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UNSTABLE MONETARY UNIONS

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Abstract

The requirement that a country with a current account surplus should have an expanding money supply, while a country with a current account deficit a contracting money supply (the "rules of the game") is an important element for the stability of a currency area. We argue in this paper, that decentralized behavior of member countries does not guarantee that the "rules of the game" are respected, and this may lead the currency area to equilibria, however, with systemic distortions. These inefficient outcomes may be removed if the member countries agree to coordinate their policies so that the "rules of the game" are respected. The conditions under which such an agreement is possible depends on the structure of the effective preferences of the member countries, and are discussed in the context of the theory of cooperative games.

Keywords: Currency areas, dynamics of economic integration, stability equilibrium conditions.

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1.Introduction

Modern theory of OCA provides a framework for the workings of an optimum currency area[1]. The theory asks under what conditions a country would prefer macroeconomic independence that comes along with an independent currency (and perhaps with flexible exchange rates) or it prefers the benefits of a fixed exchange rate system and perhaps of a common currency. A country enjoys the benefits of a common currency if it is satisfies a number of criteria (factor mobility, price flexibility, etc) that reduce the cost of sacrificing its exchange rate as a policy instrument. What the OCA theory *essentially states,* is that when a region is subjected to an asymmetric shock, the *adjustment process* requires either the factors of production to move or the real exchange rate to adjust or a combination to the two. Otherwise, regional concentrations of unemployment will be inevitable (De Grauwe and Vanhaverbeke, 1993). Thus, if factor mobility fails to restore equilibrium following an asymmetric shock, real exchange rates have to adjust. And since in a monetary union nominal exchange rates are fixed, this means that nominal prices have to change.

But beyond stating that changes in nominal prices are needed to restore equilibrium, the modern OCA theory *does not explain* (i) how this adjustment mechanism works, (ii) *what* are the effects of price changes in both the money and goods markets and, more importantly, (iii) what are the necessary conditions for its effectiveness (Demopoulos and Yannacopoulos, 2004). *The effectiveness of such an adjustment mechanism* is important *for the stability* of a monetary union, since if it proves to be ineffective, the negative effects caused by an asymmetric shock will remain (or as De Grauwe and Vanhaverbeke put it, "regional concentrations of unemployment will be inevitable"); and these disequilibria may undermine the stability of the currency area. Thus, the criteria proposed by the received OCA theory for a successful monetary union may not constitute a safe policy guide, if its existing adjustment mechanism fails to restore equilibrium following an asymmetric shock. Effectiveness of the adjustment mechanism implies that the members of the monetary union adhere to the "rules of the game" that require that the member country with a surplus in its current account should have an expanding money supply, while the country with a deficit in its current account should have a contracting money supply.

The aim of this paper is to show that if a currency area works as a *decentralized* economic system, the "rules of the game" are not necessarily respected and this may lead to equilibria with *systemic distortions*. These inefficient outcomes can be removed if the members of the currency area *agree* to coordinate their policies. The question is under what conditions such an agreement is possible. This question is to be studied within the framework of the theory of cooperative games.

This paper is organized as follows: In the next section, we define the equilibrium of a currency area and we review the classical mechanism of adjustment in the case of an asymmetric shock. In section 3, we discuss the nature of equilibrium in a currency area under

the assumption of a *decentralized* mode of behaviour, modeled in the context of a non-cooperative game framework, and conclude that equilibria with systemic distortions are not impossible. These inefficient outcomes can be removed if the members of the currency area reach an agreement to respect the "rules of the game" and this agreement is fully binding and enforceable. In section 4, we investigate the necessary and sufficient conditions for such an agreement to exist within the framework of the theory of cooperative games. In the final section we conclude.

2. Equilibrium in a monetary union and the "rules of the game"

A monetary union is defined as a group of countries with a common currency but without fiscal integration. It is assumed that the countries adopt a *decentralized* mode of economic behaviour. This means that each member country chooses its policy actions autonomously (given the restrictions that are imposed by the definition of a currency area) and its preferences are defined over the possible outcomes of these policy actions. A monetary union is in equilibrium when the common currency is allocated among its members in such a way so as the nominal expenditure in every member is equal to its nominal income. An asymmetric shock results in a misallocation of the common currency within the currency block, with some countries developing an excess supply of goods and an excess demand for money (they run a current account surplus), while others an excess demand for goods and an excess supply of money (they run a current account deficit). It is assumed that the quantity theory of money holds, the economy is fully employed and prices are quickly adjusted to clear the commodity markets. The last assumption implies that we can consider the relative prices as constant, so that the good markets are aggregated in one composite commodity. In an one commodity world, spatial arbitrage assures that prices will be the same in all members of the monetary union. If we assume that the monetary union consists of two members and, in addition, that the nominal income of both countries is equal to their nominal expenditure, we will have (Dornbusch, 1980):

$$p(y_1+y_2) = v_1m_1+v_2\, m_2 \qquad (1)$$

where py is the nominal level of income (p is the price level and y the full employment output level), v is a constant (expenditure velocity), and m the nominal money holdings. Obviously $m_1+m_2 = M$ which is the total amount of the common currency. The index indicates the country. Then, the currency area is in equilibrium when:

$$m_1\, v_1 = p\, y_1 = m_2v_2 = py_2 \qquad (2)$$

which means that the nominal expenditure in every member country is equal to its nominal income.

An asymmetric real shock (due for example to the change of the tastes from the goods of country 2 toward the goods of country 1) leads to a surplus in the current account of country 1 and a corresponding deficit in the current account of country 2. Given the condition (1), the situation resulting from the asymmetric shock can be written as:

$$py_1 - v_1 m_1 = v_2 m_2 - py_2 \qquad (3)$$

which says that the rate of hoarding of country 1 ($py_1 - v_1 m_1$) must equal the rate of dishoarding of country 2 ($v_2 m_2 - py_2$) . And since the rate of hoarding is defined as the excess of nominal income over nominal spending, we may consider hoarding as equal to the surplus of our trade balance or as the rate at which a country accumulates assets. Dishoarding, which is defined as the excess of nominal spending over nominal income, may be considered as equal to a deficit in the current account or as the rate at which a country losses assets.

According to the conventional OCA theory, changes in *relative prices* may act as an asymmetric shock absorber, or in the case in which the relative prices are constant as in the present case, the role of the asymmetric shock absorber is undertaken by changes in the rate of absorption. The country with a current account deficit must experience an outflow of money, while the reverse is true for a country with a current account surplus. The outflow of money from the deficit country will reduce dishoardind (and by implication the deficit in its current account) and the inflow of money in the surplus country will reduce the rate of hoarding (and by implication the surplus in its current account). The outflow of money from the deficit country into the surplus country will continue until the rates of hoarding and dishoarding are reduced to zero, i.e., until the condition (2) is reached. In the adjustment process the union price level will rise or fall as the surplus country-whose spending rises- has a higher or lower velocity than does the deficit country. The redistribution of money thus acts like a transfer, i.e., it restores trade and monetary equilibrium that they were disturbed by an asymmetric shock. Thus, equilibrium is stable, *provided* that the "rules of the game" are respected.

However, whenever some member countries believe that there is an advantage of having a favourable current account, they adopt policies that violate the "rules of the game". These policies include domestic *austerity programs and wage restraints* on the part of the surplus countries that guarantee a weak domestic demand and effectively eliminate any chance of narrowing their trade surplus with the rest of the currency area. Thus, the movement to equilibrium will slow down or even stop, and the currency area remains at the situation described by condition (3). These policies are consistent with the dogma of *mercantilism* and while they may be rational at the individual country level, they will eventually lead to *systemic distortions* (Blanchard and Ferretti, 2009) if they are adopted by a significant number of member countries of the union.

3. The nature of equilibrium in decentralized economic systems

The conclusion that may be drawn from the previous discussion is that if a currency area functions as a *decentralized* economic system, the equilibrium outcome is not necessarily Pareto efficient. The same conclusion can be obtained more formally if we model the decentralized behaviour of the members of a currency area as a non-cooperative game, i.e., a game in which commitments, as it is the commitment to abide by the "rules of the game", are not enforceable. In this game, every member-country has at its disposal a set of strategies (tools of economic policy). From this set of strategies we exclude those that are inconsistent with the definition of the monetary union. Thus, a member country cannot conduct a monetary policy at the national level. For each country member of a monetary union there is a preference relation over the possible consequences of its policy actions. Let Σ_i be the action space of country I and define by $\Sigma=\Sigma_1$ x... x Σ_n. The preference relation of the country i can be presented by the utility function u_i: $\Sigma \rightarrow R$ in the sense that $u_i(a) \geq u_i(b)$, whenever policy a is preferred to policy b. The key equilibrium concept of a strategic game (and the monetary union that is modeled after it) is the Nash equilibrium, which is defined as the profile of strategies (policies), such that no country can improve upon its welfare by switching unilaterally to another set of policies. Unilateral switch means that the other countries do not change their policies.

It is obvious that the condition (2) above, is not an equilibrium outcome in the Nash sense, because a country may improve upon its own welfare by switching to a different set of policies that eliminate any chance of narrowing its surplus within the currency area. The equilibrium that results from the decentralized behaviour of the member countries may be consistent with systemic distortions, i.e., with some countries experiencing current account surpluses matched by the deficits of the rest of the world. This equilibrium may be defined as in Nash, i.e., as the strategic profile σ* for which:

$$\sigma^* \in B_i(\sigma_{-i}^*) \qquad \forall i \in N \qquad (4)$$

where B_i is the best reply correspondence for the country i, and N={1,2,…n} denotes the set of members of the currency area. For any given strategy σ_{-i} , associated with a specific rate of hoarding (dishoarding) by a country different from i, $B_i(\sigma_{-i})$ is the best reply in terms of dishoarding (hoarding) by country i. The Nash equilibrium may be interpreted as a fixed point of the best reply correspondence, and in some sense it can be regarded as a *steady state* (Osborne and Rubinstein, 1994) of the currency area in which every member country holds the correct expectations about the policies adopted by the other country and acts rationally.

However, this steady state, which is reflected in the *symbiosis* of the surplus countries with the deficit ones, cannot last for a long time for the following obvious reasons: (i) Since the deficit countries have to finance their deficits (by borrowing), they may face, sooner or later,

the threat of a debt crisis. (ii) If the surplus countries insist on maintaining their surpluses, the deficit countries have to bear the burden of adjustment and its negative effects on employment and welfare. Adjustment is painful for the deficit countries because they cannot depreciate. (iii) If the deficits in the current accounts tend to increase, this may lead to massive outflows of capital and bank runs. Eventually, some of the members of the currency area may be forced to leave it, but not without a cost (UBS, 2011).

4. Removing systemic distortions

4.1. The need for cooperation. We have argued in the previous section that *decentralized* behaviour does no guarantee that the "rules of the game" will be respected and this may lead to Nash equilibria with systemic distortions. These inefficient outcomes can be removed if the members of the currency area reach an agreement to respect the "rules of the game" and this agreement is fully binding and enforceable. *The question is then under what conditions such an agreement is possible*. These conditions are investigated below in the context of the theory of cooperative games in characteristic function form. We argue that a stable agreement on the optimal functioning of the currency area (which requires that the member countries abide by the "rules of the game") depends on the structure of the effective preferences of the member countries over the benefits derived from the common currency, as they are described by the *characteristic function* of the game. Thus, the problem is to determine the class of characteristic functions (the structure of effective preferences) that support a stable agreement, i.e., an agreement from which no country can profitably deviate. In order to solve this problem we proceed as follows:

(1) We model the currency area as a cooperative game.

(2) We discuss two possible solutions for such a game, i.e., the *stable set* and the *core,* and we reach the conclusion that a stable agreement will exist if the *core is a stable set;* and

(3) we define the characteristic function that satisfies this property.

To the investigation of these issues we now turn.

4.2. The currency area as a cooperative game. Within the context of the theory of cooperative games, a currency area is defined,

(1) by the set of N={1,2, …. N} of countries (its members), and

(2) the characteristic function of this game, that summarizes the effective preferences of the member countries (Demopoulos and Yannacopoulos, 1999, 2001).

The number of the coalitions the n countries may form is given by the cardinality of the power set P(N), which is 2^n (including the empty coalition). The coalition N that includes all

member countries is called the *grand coalitio*n, and in the present context consists of all countries that are members of the currency area. The second element of this definition is the *characteristic function* of the game. The characteristic function is a real valued function, defined on the power set P(N), that assigns a real number v(S) to every coalition of countries S. This real number is called the *worth* of the coalition and gives the amount to be distributed among its members. A distribution of this total worth is a vector with as many coordinates as the members of the coalition, each coordinate corresponding to the value assigned to the particular member. Evidently the sum of the coordinates of this vector will equal v(S), the total worth of the coalition. Such vectors will be called outcomes of the game (or imputations). In a sense, the characteristic function of the game summarizes the (effective) preferences of the countries on the outcomes of the game, i.e., the vectors of utilities that represent a realizable way for the N countries to distribute the gains of the currency area v(N). These utilities are assumed to be freely transferable. An outcome w is *effectively preferred* to another outcome z (or w *dominates* z) if there is a coalition S that has the *power* to achieve w by its own efforts and the members of this coalition prefer w to z. This coalition is called an *effective* coalition. Thus, a system of effective preferences reflects the distribution of economic power in a currency area. And since a characteristic function summarizes the effective preferences of the members of the currency area on the outcomes of the game, the same characteristic function describes *the distribution of economic power* among its members.

4.3. Equilibrium of a currency area. Given the structure of effective preferences an equilibrium must define an outcome (or a set of outcomes) that is stable in some sense. In general the stability requirement is that this outcome is immune to deviations by groups of countries. Two are the solution candidates for the problem at hand: (1) the *stable set* and (2) *core*.

4.3.1. Stable sets. A *stable set* (von Neumann and Morgenstern, 1944) is a set of outcomes that satisfy the following two properties:

(i)All outcomes belonging to a stable set V are undominated (property *of internal stability*).

(ii) All outcomes not in the stable set V are dominated by at least one outcome in V (property of *external stability*).

A stable set may contain more than one elements and therefore, does not indicate a particular outcome for a game, but delineates a range of values over which the players (countries) may bargain. Therefore, the members of the currency area have to select an outcome from those that are elements of a stable set. A stable set corresponds to a *standard of behaviour* (social norms that prevail in an economy, or operating rules of an economy), and various outcomes within a *standard of behaviour* are reasonable according to this standard. The problem with

this solution concept is that a system of effective preferences may give rise to several stable sets, and the theory does not predict the particular stable set to which the economic system will finally converge. The multiplicity of stable sets may be an indication of instability in a currency area, as moving from one stable set to another involves changes in the operating rules of the economy. Thus, *if a stable set is to be used as a solution concept to the problem at hand, the structure of effective preferences has to give rise to a unique stable set.*

4.3.2. Core. Another concept of solution, which is very popular in Economics, is the *core*. The core is the set of all *undominated* outcomes. Thus, the core is a subset of the stable set. Furthermore, while a system of effective preferences may support more than one stable sets, there is only a single core (if it exists). The core is Pareto efficient in the sense that it cannot be improved by any subcoalition of countries. And since every country gets at least its own value from the outcomes in the core, no country has the incentive to defect. A necessary and sufficient condition for a game to have a core is that this *game is balanced*. The characteristic function of this game exhibits increasing returns relative the size of the coalitions (or a strong superadditivity), which implies that the worth (the economic power) of the intermediate coalitions is relatively small relative to the power of the grand coalition, i.e., the currency area as a whole. An interpretation of a balanced game is the following. Suppose that each country splits its economic resources (say labour) into several parts, each of which it devotes to a different coalition. If the countries in a coalition S each devote a proportion λ of their resources to S, then the worth of this coalition will be $\lambda v(S)$. Then, a core exists (a stable agreement is possible) if and only if the worth of the grand coalition N is at least as great as the sum of the worths $\lambda v(S)$ (Bondareva, 1963; Shapley, 1967). Thus, one may argue, if the effective preferences as they are summarized by the characteristic function of the game give rise to a core, the conditions for a stable agreement among the members of the currency area are guaranteed.

However, in some cases the core *fails to dominate outcomes not in the core*, and this may give rise to more than one stable sets (bargaining lines). For example, the effective preferences of the member countries, described by the characteristic function,

$$v(\{0\})=v(\{1\})=v(\{2\})=v(\{3\})=0,\ v(\{1,2\})=v(\{1,3\})=v(\{2,3\})=2,\ v(\{1,2,3\})=3$$

support a single point core $\sigma= (1,1,1)$. This core fails to dominate other outcomes in the outcome space , and thus is not in itself a stable set (Shapley and Shubik, 1967). The stable sets in this case are the arbitrary curves $\sigma\alpha$, $\sigma\beta$ and $\sigma\gamma$ traversing the three triangular regions as shown in Figure 1.

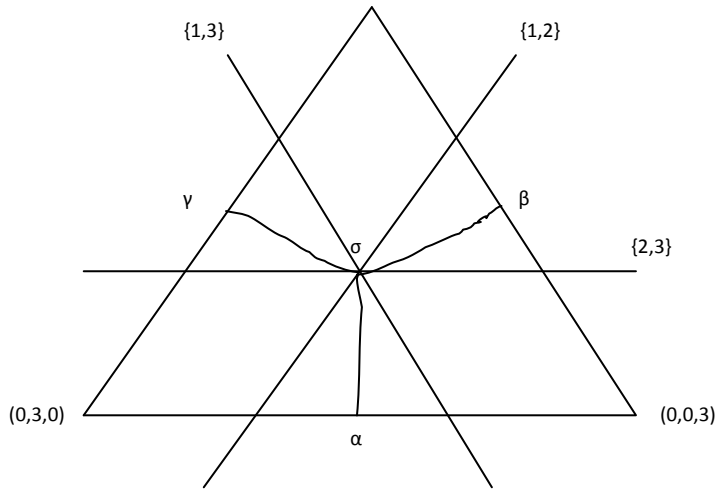

Figure 1

The equilateral triangle shown in Figure 1 is the von Neumann and Morgenstern "fundamental triangle" (defines the outcome space), and the straight lines labeled {1,3}, {1,2} and {2,3} represent the effective preferences of the coalitions {1,3},{1,2} and {2,3}respectively. Thus, despite the existence of a core, the problem of the multiplicity of "solutions" (and by implication of the economic instability) remains.

It follows from the above discussion that if the set of effective preferences of the member countries is to support a stable agreement (i.e., an agreement from which no deviation is profitable), then *the characteristic function has to give rise to a core which is a stable set*. This is desirable because the core in addition to its internal stability property (the outcomes in the core are undominated), possesses also an external stability property: for every outcome outside the core, there is at least one outcome in the core that dominates it. A characteristic function that satisfies this property is a *super-modular* characteristic function (Shapley, 1971), which is discussed below.

4.4. Super-modular characteristic functions and stable agreements. A super-modular characteristic function has the property:

$$v(S \cup \{i\}) - v(S) \leq v(T \cup \{i\}) - v(T)$$

for all i=1, …, n and all subsets S and T of N-{i}

This condition says that the marginal contribution of the i country to a coalition S increases with the size of the coalition. Coalitions are formed successively until the grand coalition (comprising all the countries of the currency area) is established. Games with a *super-modular* characteristic function (convex games) are totally balanced and therefore have a core. Furthermore, they have a unique stable set which coincides with the core, and therefore the requirement for the stability of an agreement set in the previous section is satisfied. Thus, if the effective preference of the members of the currency area are described by a super-

modular characteristic function, a core (which is a stable set) exists and therefore the outcome resulting from negotiations is Pareto efficient and stable. At the same time the currency area that results from this agreement is an optimum currency area in the sense that it satisfies the Melitz[2] (1995) criterion because it improves the welfare of all its members (Demopoulos and Yannacopoulos, 1999, 2001).

One may therefore conclude that the necessary and sufficient condition for a stable agreement to exist, is that that the characteristic function of the game (that summarizes the effective preferences of the member countries) is super-modular. The effective preferences of the member countries (and by implication the distribution of economic power between them measured by the worth of the coalition) of the intermediate coalition of countries is small relative to the economic power of the grand coalition v(N), i.e., the currency area as a whole. Since the economic power of the intermediate coalitions of countries (and by implication their bargaining power) is small relative to the power of the grand coalition (the currency area as a whole) they are unable to block an agreement reached by the totality of the members.

4.5. Unstable outcomes. If the characteristic function of the game is not *super-modular* (i.e., if its characteristic function does not exhibit increasing returns relative to the size of the coalitions), a stable and efficient agreement does not exist, as the following numerical example shows:

v({0})=0 , v({1})=v({2})=v({3})=0 ,v({1,2})=v({1,3})=v({2,3}) = 1 ,v({1,2,3})=1.

In this example, the two country coalitions have the same worth (the same economic power) with the three country coalition (the currency area as a whole). Thus, every individual country effectively prefers the outcomes obtained via a two country coalition than the outcomes that may generate by three country coalition, which implies that an agreement by the three countries can be blocked by a two country coalition. Therefore, no core exists. The resulting situation is unstable. Potential coalitions are rapidly formed to agree on a certain issue and dissolved once a coalition capable of objecting becomes aware of its own power. The instability of this situation is described by the *multiplicity* of stable sets that exist in this case. In fact, the above characteristic function possesses a unique symmetric stable set V= {(1/2, 1/2,0),(1/2,0,1/2),(0,1/2,1/2)} and many non-symmetric (discriminatory) stable sets. The symmetric stable set consists of three outcomes, each of which corresponds to a two country coalition which then divides the available payoff equally. Each of the non-symmetric stable sets specifies that some fixed two country coalition forms, assigns the remaining player a fixed amount (this amount is less than the half of the total payoff) and then the two person coalition divides the remaining amount between its members. The theory does not predict the stable set to which the economy will converge. The final outcome is indeterminate. A change in the stable set (a movement from one stable set to another) involves a change in the

operating rules of the economy (a change in the "standard of behaviour") implying an unstable economic organization.

5. Concluding remarks

The conclusion to be drawn from this theoretical discussion is that in decentralized systems the "rules of the game" are not necessarily respected and this may lead to inefficient outcomes (equilibria with systemic distortions), that may destabilize the economic system. These inefficient outcomes may be removed if the countries involved agree to coordinate their economic policies and to reach agreements that cannot be challenged by no one. The possibility to reach a stable agreement depends on the structure of the effective preferences of the countries involved. We found that a stable agreement can be reached only in the case in which the core is a stable set, and this can happen only if the effective preferences of the member countries are described by a super-modular characteristic function.

This theoretical conclusion is supported by historical experience. That the "rules of the game" in fixed exchange rates regimes and in monetary unions were rarely respected, was emphasized by Keynes when he remarked that the "process of adjustment is compulsory for the debtor and voluntary for the creditor" (Keynes, 1980, p.28). Thus, during the 1928-32 crisis the then surplus countries (USA and France) refused to abide by the rules of the gold standard, and adopted a restrictive monetary policy despite the inflow of gold, that eventually destroyed the system. Today, the surplus countries of the Eurozone refuse to abide by the rules of the game of a monetary union that, require the reduction of their surpluses. They adopt austerity programs that guarantee a very weak domestic demand and effectively remove any chance of narrowing their trade surpluses with the rest of the currency area. This policy of running large current account surpluses, that have to be matched by the deficit of the others, leads to systemic distortions that undermine the stability of the currency area. These inefficient outcomes can be removed if the members of the currency area (both debtors and creditors) agree to coordinate their policies, i.e., agree to "clear" their accounts. However, given the distribution of economic power among the members of the Eurozone, the chances of reaching a stable agreement on this issue are almost non-existent.

Notes

1.The modern theory of optimal currency area is usually credited to Mundell (1961), Kennen (1969) and McKinnon (1963), although the criteria for an optimal currency area (free trade in final goods and factors of production) were emphasized by Lerner back in 1944 (Lerner, 1949, p.375). On the OCA theory and developments, see also Dellas and Tavlas (2009).

2. Melitz (1995, p. 496) states, if “we take the membership (and therefore the size) of a currency union as given, the only question we can really ask is whether the currency area would be welfare improving for everyone”.

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