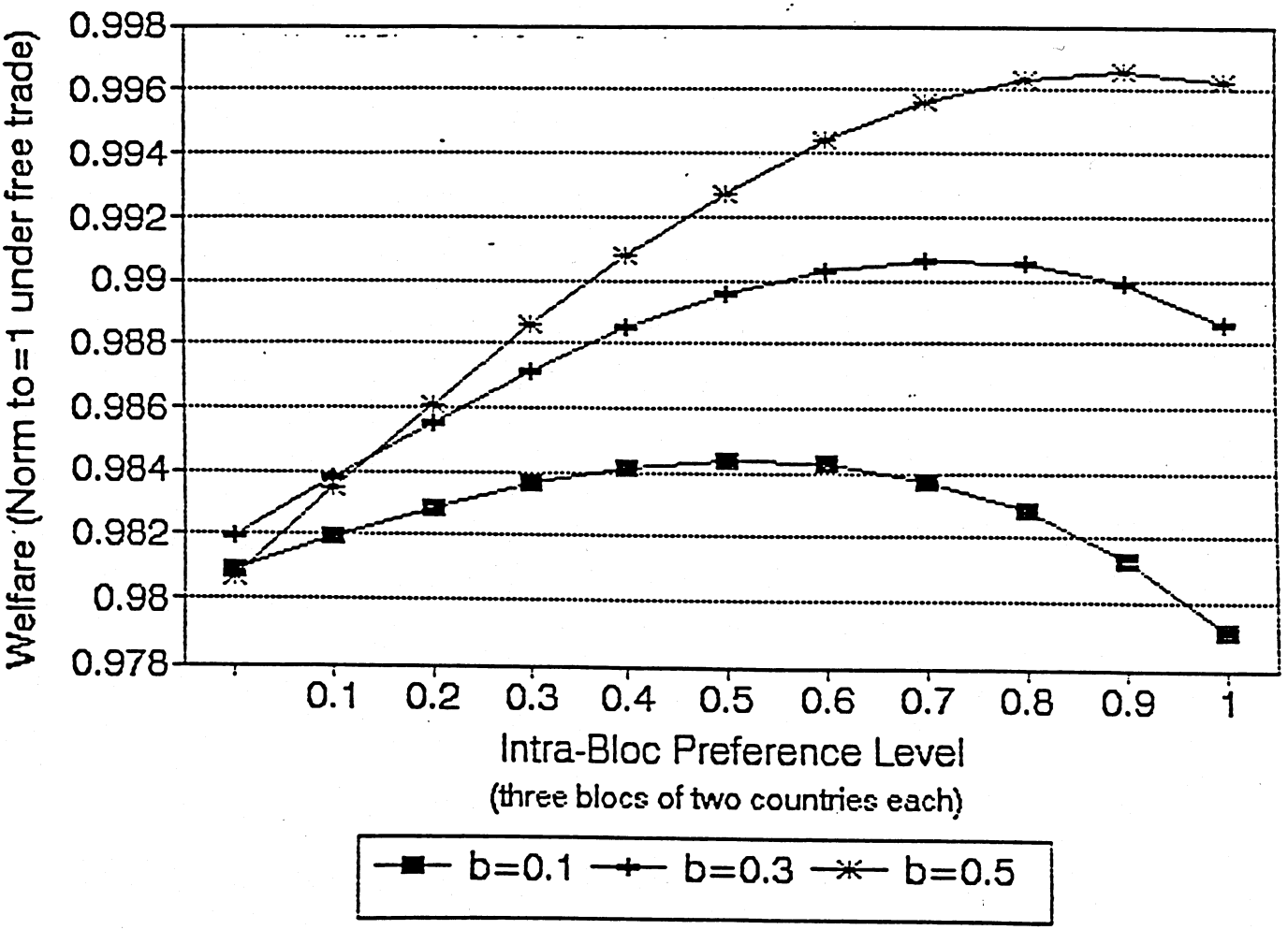
Figure 2: Welfare Effects of Agreements

(Theta=0.75; t=0.3; a=0; N=2; C=3)



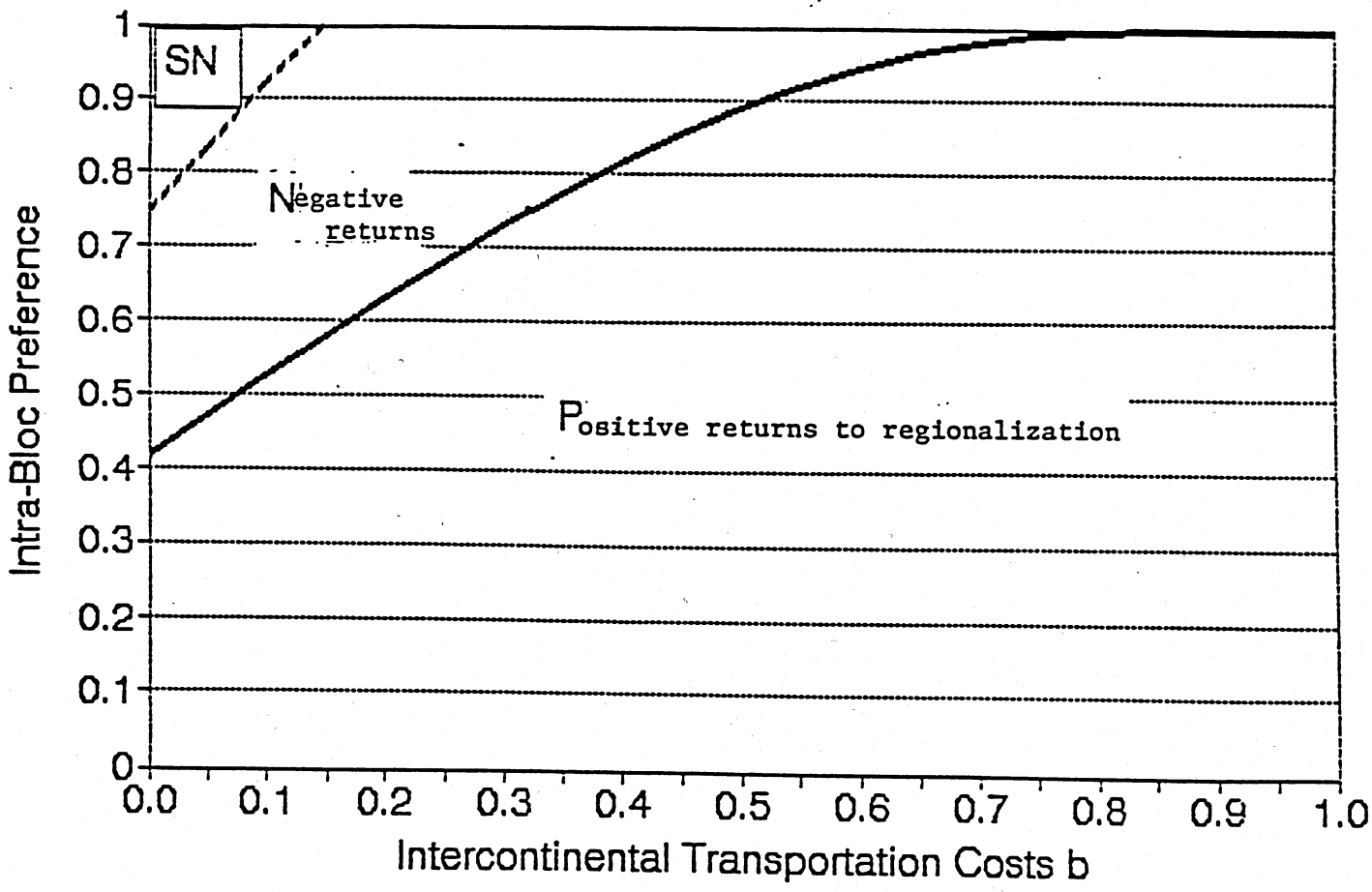
Free-trade Areas, even if drawn along natural continental lines, can reduce welfare relative to MFN, if transport costs are low enough.

Figure 3: Intra-Bloc Preference Level and Welfare (t=0.3; theta=0.75)



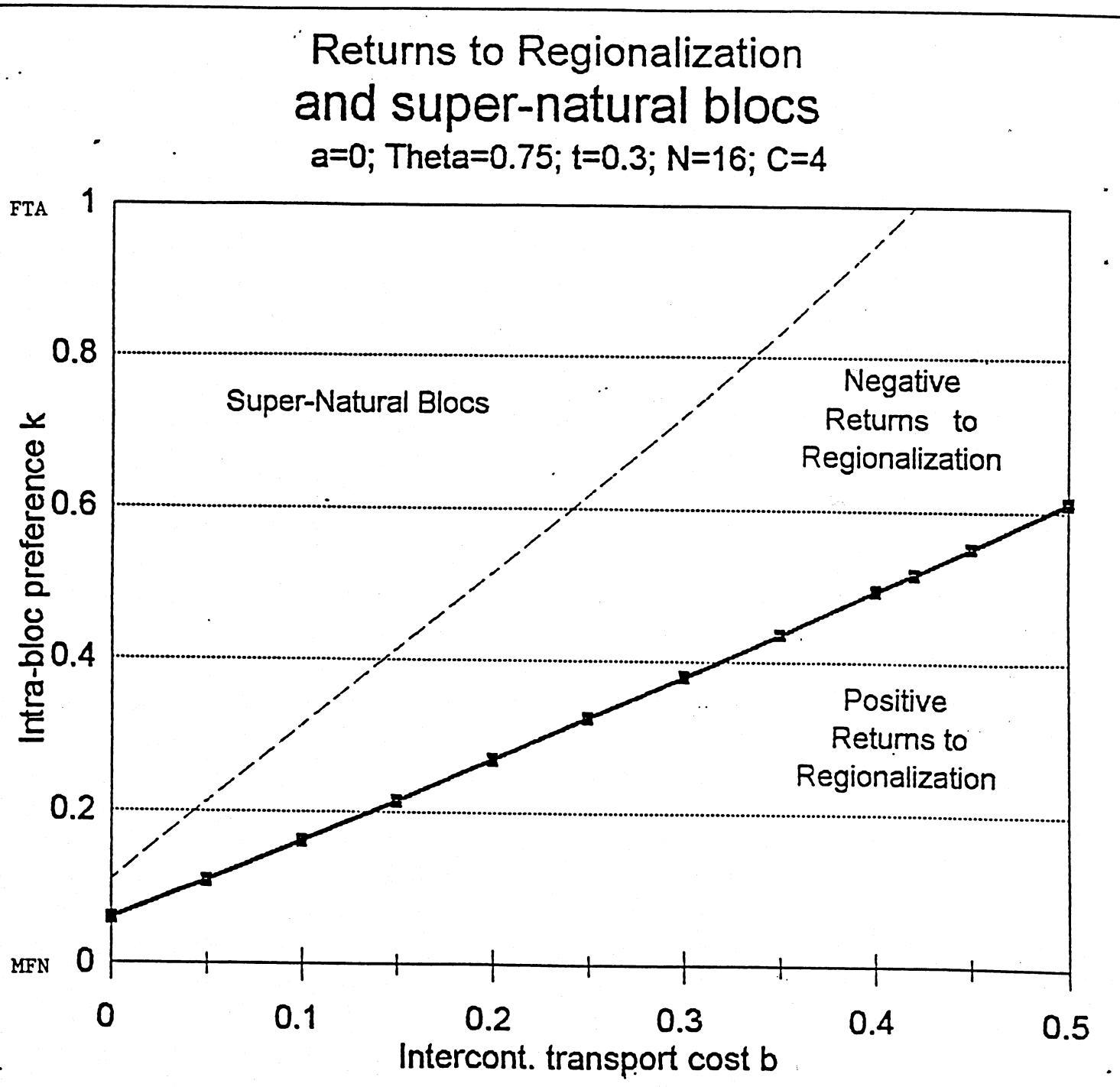
Partial preferences within continental blocs are better than either full Free Trade Areas or strict Most Favored Nation rules.

Figure 4: Returns to Regionalization & Supernatural Blocs (t=0.3; theta=0.75)



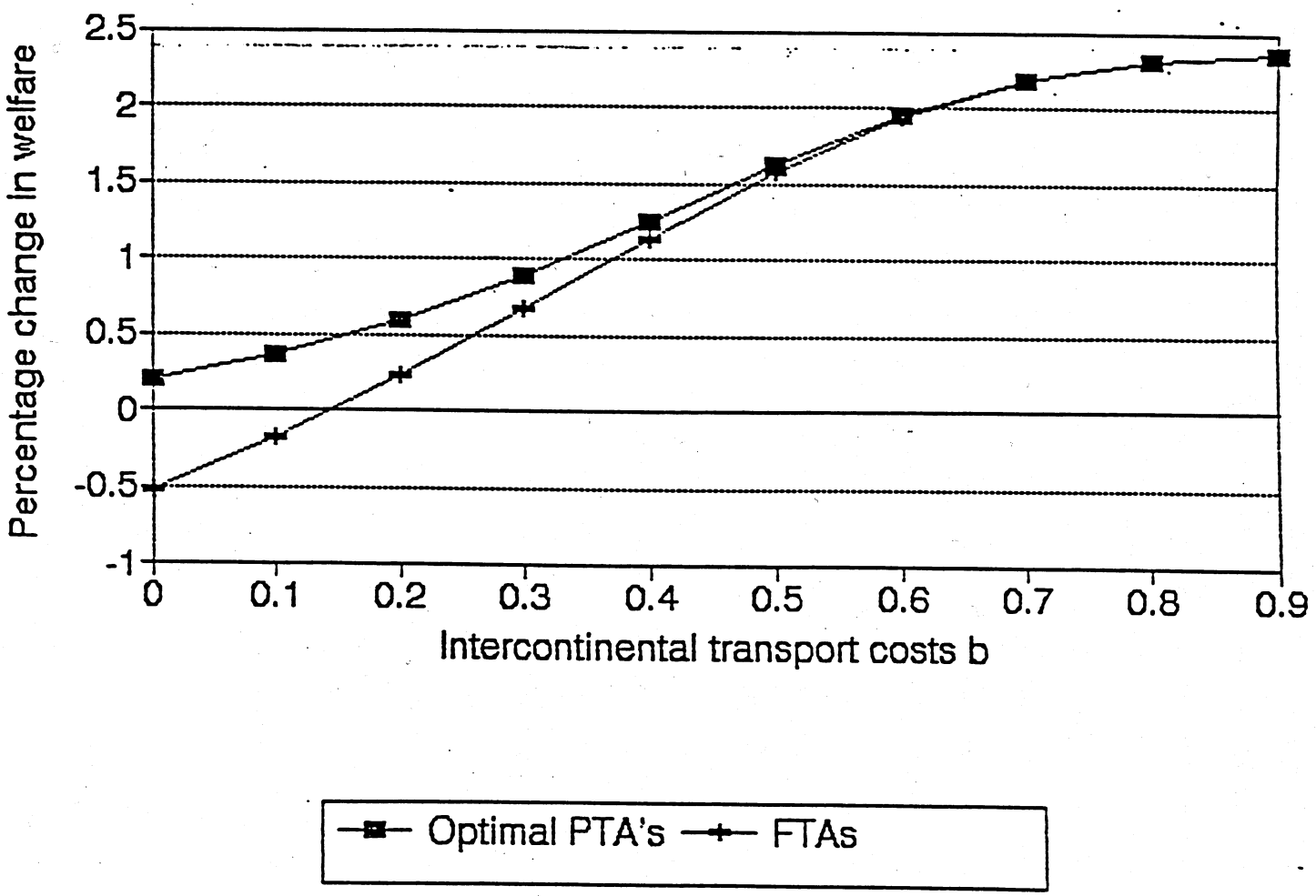
Super-natural blocs are more likely if transport costs are low and the degree of intra-bloc preferences is high.

Figure 4b



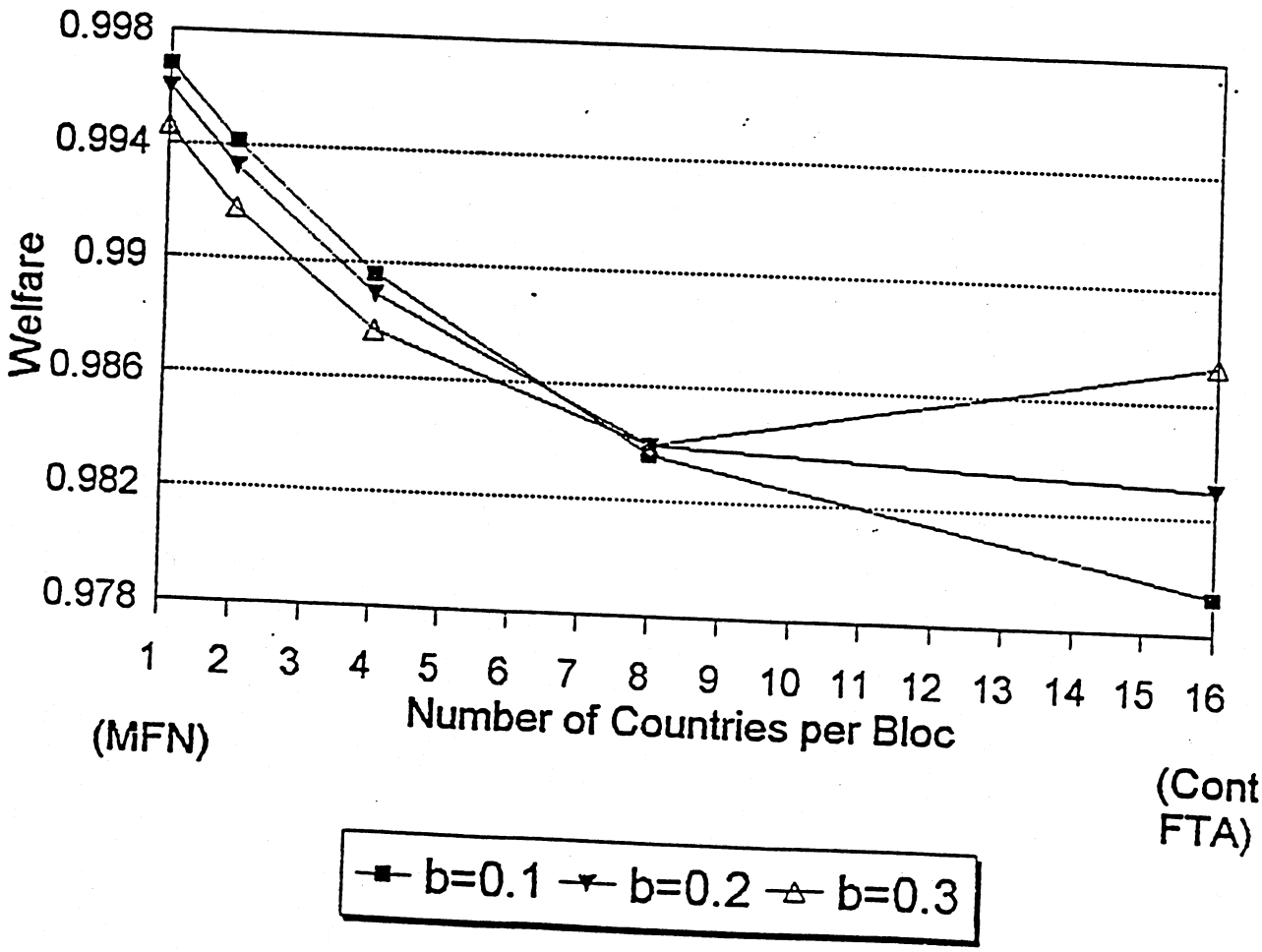
Super-natural blocs are even more likely in the (more realistic) case where there are many countries on each continent.

Figure 5: Welfare Effects of Agreements FTAs and Opt. PTAs (Theta=0.75; t=0.3)



If the degree of intra-bloc preferences is chosen optimally, then they raise welfare even if transport costs are low.

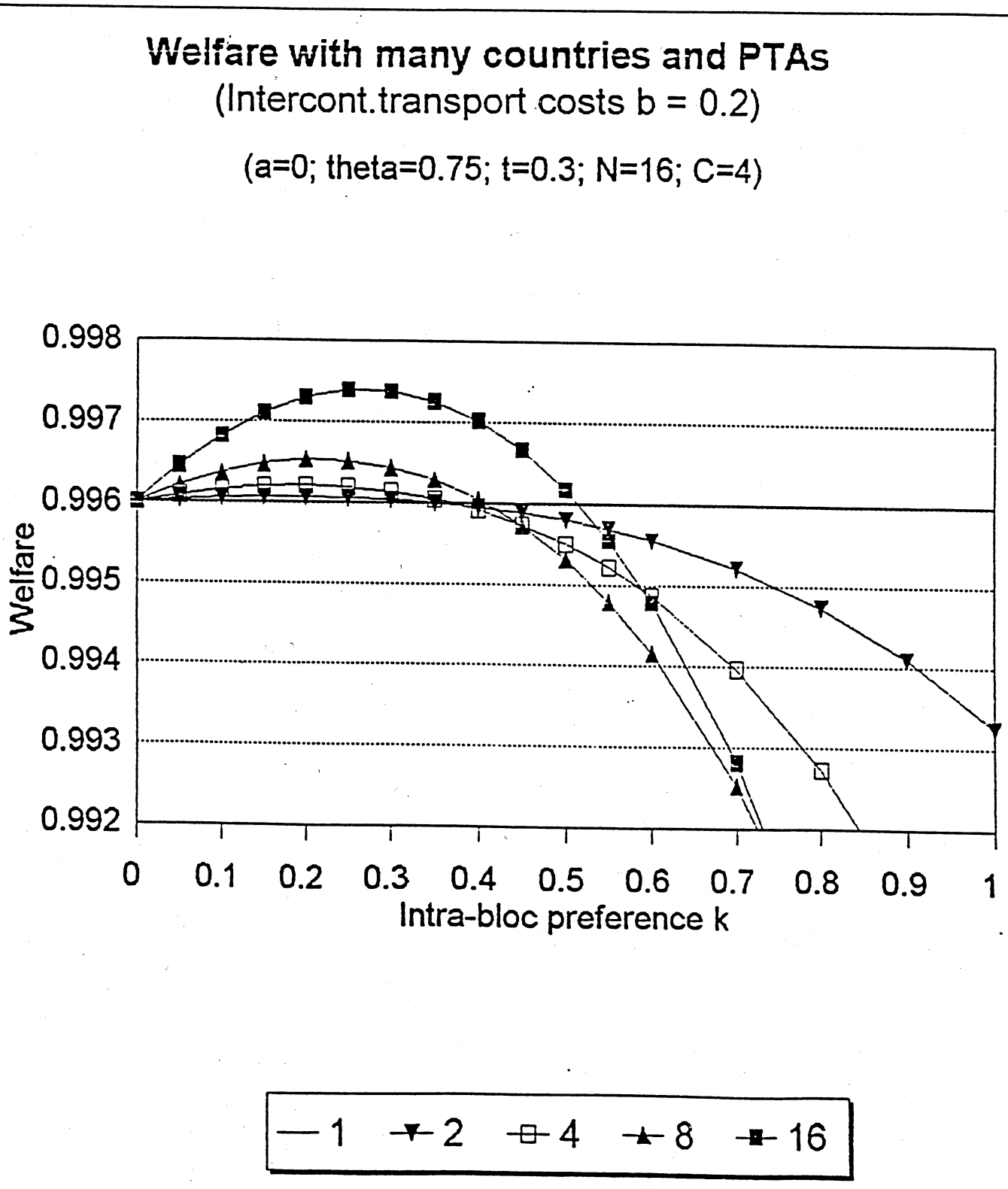
Figure 6: Sub-Continental Blocs and Welfare (t=0.3; theta=0.75; C=4; N=16)



Welfare is normalized to be 1 under free trade

Even the formation of small FTAs on each continent lowers welfare.

Figure 7



If preferences are only partial, the formation of regional blocs can raise welfare.

Figure 7a

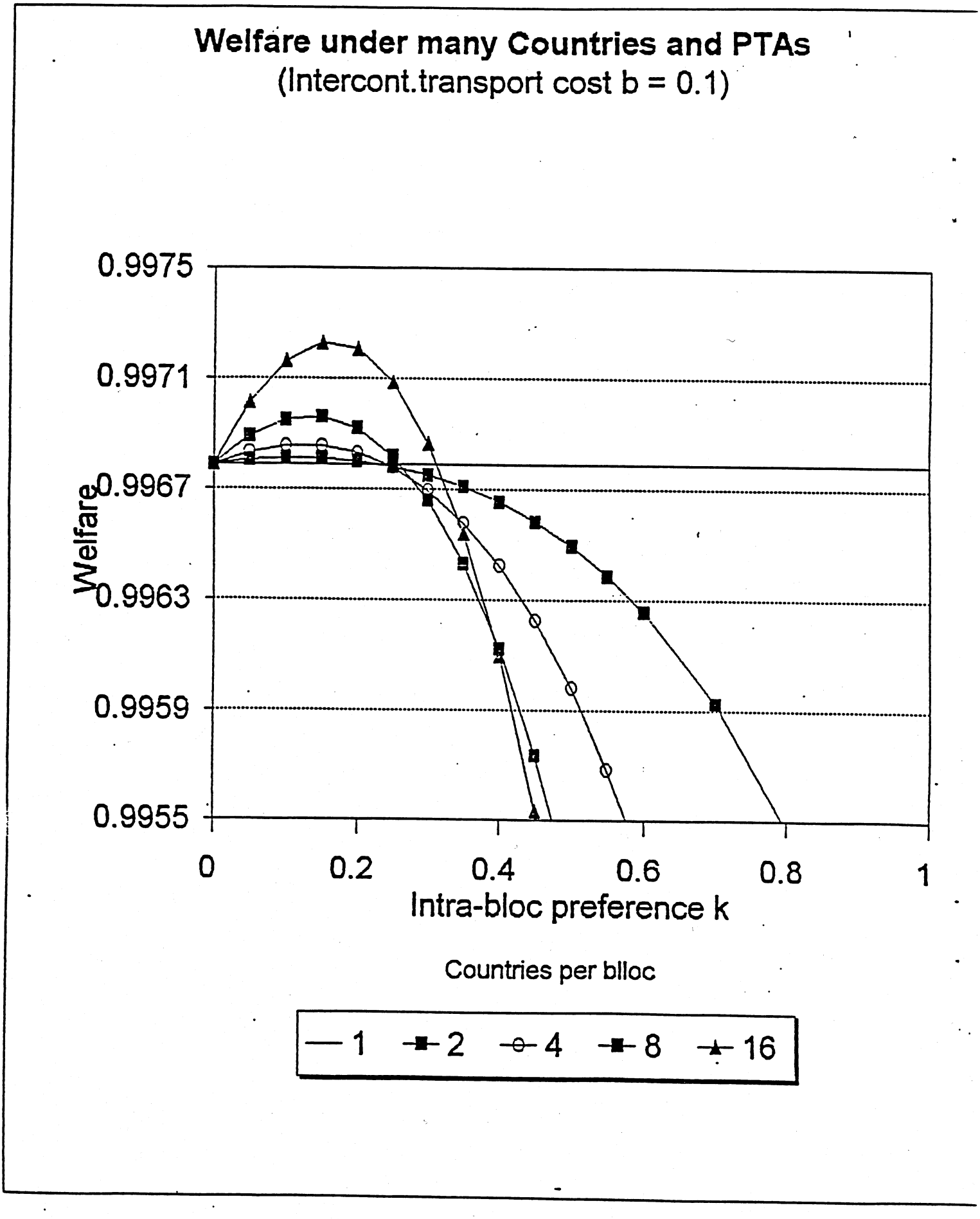
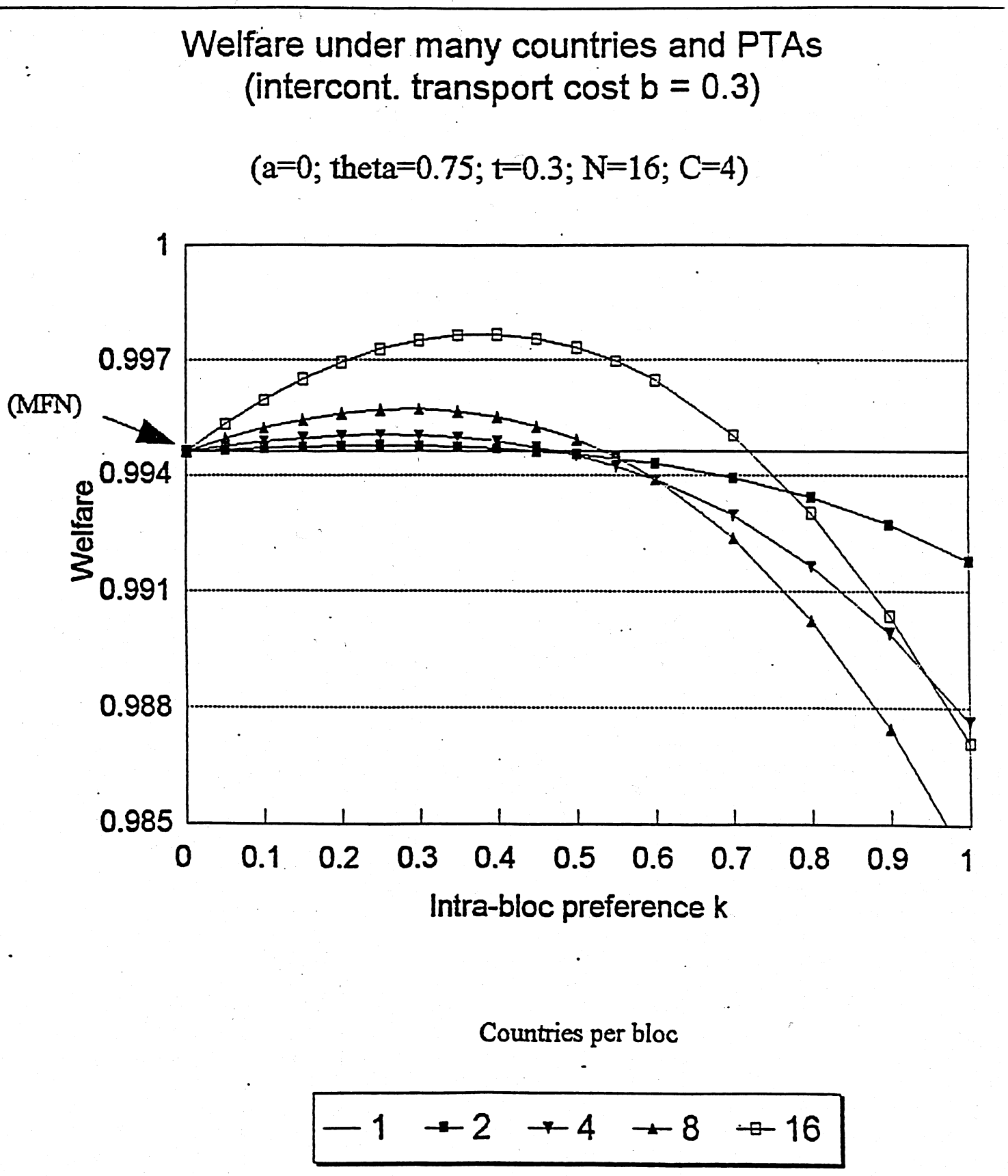

Welfare under many Countries and PTAs
(Intercont.transport cost b = 0.1)
0.9975
0.9971
0.9967
0.9963
0.9959
0.9955
Welfare
0
0.2
0.4
0.6
0.8
1
Intra-bloc preference k
Countries per blloc
1
2
4
8
16

Figure 7b


Welfare under many countries and PTAs
(intercont. transport cost b = 0.3)
(a=0; theta=0.75; t=0.3; N=16; C=4)
1
0.997
(MFN)
0.994
0.991
0.988
0.985
Welfare
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Intra-bloc preference k
Countries per bloc
1
2
4
8
16

Appendix: List of Countries Used in the Gravity Equation

Regional Groupings and Main City

Americas *(WH, 13)*

Canada	Ottawa
United States	Chicago
Argentina	Buenos Aires
Brazil	Sao Paulo
Chile	Santiago
Colombia	Bogota
Ecuador	Quito
Mexico	Mexico City
Peru	Lima
Venezuela	Caracas
Bolivia	La Paz
Paraguay	Asuncion
Uruguay	Montevideo

European Community *(EC, 11)*

West Germany	Bonn
France	Paris
Italy	Rome
United Kingdom	London
Belgium	Brussels
Denmark	Copenhagen
Netherlands	Amsterdam
Greece	Athens
Ireland	Dublin
Portugal	Lisbon
Spain	Madrid

European Free Trade Area *(EFTA, 6)*

Austria	Vienna
Finland	Helsinki
Norway	Oslo
Sweden	Stockholm
Switzerland	Geneva
Iceland	Reykjavik

East Asia *(EAEG, 10)*

Japan	Tokyo
Indonesia	Jakarta
Taiwan	Taipei
Hong Kong	Hong Kong
South Korea	Seoul
Malaysia	Kuala Lumpur
Philippines	Manila
Singapore	Singapore
Thailand	Bangkok
China	Shanghai

Other countries *(23)*

South Africa	Pretoria
Turkey	Ankara
Yugoslavia	Belgrade
Israel	Jerusalem
Algeria	Algiers
Libya	Tripoli
Nigeria	Lagos
Egypt	Cairo
Morocco	Casablanca
Tunisia	Tunis
Sudan	Khartoum
Ghana	Accra
Kenya	Nairobi
Ethiopia	Addis Ababa
Iran	Tehran
Kuwait	Kuwait
Saudi Arabia	Riyadh
India	New Delhi
Pakistan	Karachi
Hungary	Budapest
Poland	Warsaw
Australia	Sydney
New Zealand	Wellington

Notes: (a) The distance between countries was computed as the great circle distance - between the relevant pair of cities

(b) APEC consists of East Asia, plus Australia, New Zealand, Canada and the United States.

Appendix: Sensitivity analysis

We have attempted in this paper to shed some light on the type of symmetrical trade arrangements that would result in a second best outcome, provided the achievement of multilateral free trade is not realistic. Throughout the simulations, we have worked with the following "benchmark" set of parameter values: $a=0$; $\theta= 0.75$; $t=0.3$; in the case of intercontinental transportation costs b, in several simulations we allowed it to vary to see the effects of different values of b on welfare. When we had to choose a value, we adopted 0.2, which is not very far from our estimation based on the data on bilateral trade. For these parameter values, and a stylized world of 4 continents formed by 16 countries each, the second best entails the formation of continent-wide PTAs with levels of intra-bloc preference of the order of 27%. Furthermore, we have determined that the level of preferences beyond which welfare falls below the level associated with the MFN rule is 51.5%.

The purpose of this appendix is to study how sensitive these results are to changes in the parameters θ, t and a, and to changes in the configuration of the world. We have done two simulations regarding the effect of different values of θ on the optimal level of intra-bloc preferences, and on the level beyond which blocs enter the supernatural region. In the first of these simulations, θ is allowed to vary while a, b, and t remain at their benchmark level. The results can be seen in figure A: for any value of θ below 0.85, the qualitative results do not change much. The optimal degree of regionalization occurs for intra-bloc preference levels of the order of 20-40% (increasing as a function of the substitution parameter θ), and super-natural blocs remain a distinct possibility. It is only for values of $\theta > 0.85$ that the optimal level of k starts to increase rapidly, and the possibility of super-natural blocs becomes highly unlikely. However, these high values of the parameter θ would be associated with elasticities of

substitution larger than 6.66 (remember that the elasticity of substitution is $1/(1-\theta)$), which seems too high.[1]

The reason why the optimal level of preference and the level at which we enter the super-natural region increase with θ is the following: as θ increases, the preference for variety falls, and a given difference in relative prices due to natural barriers (such as transport costs) or artificial barriers (such as tariffs) has a larger effect. Thus, increasing θ implies that geography becomes more important, and therefore natural trading blocs such as the ones considered here are more likely to improve welfare, even at higher levels of intra-bloc preference.

The difference between the second simulation and the first one is that now inter-continental transport costs b are made to depend on θ, as in our preferred estimate of b. Figure B shows how transport costs between continents will depend on the value of θ we assume. The logic for this dependence is intuitive: the distance estimates of the gravity equation (together with the average distances between two countries in the same continent and two countries in different continents) tells us how much more on average is a country likely to trade with members of its own continent, compared to trade with non-members. There are two reasons why trade with neighbors is higher: one is inter-continental transport costs, which introduce a price differential between varieties from neighbors and non-neighbors. The other reason is related to the elasticity of substitution. A given level of inter-continental transport costs will have a much larger effect on trade the higher the elasticity of substitution between varieties. Our gravity estimates tell us that, on average, two countries in the same continent will trade approximately twice as much as

---

[1]For this level of elasticity of substitution, if two varieties enter symmetrically into the utility function but the price of one of them is 15% higher than that of the other one, the lower-price variety will be consumed about three times as much as the higher price variety.

two countries in different continents, other things being equal. If the value of θ is very high, and so is the elasticity of substitution, a small value of intercontinental transport cost (with the corresponding small effect on relative prices of neighbor and non-neighbor varieties) will be enough to assure that on average, countries in the same continent trade twice as much among themselves than countries in different continents. On the other hand, for low values of θ, and correspondingly low values of the elasticity of substitution, the level intercontinental transport costs b necessary to bring about this pattern of trade will be much higher. This explains the negative relationship between b and θ shown in figure B.

In our second simulation, then, we allow θ to vary, and b is determined by the relationship given by figure B (a and t remain at their benchmark levels). The results of this simulation can be seen in figure C. In this case, our basic conclusions remain intact even at higher levels of elasticity of substitution. Throughout the range of θ allowed, the optimal level of preferences remain within the range of 23-37%. Super-natural blocs kick in at levels of preference between 43 and 70%.

Note that both curves in figure C are U-shaped. This is due to the combination of two factors that work in opposite directions. On the one hand, as we saw in figure A, the optimal preference level k and the level of k at which blocs become super-natural increase with θ. But, on the other hand, they decrease as b decreases, and we have seen that there is an inverse relationship between θ and b. For low values of θ, changes in this parameter do not affect the elasticity of substitution very much, and the effect of b dominates (thus, the curves in figure C are downward sloping for low values of θ). But for higher values of θ, changes in this parameter have a substantial effect on the elasticity of substitution, and the positive effect of θ becomes the

overriding factor.[2]

In our third simulation, we allow the level of external tariff t to vary. The outcome can be seen in figure D. The lower curve, which represents the optimal degree of intra-bloc tariff at each level of t, can be interpreted as the optimal path toward trade liberalization in a world where regional blocs are formed, but multilateral negotiations through GATT continue to lower the external level of tariffs t. The more successful the multilateral trade negotiations are in lowering t, the lower the optimal level of intra-bloc preference, so trade policy becomes less and less discriminatory. Obviously, when external tariffs become 0, it does not make sense any more to talk about levels of intra-bloc preference.

To understand the positive slope of the curves, imagine the extreme case in which tariffs are set at a prohibitively high level. In this case, countries would not trade outside their bloc regardless of the preference level k, and therefore the formation of FTAs does not involve any trade diversion. This means that 100% preferences would be optimal in this extreme situation, which is analogous to the formation of natural FTAs when intercontinental transport costs b are infinite (as in Krugman's second example).

In the next simulation, we allow transport costs within the continent (a) to vary. Figure E shows how this variable affects the optimal preference level. Again, the qualitative conclusions do not change much when a is allowed to vary. The optimal level of preference only shifts from 27% to 34% in response to a sizable change in a, from 0 to 0.3. The change in the level at which blocs become super-natural is not substantial either.

Finally, in our last exercise we look at how the optimal degree of preference depends on

---

[2]A change in θ from 0.5 to 0.6, for example, changes the elasticity of substitution from 2 to 2.5. A change in the parameter θ from 0.8 to 0.9 changes the elasticity of substitution from 5 to 10.

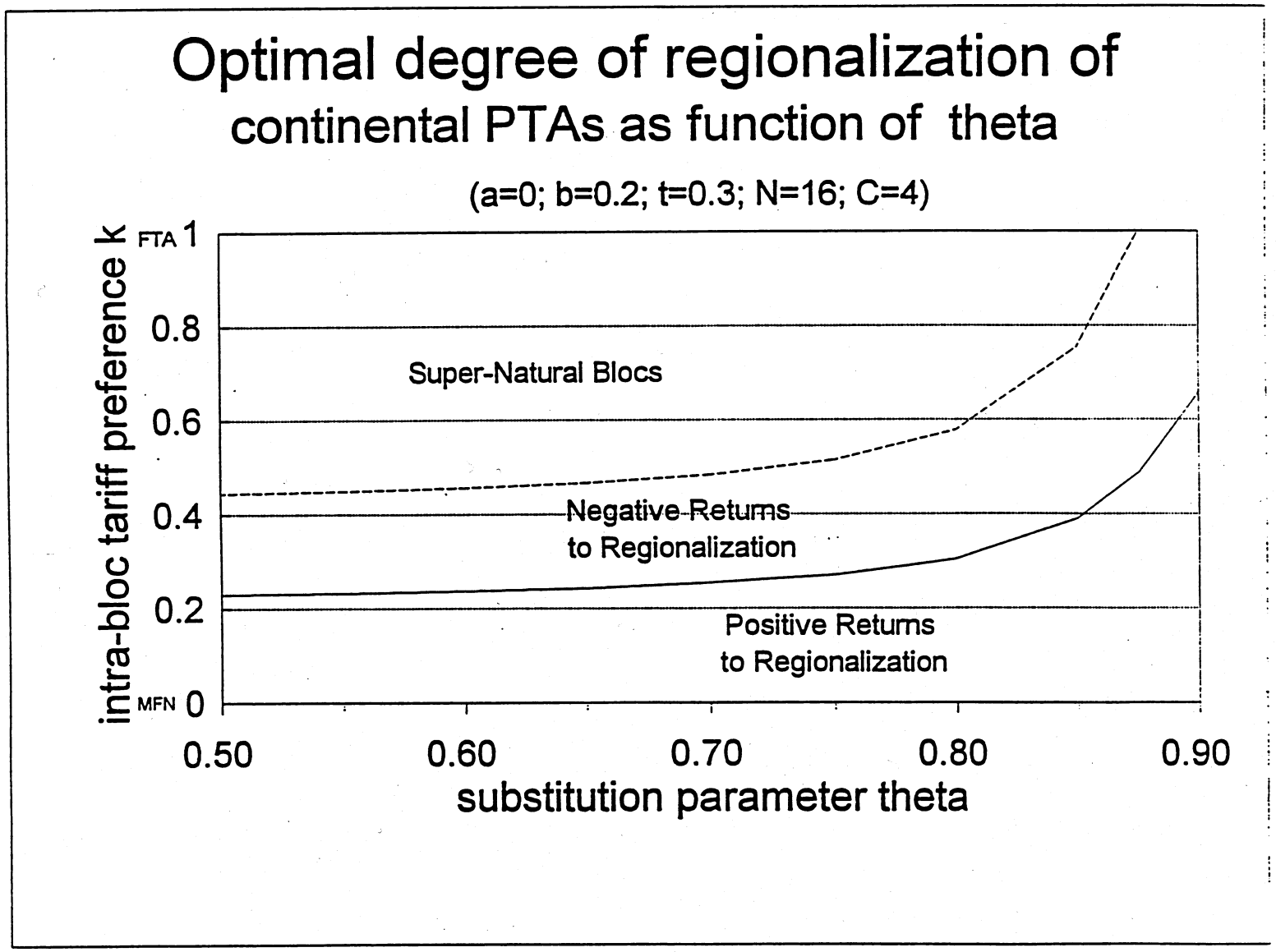
the assumptions made about the configuration of the world. Figure F shows that the optimal preference level decreases as the number of continents or the number of countries per continent increases. In addition, the likelihood that blocs will be super-natural increases with the size of the world.

Appendix: Sensitivity analysis

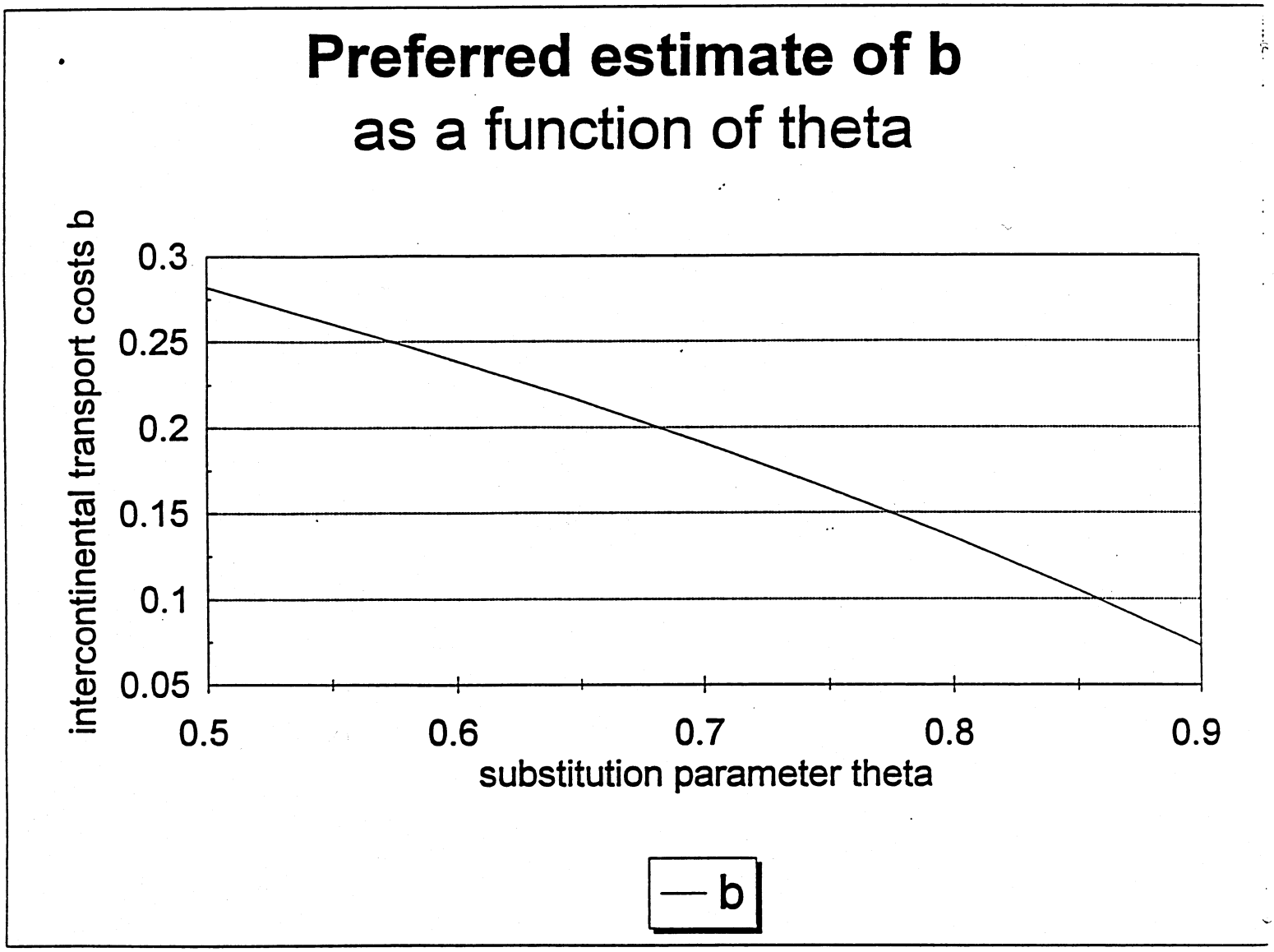
We have attempted in this paper to shed some light on the type of symmetrical trade arrangements that would result in a second best outcome, provided the achievement of multilateral free trade is not realistic. Throughout the simulations, we have worked with the following "benchmark" set of parameter values: a=0; θ= 0.75; t=0.3; in the case of intercontinental transportation costs b, in several simulations we allowed it to vary to see the effects of different values of b on welfare. When we had to choose a value, we adopted 0.2, which is not very far from our estimation based on the data on bilateral trade. For these parameter values, and a stylized world of 4 continents formed by 16 countries each, the second best entails the formation of continent-wide PTAs with levels of intra-bloc preference of the order of 27%. Furthermore, we have determined that the level of preferences beyond which welfare falls below the level associated with the MFN rule is 51.5%.

The purpose of this appendix is to study how sensitive these results are to changes in the parameters θ, t and a, and to changes in the configuration of the world. We have done two simulations regarding the effect of different values of θ on the optimal level of intra-bloc preferences, and on the level beyond which blocs enter the supernatural region. In the first of these simulations, θ is allowed to vary while a, b, and t remain at their benchmark level. The results can be seen in figure A: for any value of θ below 0.85, the qualitative results do not change much. The optimal degree of regionalization occurs for intra-bloc preference levels of the order of 20-40% (increasing as a function of the substitution parameter θ), and super-natural blocs remain a distinct possibility. It is only for values of $\theta >$ 0.85 that the optimal level of k starts to increase rapidly, and the possibility of super-natural blocs becomes highly unlikely. However, these high values of the parameter θ would be associated with elasticities of

Sensitivity Appendix: Table A



Sensitivity Appendix: Table B



substitution larger than 6.66 (remember that the elasticity of substitution is $1/(1-\theta)$), which seems too high.[1]

The reason why the optimal level of preference and the level at which we enter the super-natural region increase with θ is the following: as θ increases, the preference for variety falls, and a given difference in relative prices due to natural barriers (such as transport costs) or artificial barriers (such as tariffs) has a larger effect. Thus, increasing θ implies that geography becomes more important, and therefore natural trading blocs such as the ones considered here are more likely to improve welfare, even at higher levels of intra-bloc preference.

The difference between the second simulation and the first one is that now inter-continental transport costs b are made to depend on θ, as in our preferred estimate of b. Figure B shows how transport costs between continents will depend on the value of θ we assume. The logic for this dependence is intuitive: the distance estimates of the gravity equation (together with the average distances between two countries in the same continent and two countries in different continents) tells us how much more on average is a country likely to trade with members of its own continent, compared to trade with non-members. There are two reasons why trade with neighbors is higher: one is inter-continental transport costs, which introduce a price differential between varieties from neighbors and non-neighbors. The other reason is related to the elasticity of substitution. A given level of inter-continental transport costs will have a much larger effect on trade the higher the elasticity of substitution between varieties. Our gravity estimates tell us that, on average, two countries in the same continent will trade approximately twice as much as

---

[1]For this level of elasticity of substitution, if two varieties enter symmetrically into the utility function but the price of one of them is 15% higher than that of the other one, the lower-price variety will be consumed about three times as much as the higher price variety.

two countries in different continents, other things being equal. If the value of θ is very high, and so is the elasticity of substitution, a small value of intercontinental transport cost (with the corresponding small effect on relative prices of neighbor and non-neighbor varieties) will be enough to assure that on average, countries in the same continent trade twice as much among themselves than countries in different continents. On the other hand, for low values of θ, and correspondingly low values of the elasticity of substitution, the level intercontinental transport costs b necessary to bring about this pattern of trade will be much higher. This explains the negative relationship between b and θ shown in figure B.

In our second simulation, then, we allow θ to vary, and b is determined by the relationship given by figure B (a and t remain at their benchmark levels). The results of this simulation can be seen in figure C. In this case, our basic conclusions remain intact even at higher levels of elasticity of substitution. Throughout the range of θ allowed, the optimal level of preferences remain within the range of 23-37%. Super-natural blocs kick in at levels of preference between 43 and 70%.

Note that both curves in figure C are U-shaped. This is due to the combination of two factors that work in opposite directions. On the one hand, as we saw in figure A, the optimal preference level k and the level of k at which blocs become super-natural increase with θ. But, on the other hand, they decrease as b decreases, and we have seen that there is an inverse relationship between θ and b. For low values of θ, changes in this parameter do not affect the elasticity of substitution very much, and the effect of b dominates (thus, the curves in figure C are downward sloping for low values of θ). But for higher values of θ, changes in this parameter have a substantial effect on the elasticity of substitution, and the positive effect of θ becomes the

overriding factor.[2]

In our third simulation, we allow the level of external tariff t to vary. The outcome can be seen in figure D. The lower curve, which represents the optimal degree of intra-bloc tariff at each level of t, can be interpreted as the optimal path toward trade liberalization in a world where regional blocs are formed, but multilateral negotiations through GATT continue to lower the external level of tariffs t. The more successful the multilateral trade negotiations are in lowering t, the lower the optimal level of intra-bloc preference, so trade policy becomes less and less discriminatory. Obviously, when external tariffs become 0, it does not make sense any more to talk about levels of intra-bloc preference.

To understand the positive slope of the curves, imagine the extreme case in which tariffs are set at a prohibitively high level. In this case, countries would not trade outside their bloc regardless of the preference level k, and therefore the formation of FTAs does not involve any trade diversion. This means that 100% preferences would be optimal in this extreme situation, which is analogous to the formation of natural FTAs when intercontinental transport costs b are infinite (as in Krugman's second example).

In the next simulation, we allow transport costs within the continent (a) to vary. Figure E shows how this variable affects the optimal preference level. Again, the qualitative conclusions do not change much when a is allowed to vary. The optimal level of preference only shifts from 27% to 34% in response to a sizable change in a, from 0 to 0.3. The change in the level at which blocs become super-natural is not substantial either.

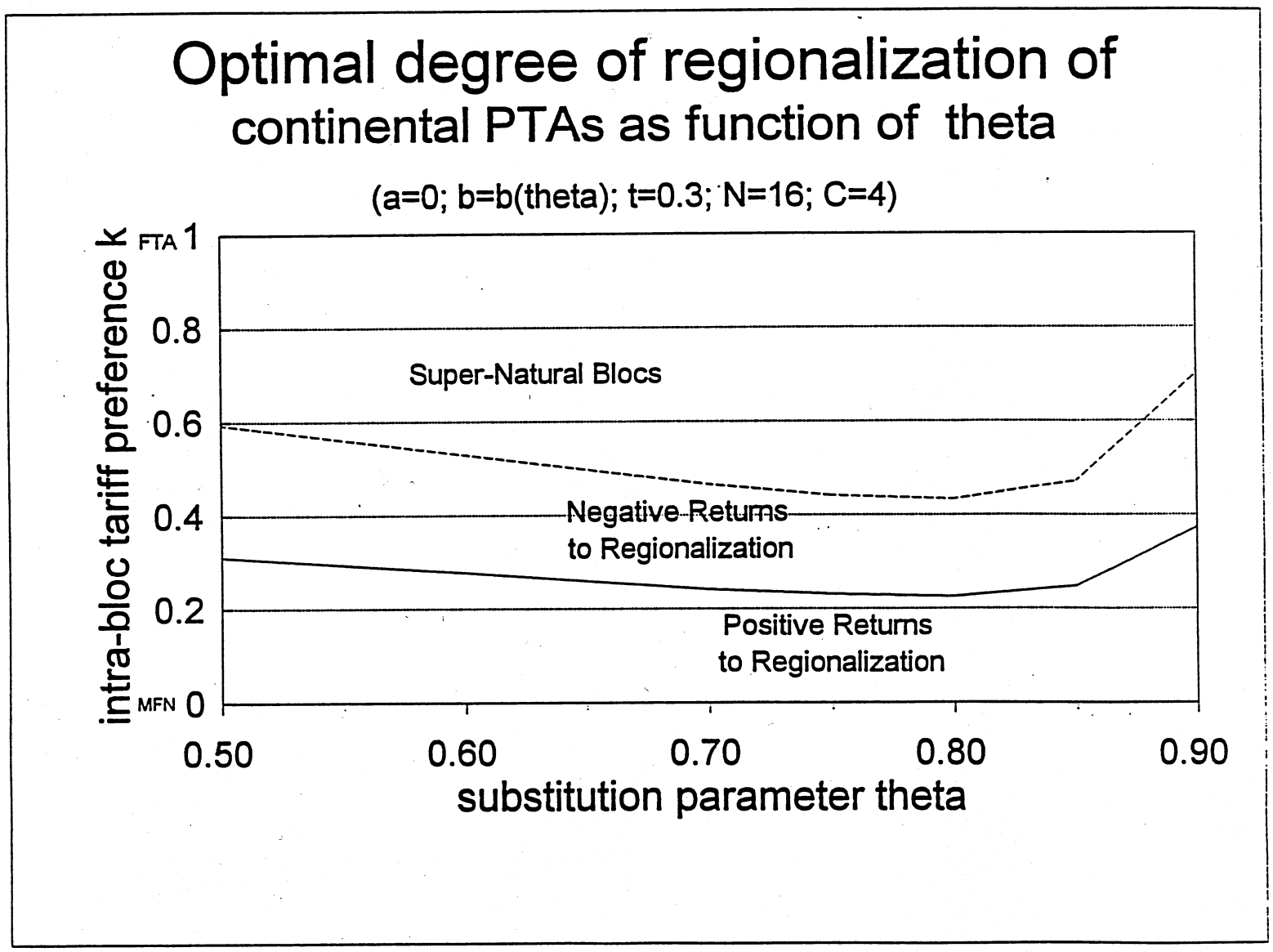
Finally, in our last exercise we look at how the optimal degree of preference depends on

---

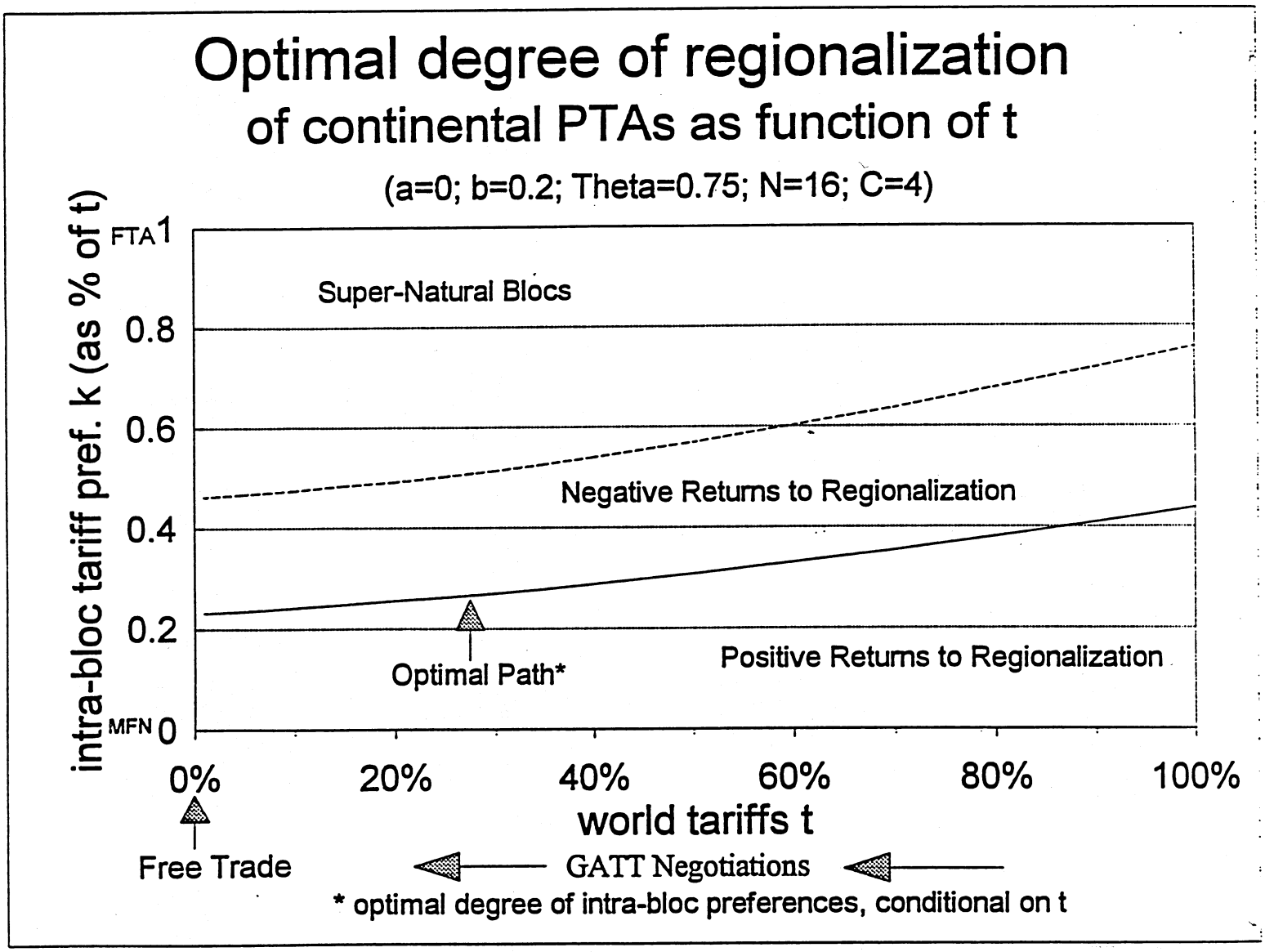
[2]A change in θ from 0.5 to 0.6, for example, changes the elasticity of substitution from 2 to 2.5. A change in the parameter θ from 0.8 to 0.9 changes the elasticity of substitution from 5 to 10.

the assumptions made about the configuration of the world. Figure F shows that the optimal preference level decreases as the number of continents or the number of countries per continent increases. In addition, the likelihood that blocs will be super-natural increases with the size of the world.

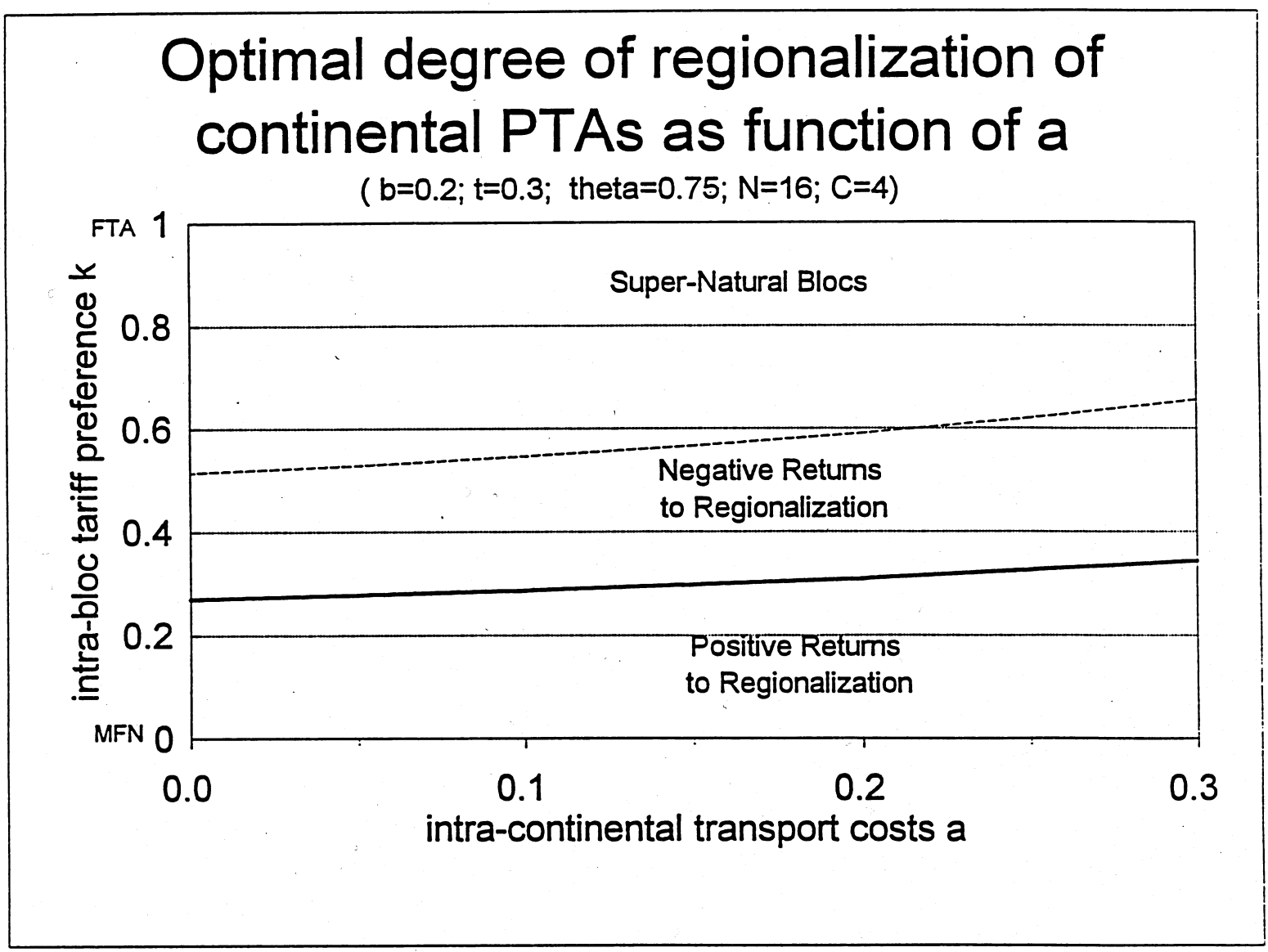
Sensitivity Appendix: Table C



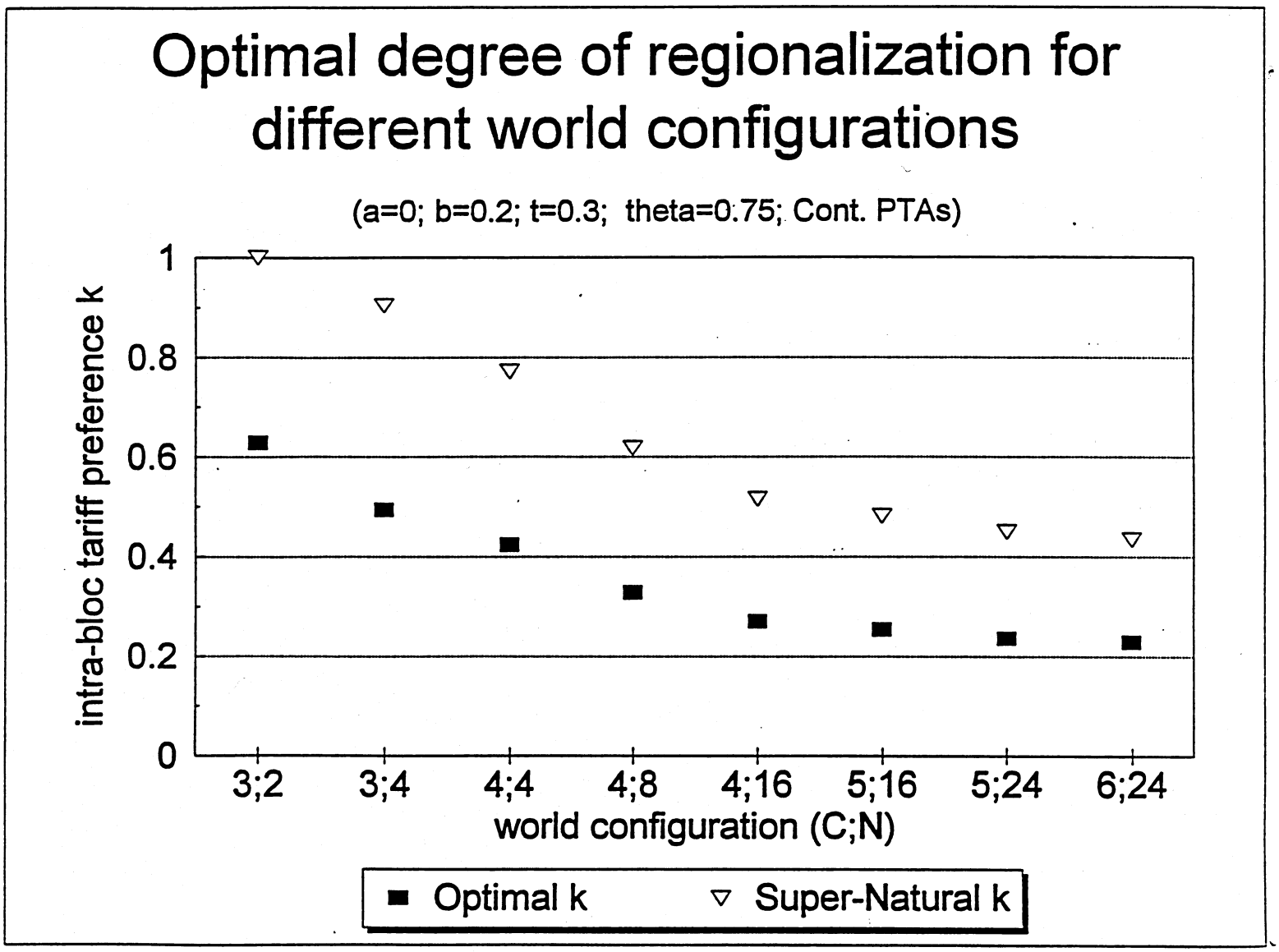
Sensitivity Appendix: Table D

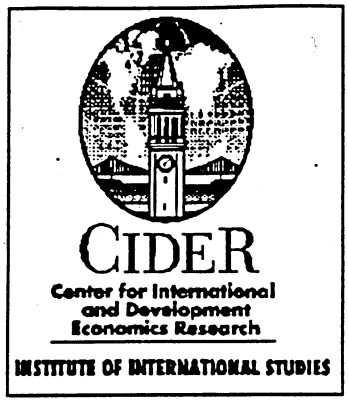


Sensitivity Appendix: Table E



Sensitivity Appendix: Table F





Center for International and Development Economics Research

The Center for International and Development Economics Research is funded by the Ford Foundation. It is a research unit of the Institute of International Studies which works closely with the Department of Economics and the Institute of Business and Economic Research (IBER). All requests for papers in this series should be directed to IBER, 156 Barrows Hall, University of California at Berkeley, Berkeley CA 94720, (510) 642-1922.

Recent Papers in the Economics Department/CIDER Working Paper Series:

C92-003 "Arbitration in International Trade." Alessandra Casella. December 1992.

C92-004 "The Political Economy of Fiscal Policy After EMU." Barry Eichengreen. December 1992.

C92-005 "Financial and Currency Integration in the European Monetary System: The Statistical Record." Jeff Frankel, Steve Phillips, and Menzie Chinn. December 1992.

C93-006 "Macroeconomic Adjustment under Bretton Woods and the Post-Bretton-Woods Float: An Impulse-Response Analysis." Tamim Bayoumi and Barry Eichengreen. January 1993.

C93-007 "Is Japan Creating a Yen Bloc in East Asia and the Pacific?" Jeffrey A. Frankel. January 1993.

C93-008 "Foreign Exchange Policy, Monetary Policy and Capital Market Liberalization in Korea." Jeffrey A. Frankel. January 1993.

C93-009 "Patterns in Exchange Rate Forecasts for 25 Currencies." Menzie Chinn and Jeffrey Frankel. January 1993.

C93-010 "A Marshall Plan for the East: Options for 1993." Barry Eichengreen. February 1993.

C93-011 "Model Trending Real Exchange Rates." Maurice Obstfeld. February 1993.

C93-012 "Trade as Engine of Political Change: A Parable." Alessandra Casella. February 1993.

C93-013 "Three Comments on Exchange Rate Stabilization and European Monetary Union." Jeffrey Frankel. March 1993.

C93-014 "Are Industrial-Country Consumption Risks Globally Diversified?" Maurice Obstfeld. March 1993.

C93-015 "Rational Fools and Cooperation in a Poor Hydraulic Economy." Pranab Bardhan. May 1993.

C93-016 "Risk-Taking, Global Diversification, and Growth." Maurice Obstfeld. July 1993.

C93-017 "Disparity in Wages but not in Returns to Capital between Rich and Poor Countries." Pranab Bardhan. July 1993.

C93-018 "Prerequisites for International Monetary Stability." Barry Eichengreen. July 1993.

C93-019 "Thinking about Migration: Notes on European Migration Pressures at the Dawn of the Next Millennium." Barry Eichengreen. July 1993.

C93-020 "The Political Economy of Fiscal Restrictions: Implications for Europe from the United States." Barry Eichengreen and Tamim Bayoumi. September 1993.

C93-021 "International Monetary Arrangements for the 21st Century." Barry Eichengreen. September 1993.

C93-022 "The Crisis in the EMS and the Transition to EMU: An Interim Assessment." Barry Eichengreen. September 1993.

C93-023 "Financial Links around the Pacific Rim: 1982-1992." Menzie David Chinn and Jeffrey A. Frankel. October 1993.

C93-024 "Sterilization of Money Inflows: Difficult (Calvo) or Easy (Reisen)?" Jeffrey A. Frankel. October 1993.

C93-025 "Is There a Currency Bloc in the Pacific?" Jeffrey A. Frankel and Shang-Jin Wei. October 1993.

C93-026 "Emerging Currency Blocs." Jeffrey A. Frankel and Shang-Jin Wei. October 1993.

C93-027 "The Implications of New Growth Theory for Trade and Development: An Overview." Pranab Bardhan. October 1993.

C93-028 "The Reconstruction of the International Economy, 1945-1960." Barry Eichengreen. November 1993.

C93-029 "International Economics and Domestic Politics: Notes on the 1920s." Barry Eichengreen and Beth Simmons. November 1993.

C93-030 "One Money or Many? On Analyzing the Prospects for Monetary Unification in Various Parts of the World." Tamim Bayoumi and Barry Eichengreen. November 1993.

C93-031 "Recent Changes in the Financial Systems of Asian and Pacific Countries." Jeffrey A. Frankel. December 1993.

C94-032 "Deja Vu All Over Again: Lessons from the Gold Standard for European Monetary Unification." Barry Eichengreen. January 1994.

C94-033 "The Internationalization of Equity Markets: Introduction." Jeffrey A. Frankel. April 1994.

C94-034 "Trading Blocs: The Natural, the Unnatural, and the Super-Natural." Jeffrey Frankel, Ernesto Stein and Shang-jin Wei. April 1994.

C94-035 "A Two-Country Analysis of International Targeting of Nominal GNP." Jeffrey A. Frankel and Norbert Funke. April 1994.

C94-036 "Monetary Regime Choices for a Semi-Open Country." Jeffrey A. Frankel. April 1994.