Stability and Welfare of an Enlarged Common Market:
A Cooperative Game Approach[*]

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The authors assume full responsibility for the accuracy of this paper as well as for the opinions expressed therein.

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Abstract

The issue of the enlargement of a common market or more generally of a preferential trading area (PTA), that is, the addition of new members to an existing common market, which is high on the political agenda as recent events in Europe indicate, raises the following question: Under what conditions is an enlargement beneficial to its members, and therefore desirable? We argue in this paper that this is possible, when the benefits derived from such a policy, are elements of the core, that is, an outcome from which no deviations are profitable. We investigate the economic conditions of the existence of a core, in an enlarged common market, using the flexible approach of the theory of cooperative games, and find that a sufficient condition for this to happen occurs when the average gains from trade, derived from the enlargement of a common market (or PTA) exhibit non-decreasing returns relative to the size of the market.

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1. Introduction

The issue of the enlargement of a common market, or more generally of a preferential trading area (PTA), that is the addition of new members to an existing common market, which is high on the political agenda as recent events in Europe indicate, raises the following question: Under what conditions is an enlargement beneficial to its members, and therefore desirable? We argue in this paper that this is possible, when the benefits derived from such a policy, are elements of the core that is an outcome from which no deviations are profitable. We investigate the economic conditions of the existence of a core, in an enlarged common market, using the flexible approach of the theory of n-person cooperative games, and find that a sufficient condition for this to happen occurs when the average gains from trade, derived from the enlargement of a common market (or PTA) exhibit non-decreasing returns relative to the size of the market. The reason for selecting the core as a solution concept for the enlargement is that the core is a generalization of the Edgeworth's contract curve, and this brings our analysis closer to the traditional theory of welfare economics[1].

The paper is organized as follows: In the next section, we offer a short survey of the relevant literature. In section three, we set out our model. In section four, we discuss the sufficient economic conditions for the existence of the core for the symmetric case, the only case discussed in this paper. And in the final section we offer some conclusions.

2. A Short Survey of the Literature

The question raised above is not posed for the first time. In a well known paper, Kemp and Wan (1976) show that under certain conditions, a customs union may be beneficial to its members and therefore desirable. The Kemp and Wan theorem is interesting because it implies that an incentive to form and enlarge a customs union persists, until the world adopts free trade, provided that the common external tariff is chosen so as to exclude trade diversion. The main objection against the Kemp and Wan theorem has to do with their assumptions on the common external tariff, which imply that this tariff is not necessarily optimal. If it is optimal then, as Krugman (1991a) has shown, the world will be fragmented into a number of trading blocks of the same size (that is, coalitions of countries with internal free trade, and a common external optimal tariff) and will not end up as an enlarged customs union including all countries of the world, as Kemp and Wan suggest.

Krugman works with a model of imperfect competition in which countries specialize in the production of a differentiated product, and assumes that transportation costs are negligible. The fragmentation of the world into trading blocks raises the question of whether the merging of coalitions (and by implication the enlargement of the markets) increases welfare. Krugman shows that the relationship between the number of coalitions and welfare is U-shaped, reaching a minimum at the number of three. This means that if consolidation reduces the number of coalitions to three or more, the world welfare will decline. But if this consolidation reduces the number of coalitions to two or one (in this last case the world adopts free trade) welfare increases, reaching its maximum when the world as a whole forms a single coalition. However, as Krugman himself has emphasized, his conclusions relating to the relationship between economic welfare and the number of coalitions are not robust, because they are based on very restrictive assumptions.

The enlargement of a market increases the domain for free trade, but in the presence of increasing returns, this may lead to losses, and thus may be a factor that undermines an agreement for the enlargement (Krishna 1998; Levy 1994). Many years ago Graham (1923) argued that with increasing returns, an industry facing import competition may be forced to contract, leading to higher average costs, and this may be a reason for protection. Ethier (1982) has confirmed this result. He found that under certain conditions, a small country may experience losses from free trade due to the contraction of its increasing-cost industry. Markusen (1981) finds that the monopolistic firm in the large country might be forced to contract, due to trade. One may conclude, therefore, that a sufficient condition for gains from trade, under conditions of imperfect competition, is that the increasing-returns industry does not contract with the enlargement of the market. Sufficient conditions to have all countries gain from trade, under conditions of monopolistic competition, are given by Helpman and Krugman (1985).

In this paper, we adopt a different, and more general, approach to the problem. Using a model of monopolistic competition, proposed by Krugman (1979), we argue that free trade (resulting from the enlargement of a market) is beneficial to all countries if the gains of trade resulting from the enlargement are feasible for all countries acting collectively, and no group of countries can improve upon on these gains. In other words, we argue that the enlargement is beneficial to all participants if the gains from trade are in the core.

3. Enlargement as a Cooperative Game

In this section we consider the enlargement of a common market as an n-person cooperative game[2]. This game consists of N players (counties), and a function u, that associates with every subcoalition of countries S of N, a real number u(S) indicating the gains from trade. Utilities are assumed to be transferable. The outcome of this game is in the core if no deviations from it are profitable.

3.1. *The Players* Our economic universe consists of N countries (not necessarily all the countries of the world) that are similar in their economic structure (that is, similar in tastes, factor endowments, and technology), each of which produces a range of differentiated products. These countries play a cooperative game, and it is assumed that utilities are transferable. There are no restrictions as to the number of the coalitions that these countries can form. Each coalition may consist either of a single country representing an isolated economy, or groups of countries representing PTAs. Alternatively, we may think of every coalition (with at least two countries as members) as representing a fully integrated economy, as in Dixit and Norman (1980) where the member countries are engaged in intra-industry trade. Within this context, the enlargement of a PTA corresponds to the formation of a grand coalition that includes all the countries that participate in this game.

(i) Number of varieties produced under conditions of autarky (that is, by coalitions consisting of a single country). It will be assumed that in each country, labour is the only factor of production, and that each firm, located in a particular country, produces a particular variety i (i = 1,2,3,…Z). Since every firm specializes in the production of a particular variety of a product, we use the same symbol i to denote the firm.   For the production of the output y_i, of the variety i, the firm uses the following production function:

$$L_i = a + b \, y_I$$

where L_i denotes the labour supply used by the firm i, for the production of the variety i; a is a factor denoting fixed labour supply, and b is the marginal labour input (Krugman 1979).

In order to determine the total number of varieties Z produced by a single country (under autarky), we assume (as in Krugman 1979), that labour is fully employed, and therefore:

$$L = \Sigma \, (a + b \, y) = Z(a + b \, Lc)$$

where Lc =y, that is, the consumption of each variety c, multiplied by the labour force L, equals output y of an economy under isolation.

From the right hand side of the above expression, we obtain the number of varieties produced in a country under autarky, which is equal to:

$$Z = 1 / [(a/L) + bc] \qquad (1)$$

(ii)Number of varieties produced by integrated economies (that is, by coalitions consisting of more than one country). Forming a two-country coalition (that is, having two identical countries trading), is like doubling the population L. From the expression (1) above, it follows that an increase in L will increase, ceteris paribus, Z. In other words, the sum of varieties from both countries under free trade exceeds the number of varieties produced by any single country under autarky. Obviously, this holds true for any number of countries. This conclusion is summarized in the following proposition:

Proposition 1: The number of varieties produced increases with the size of the coalition.

With this proposition is associated the view that the increase in the product varieties, following economic integration, is a source of gains of trade for consumers (Feenstra 2004). This view derives from the love-for-variety approach (Spence 1976; Dixit and Stiglitz 1977) according to which the welfare of a consumer is maximized with the number of varieties consumed. Therefore, Proposition 1 can be modified as follows:

Proposition 2: The gains from trade increase with the size of the coalition.

These two propositions are summarized by the characteristic function of the enlarged game, which is treated in the next subsection.

3.2. *Characteristic Function* The characteristic function is a function v which assigns a real number v(S) to every coalition indicating the gains of trade associated with it. The number v(S) is called the worth of the coalition.

A characteristic function satisfies the superadditivity property. This property is written as:

$$v(S) + v(T) \leq v(S \cup T)$$

where S and T are two disjoint coalitions, that is, two PTAs having different members, and by implication different product varieties. It says that since the enlargement of a PTA results from the merging of two separate PTAs, the gains from trade resulting from this enlargement must be at least equal to the sum of the gains from trade of the two PTAs acting independently. Otherwise, the enlargement is not profitable. The superadditivity property is satisfied in the Krugman's model. From expression (1) follows that the sum of varieties from both countries under free trade exceeds the number of any single country before trade (Feenstra 2004).

We introduce the following postulates

Postulate 1 : A one-country coalition has v(S) = 0. This is so because these coalitions represent isolated economies with no trade with the rest of the world (and therefore no gains from trade are present).

Postulate 2: Coalitions of the same size have the same worth (symmetry postulate). This may be justified by the assumption that all countries are similar in their economic structure. The symmetry postulate implies that the worth of every coalition is independent of the varieties traded. Thus the coalitions (12) and (23) have the same worth, despite the fact that their member countries produce different varieties.

3.3. *Equilibrium.* The question, however, is whether the superadditivity property (which summarizes Propositions 1 and 2) is sufficient to guarantee that the increase in the gains from trade is welfare-improving for every one. The increase in the gains from trade will be welfare-improving for everyone (and therefore the enlargement is desirable) if the vector u that gives the gains from trade derived from the enlarged common market, is feasible for the entire group of countries, and can be blocked by no coalition. In other words, vector u must be in the core. More formally, the vector u is in the core if the following two conditions are satisfied:

(i) $\Sigma u_i \geq v(S)$ $S \subset N$ (condition for individual rationality)

(ii) $\Sigma u_i = v(N)$ (condition for Pareto optimality)

Suppose that the condition for individual rationality failed to hold for some $S \subset N$. This means that these coalitions of countries will be better off by staying off the enlarged

market. The condition for Pareto optimality says that the sum from the gains from trade of the countries participating in the enlarged market game must be equal to the gains from trade achievable within the enlarged market as a whole. Therefore, u is Pareto optimal in the sense that it is impossible for any member of the enlarged market to be better off without at the same time another member country being worse off. Thus, if the process of the enlargement leads to gains from trade that are elements of the core, then these gains are Pareto optimal (and therefore desirable), and at the same time *stable* because no deviation from them is profitable.

From the superadditivity property we cannot infer that the increase in the size of a coalition, and the associated increase in the gains of trade are welfare-improving for every one, in the sense that the conditions (i) and (ii) above are satisfied. The following example illustrates:

Example 1. Consider the following characteristic function:

$v(1)=v(2)=v(3)=0$

$v(12)=v(13)=v(23)=2.5$

$v(123)=3$.

The average benefits accruing to the members of the grand coalition (enlarged common market) (123), are $v(123) / 3 = 1$, and therefore less than the benefits going to the two-country coalitions, which are $v(12) = v(13) = v(23) = 2,5 / 2 = 1,2$. It follows that the core is empty, implying that the welfare is not improving for everyone. The conclusion therefore is that the superadditivity property is not sufficient to guarantee the existence of a core.

4. Economic Conditions for the Existence of Equilibrium

From the above discussion one may conjecture that an enlarged game has a non-empty core if the gains from trade accruing to the subcoalitions of N are not too large. This conjecture turns out to be correct, and can be formalized by introducing the concept of the *balanced* game (Bondareva 1963; Shapley 1967).

A game is balanced if:

$$\sum_{S \in M} \lambda_S v(S) \leq v(N)$$

where M is the set of all coalitions and λ_S is a balanced collection of weights. A collection λ_S is a balanced collection of weights if for every country i the sum of all λ_S over all coalitions that contain i is unity. The weights λ_S may be interpreted (Osborn and Rubinstein 1994; Moulin 1995) as the fraction of the resources (for example, labour) that every country devotes to the coalition S in which it participates, and $\lambda_S v(S)$ as the average gains from trade obtained by the members of this coalition. Therefore, the definition of a balanced game says that a country pays to join a grand coalition (to participate in an enlarged market), as there is no way to achieve the same gains from trade by allocating its resources into a balanced set of coalitions.

A theorem by Bondareva (1963) and Shapley (1967) shows, that every balanced game has a core.

An example of a balanced game follows:

Example 2. The game described by the characteristic function:

$v(1) = v(2) = v(3) = 0$

$v(12) = v(13) = v(23) = 1$

$v(123) = 3$

has a core, because $v(123) = 3$ is sufficiently large, so that it cannot be blocked by any subcoalition.

From the definition of a balanced game, and the assumption of symmetry, one may derive the following proposition, which modifies Proposition 2.

Proposition 3: The enlargement game is balanced, and therefore has a core, if the average gains of trade associated with every coalition are not decreasing with the size of the coalition.

If a core exists, then all countries participating in the enlarged common market are better off, and therefore no country has the intention to leave it. The enlarged market is stable. And since the condition of the individual rationality is satisfied (by the definition of the core), there are no losers to be compensated by the gainers. The gains from trade are actual not potential. But if the average gains from trade decrease with the enlargement, then a core does not exist, implying that some countries may gain by not participating in the enlarged market. The creation of an enlarged common market, in this last case, may be a source of conflicts over the distribution of a declining income, leading not only to economic, but also to political instability.

5. Conclusions

Our analysis suggests that an enlargement will be beneficial to all participants if the gains from trade offered by the subcoalitions of the grand coalitions are not too large. This requirement, formalized by the concept of the balanced game, is appealing to our intuition. If a subcoalition of countries can provide higher utility levels to all its members than the enlarged market does, then it is not profitable for it to participate in the enlarged market. If it is forced to participate, then the average benefits of the member countries will decline with the enlargement and this may give rise to conflicts over the distribution of a declining income.

Of course, in a less symmetric situation, Proposition 3 may not be valid. However, the general rule concerning the size of the gains from trade going to the middle-sized coalitions seems to persist. In general, in any situation (symmetric or non-symmetric) the cooperative game, corresponding to an economic situation, must be balanced for a *solution* a core to exist.

Acknowledgments

Notes

[1] The paper discusses the welfare aspects of the enlargement of a common market under conditions of monopolistic competition. Other aspects of the enlargement process have been discussed by others (e.g. Buch 1999; Burda 1998; Waltz 1998; Prausello 2003).

[2] This is a modified version of a formal model presented in Demopoulos and Yannacopoulos (1999, 2001).

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