Economic Modelling 26 (2009) 1398–1402

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

International organizations and arrangements: Pivotal countries and manipulations

Dragan Miljkovic *

NDSU Dept. 7610, Richard H. Barry Hall, 811 2nd Avenue N., P.O Box 6050, Fargo, ND 58108-6050, USA

ARTICLE INFO

Article history:
Accepted 17 July 2009

JEL classification:
D72
O19
F00

Keywords:
International arrangements
Pivotal countries
Dominant strategy
Pareto optimality

ABSTRACT

A problem of making an investment in a large developing or transition economy by an international organization is considered in this paper. We design a dominant strategy (the truth-telling) mechanism in a decision making problem where both Pareto optimality and optimization of an international organization's welfare are achieved. We determine that if there are pivotal countries within an international organization, necessary assumptions made for such a mechanism to work cannot be all satisfied. The mere presence of pivotal countries within an international organization is an empirical question, but casual empiricism suggests their existence.

1. Introduction

International economic arrangements or organizations in the areas of trade, finance, or development are perceived to be based on interests of all countries involved. In other words a country will become a member of a regional or global arrangement if it perceives its membership as welfare enhancing. Each individual issue debated within any of these arrangements, however, may not always be resolved in a way that is either welfare enhancing or simply satisfactory to each and every member country. Examples which illustrate this point include, for instance, the side agreements on environmental and labor standards within the North American Free Trade Agreement (NAFTA) which are favored by the United States much more than by Mexico, or a long-standing agricultural policy debate within the European Union countries which has not been resolved in a manner to satisfy all players involved.

This paper addresses the problem of mechanism design, *i.e.*, the problem of how individual countries within an international arrangement make their decisions when facing a set of criteria to which they previously agreed upon. Methodologically this paper relies on some public choice models, *i.e.*, more specifically it is one of Clarke–Groves mechanisms (*e.g.*, Clarke, 1971; Groves, 1973; Green and Laffont, 1979; Moulin, 1986). A comprehensive review of this type of mechanism design is provided in Mas-Colell et al. (1995). We do not look for an "optimal mechanism," according to the interests of some country which presumably is designing the mechanism with its own interest in mind. Rather, we will look at a mechanism design where the objective is to satisfy a set of criteria. We design a dominant strategy mechanism which achieves a Pareto optimal outcome and at the same time optimizes the organization's welfare in a hypothetical international arrangement. More specifically, our mechanism is an extension of the Clarke pivotal mechanism enriched with the addition of the augmented revelation mechanism introduced by Mookherjee and Reichelstein (1990). The application of the mechanism to the problem of eliciting preferences among countries within an international organization for funding a project in a country which is not member of the group is completely novel. The realism of the assumptions necessary for such a mechanism to function is discussed as well as the implications of their violations.

2. Mechanism design

Consider the following situation. Several developed countries are members of some international arrangement which we will call GROUP. The number of countries is I, and we index them by $i = 1, 2, \ldots, I$. The countries in GROUP consider making a joint major investment (*e.g.*, infrastructure investment such as major railroad, road network, irrigation system, power plants) in a very large developing or transition economy, which is not a member of GROUP. This large country represents potentially a large market for most countries which are members of the GROUP. Making this investment may also be a good public relations move on the part of the GROUP in order to enhance its image around the world. The project will cost C to undertake and, if the GROUP decides to make the investment, the funds will have to come from the member countries' budgets. Each member country attaches some value to having the investment made, but none is sure what value the other member countries attach to it.

* Tel.: +1 701 231 9519; fax: +1 701 231 7400.
E-mail address: Dragan.Miljkovic@ndsu.edu.

0264-9993/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.econmod.2009.07.010

Thus, the GROUP member countries must decide whether or not to make the investment.

We assume that if the investment is made, each GROUP country will pay its pro rata share of the costs of undertaking the project which we denote C/I. In addition to this GROUP countries are willing to consider transfers among themselves. They can take forms of either tax or subsidy. We denote them by $t^i>0$ and $t^i<0$ for a tax paid by country i and subsidy paid to country i respectively.

Country i's social welfare depends on (a) whether the investment is made, and (b) any monetary transfer t^i that is made to or from it. Therefore we suppose that each country i attaches some monetary value M^i to the project. Furthermore, we allow that some countries do not have to like having this investment made, *i.e.*, $M^i<0$ is possible. We also permit transfers if the project is not undertaken. Finally, to make it more convenient to work with the country's valuation of the project we allow it to be net of its contribution, *i.e.*, $v^i=M^i-C/I$. Thus we have the social welfare function for country i defined as $W^i=V(v^i, t^i)$. W^i is strictly increasing in v^i and strictly decreasing in t^i.

The difficult issue between the GROUP countries is a potential dichotomy of the GROUP interests and individual member country interests. One obvious choice of decision rule would be the majority rule with no transfers. However, this may lead to the situation where some countries (minority) may like making the investment very much while the others (majority) may dislike or be indifferent to the idea of getting involved in the project. Then even if the overall GROUP's welfare would increase the investment is not going to be made. As a corollary some countries may not want the project to begin, and yet if they are "outvoted" they will be assessed the fee C/I. Thus a mechanism that will satisfy the following set of conditions is proposed.

(i) The investment will be made only if it is socially efficient at the aggregate GROUP level, *i.e.*, iff $\sum_i v^i\geq 0$.
(ii) The optimal actions of each member country in the mechanism are the function of the country's independent valuation v^i. They (the optimal actions) should dominate any other actions the countries might take, no matter what other member countries do.
(iii) The mechanism should not be so detrimental to the welfare of the country that it would prefer that the decision to make the investment or not is taken by decree. In other words, the social welfare of country i, if the mechanism is played optimally by the country, should never be less than min $\{|v^i|, 0\}$.
(iv) The net taxes collected (not including the C/I) must be nonnegative, *i.e.*,$\sum_i t^i\geq 0$, because no investor outside the GROUP is willing to put up the money to allow the mechanism to function.

While the third and fourth conditions seem to be sufficiently intuitive the first two conditions may require some explaining. The first condition can be defended simply by establishing that we are trying to achieve an organization (the GROUP) optimum which implies maximizing the sum of individual countries welfare. The second condition can be interpreted that the GROUP countries want a mechanism in which each country has a dominant strategy to play as a function of its valuation v^i. Having said this we refer to the revelation principle for dominant strategy mechanisms which states that the outcome of any dominant strategy mechanism can be achieved in a direct revelation mechanism for which truth-telling and participation is a dominant strategy (Mookherjee and Reichelstein, 1990; 1992).

Following the direct revelation principle, each country is asked to reveal its own valuation. We denote the revealed valuation of country i by bold $\boldsymbol{v^i}$ in order to make a distinction from the true valuation v^i. We also let $\boldsymbol{v^{-i}}=(\boldsymbol{v^1},\ldots, \boldsymbol{v^{i-1}}, \boldsymbol{v^{i+1}},\ldots, \boldsymbol{v^I})$. Thus a decision is made whether to undertake the project or not as a function of the vector of revealed valuations $\boldsymbol{v}=(\boldsymbol{v^1},\ldots, \boldsymbol{v^I})$. This decision function is denoted as $D(\boldsymbol{v})$. Given the condition (i), $D(\boldsymbol{v})$ is a binary function, *i.e.,* if $D(\boldsymbol{v})=1$ the investment will be made and if $D(\boldsymbol{v})=0$ the investment will not be made. We also allow $t^i(\boldsymbol{v})$ for the tax imposed on country i. The equivalent representation of $t^i(\boldsymbol{v})$ is $t^i(\boldsymbol{v^i}, \boldsymbol{v^{-i}})$. Combining now the notion that truth-telling is a dominant strategy and condition (i) yields the function D which must be

$$D(\boldsymbol{v}) = 1 \text{ if } \sum_i \boldsymbol{v^i}\geq 0 \tag{1}$$

or

$$D(\boldsymbol{v}) = 0 \text{ if } \sum_i \boldsymbol{v^i}< 0. \tag{2}$$

Given all the above, we have the following results.

Lemma 1. *The taxes paid by country i must be either*

$$t^i\left(\boldsymbol{v^i}, \boldsymbol{v^{-i}}\right) = \underline{t}^i\left(\boldsymbol{v^{-i}}\right) \text{ if } \sum_i \boldsymbol{v^i}\geq 0 \text{ for all } \boldsymbol{v^i} \tag{3}$$

or

$$t^i\left(\boldsymbol{v^i}, \boldsymbol{v^{-i}}\right) = \underline{\underline{t}}^i\left(\boldsymbol{v^{-i}}\right) \text{ if } \sum_i \boldsymbol{v^i}< 0 \text{ for all } \boldsymbol{v^i}. \tag{4}$$

Lemma 1 claims that what country i will pay in taxes cannot depend on what it reveals as its valuation, except if this revelation changes the decision whether or not to make the investment. Note that $\underline{t}^i$ denotes taxes (transfers) when the investment is to be made, while $\underline{\underline{t}}^i$ denotes taxes (transfers) when the investment is not to be made.

Proof. Let v^i and $\boldsymbol{v^{-i}}$ be such that $v^i+\sum_i \boldsymbol{v^{-i}}\geq 0$. Let z^i be an alternative valuation for i such that $z^i+\sum_i \boldsymbol{v^{-i}}\geq 0$. Also let $t^i(v^i, \boldsymbol{v^{-i}})> t^i(z^i, \boldsymbol{v^{-i}})$. What these three statements mean is that if the other countries are announcing $\boldsymbol{v^{-i}}$, then whether i announces v^i or z^i, the investment will be made. However, when the other countries are announcing $\boldsymbol{v^{-i}}$, announcing v^i would result in higher taxes for country i than if it is to announce z^i. Under these circumstances the mechanism obviously does not have truth-telling as the dominant strategy and country i would prefer to misrepresent its valuation as z^i even if its true valuation is v^i. Thus for $\boldsymbol{v}$ such that $\sum_i \boldsymbol{v^i}\geq 0$, $t^i(\boldsymbol{v})$ depends only on $\boldsymbol{v^{-i}}$. A similar argument (when signs are changed in first two inequalities, *i.e.*, $v^i+\sum_i \boldsymbol{v^{-i}}<0$ and $z^i+\sum_i \boldsymbol{v^{-i}}<0$) can be used to prove the second part of this lemma. □

Lemma 2.

$$\underline{t}^i\left(\boldsymbol{v^{-i}}\right) - \underline{\underline{t}}^i\left(\boldsymbol{v^{-i}}\right) = -\sum_i \boldsymbol{v^{-i}} \tag{5}$$

Lemma 2 claims that if the investment is made, country i will pay a lesser tax than if the investment is not made, the difference being the sum of revealed valuations of all GROUP countries excluding country i.

Proof. First, fix $\boldsymbol{v^{-i}}$ and then consider the case where $v^i=-\sum_i \boldsymbol{v^{-i}}$. If country i reveals its true v^i valuation when the other countries reveal $\boldsymbol{v^{-i}}$, then country i must prefer revealing v^i to revealing $v^i-\varepsilon$ for all $\varepsilon>0$. However, revealing v^i here means the investment will be made while revealing $v^i-\varepsilon$ means the investment will not be made. Thus by revealing v^i country i would net $v^i-t^i(\boldsymbol{v^{-i}})$ while by revealing $v^i-\varepsilon$ country i would net $-\underline{t}^i(\boldsymbol{v^{-i}})$. Since the former must be at least as large as the latter in order to support the truth-telling, then

$$\boldsymbol{v^i} = -\sum_i \boldsymbol{v^{-i}}\geq \underline{t}^i\left(\boldsymbol{v^{-i}}\right) - \underline{\underline{t}}^i\left(\boldsymbol{v^{-i}}\right). \tag{6}$$

Let us now consider the case where $v^i=-\sum_i \boldsymbol{v^{-i}}-\varepsilon$ for all $\varepsilon>0$. Revealing the true valuation v^i causes the investment not to be made. Country i's social welfare would therefore be $-\underline{\underline{t}}^i(\boldsymbol{v^{-i}})$. However, if country i falsely reveals $v^i+\varepsilon$, that would cause the investment to be made and country i's social welfare would be $v^i-\underline{t}^{ii}(\boldsymbol{v^{-i}})$. Again, in