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General equilibrium analysis on arms exports to developing countries in conflict

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Abstract

In this paper a conflict game between the two developing countries is constructed. It is assumed that weapons are imported at the fixed world price, p_M, and the consequence of the decline of p_M is examined, which happened when the former Soviet Union collapsed. In Section 2, specifying the utility and production functions in general equilibrium (GE) model by Cobb-Douglass type, we actually derive the reaction functions of GE conflict game. In Section 3, we examine the effect of the decline of p_M on the "existence" of solution to the game, its "stability", and finally on the utility levels of two countries in the "stability" case. By simulation we show that as p_M falls, the number of "non-existence" cases increases, the percentage of "instability" cases among "existence" cases rises, and finally as p_M falls, the percentage of "rising utility levels of two countries" cases among "stability" cases falls. In Section 4, assuming that the above countries have domestic military industries, we derive the reaction functions in this conflict game.

Keywords: Conflict game; General equilibrium; Existence; Stability; Simulation

1. Introduction

After the crumble of Berlin Wall in 1989 the Eastern Bloc began to disintegrate itself, resulting in the disappearance of USSR in 1991. On the one hand, the victory of Western Bloc forced the other bloc to reconstruct its economy through introduction of Market Mechanism. On the other hand, the defeat of the Eastern Bloc unleashed racial conflicts: e.g. the one in Yugoslavia. In 1992, Economists Allied For Arms Reduction (ECAAR) held a conference at Hague, to discuss the international security. In this

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conference, [3] attempted statistical examination of armament burden of developing countries, stressing Japanese light military burden as one of the main reasons for her post-war economic growth (see also [4]). Galbraith, an other leading participant at the conference, urged mainstream economists to incorporate military factors into the traditional civilian economic models, especially, the "arms trade to the poor countries of the planet: a trade that denies people the first essentials of survival and supports the most egredious of human slaughter" ([2], p. 9). According to him, "in the eight years from 1981 to 1989, the less developed countries (LDCs) acquired from various sources 37,000 surface-to-air missiles, 20,000 artillery pieces, 11,000 tanks and self-propelled howitzers, 3200 supersonic planes and 540 warships and submarines at a cost of $354.6 billion" (p. 11).

The aim of this paper is to respond to the urging by Galbraith, by modifying [1].

2. Two-LDC model with arms trade

In this section, we formulate a two-country model in which two confronting countries intentionally exert external diseconomy upon each other: i.e., they are at war with each other. On this subject, one of the pioneers is Lewis F. Richardson, a Quaker physicist, who studied the causes and origins of war through mathematical modelling. His pioneering contributions were collected in [7], which essentially consists of simple differential equations. Let D_1 and D_2 be national defense levels of two countries. It is assumed that D_1 and D_2 obey the following differential equations:

$$\frac{\mathrm{d}D_1}{\mathrm{d}t} = \kappa_1 D_2 - \phi_1 D_1 + \nu_1, \tag{2.1}$$

$$\frac{\mathrm{d}D_2}{\mathrm{d}t} = \kappa_2 D_1 - \phi_2 D_2 + \nu_2, \tag{2.2}$$

where κ_1 and κ_2 are positive defense coefficients, while ϕ_1 and ϕ_2 represent the fatigue and expense of keeping up defenses. It is shown that if

$$\phi_1\phi_2 > \kappa_1\kappa_2$$

holds, the system of differential equations is stable, while otherwise it is unstable. It was examined later, whether simple formulation as in (2.1) and (2.2) could explain an actual arms race, with the conclusion that at the starting point of an arms race beginning in 1908, the system had direction for war: unstable.

The spirit of his research was subsequently succeeded and was expanded with the help of game theory: e.g. see [6]. Our purpose in this section is to examine how coefficients such as κ_i and ϕ_i in (2.1) and (2.2) are determined in a two-country model with each bloc maximizing utility, and how they change by the shift in parameters of the model.

In the model, constructed below, the aim of (aggregate) household of the first country with initial endowment of labor, $\bar{l}_1$, is the utility maximization:

$$\max U_1(x_1, z_1) = x_1^{\alpha_1} {z_1}^{1-\alpha_1} \quad 0 \leqq \alpha_1 \leqq 1$$

$$\text{s.t. } z_1 = m_1^{\gamma_1} v_1^{1-\gamma_1}, \quad 0 \leqq \gamma_1 \leqq 1, \quad p_1 x_1 + p_M m_1 = W_1(\bar{l}_{1-v_1}) + \pi_1$$

where x_i is the ith country's consumption of civilian goods with p_i commodity price, and z_i is the ith country's armed force (defense level), consisting of manpower, v_i, and weapons, m_i, imported from the