Implementation of balanced linear cost share equilibrium solution in Nash and strong Nash equilibria

Guoqiang Tian[*]

Department of Economics, Texas A&M University, College Station, TX 77843, USA

Abstract

This paper considers the incentive aspect of the Balanced Linear Cost Share Equilibrium (BLCSE), which yields an endogenous theory of profit distribution for public goods economies with convex production technologies. We do so by presenting an incentive compatible mechanism which doubly implements the BLCSE solution in Nash and strong Nash equilibria so that Nash allocations and strong Nash allocations coincide with BLCSE allocations. The mechanism presented here allows not only preferences and initial endowments, but also coalition patterns to be privately observed. In addition, it works not only for three or more agents, but also for two-agent economies. © 2000 Elsevier Science S.A. All rights reserved.

Keywords: Mechanism design; Incentives; Double implementation; Balanced linear cost share equilibrium; Public goods economies

JEL classification: C72; D61; D78

1. Introduction

This paper considers the problem of doubly implementing Balanced Linear Cost Share Equilibrium (BLCSE) allocations, which is a solution concept introduced by Mas-Colell and Silvestre (1989), in Nash and strong Nash equilibria by a feasible and continuous mechanism when coalition patterns, preferences, and endowments

*Tel.: +1-409-845-7393; fax: +1-409-847-8757.

E-mail address: gtian@tamu.edu (G. Tian)

are unknown to the designer. The notions of various cost share equilibria have been introduced in the literature, including the Ratio equilibrium notion of Kaneko (1977), the Generalized Ratio equilibrium notions of Diamantaras and Wilkie (1994), and Tian and Li (1994a, 1994b), as well as the more general solution notions of Linear Cost Share Equilibrium (LCSE) and BLCSE of Mas-Colell and Silvestre (1989). All of these cost-share solutions have desired properties that the conventional Lindahl equilibrium principle does not share: (1) They yield Pareto efficient allocations even in the presence of some types of increasing returns production technologies; (2) they do not need to take profit shares as exogenously given, and (3) the core equivalence holds for cost share equilibria under regularity conditions (see Kaneko, 1977 and Weber and Wiesmeth, 1991). The various cost share equilibrium notions are not radically different from the Lindahl equilibrium solution. They actually coincide with the Lindahl equilibrium notion for the case of convex economies with constant returns to scale.

Like the Lindahl mechanism, these various cost share equilibrium solutions are not incentive-compatible either. Tian and Li (1994a) and Tian (1994) presented incentive-compatible mechanisms which implement the (Generalized) Ratio Equilibrium allocations and LCSE allocations by using Nash equilibrium as a solution concept to describe individuals' self-interested behavior. Nash equilibrium is a strictly noncooperative notion and is only concerned with single individual deviations from which no one can be improved by unilateral deviation from a prescribed strategy profile. No cooperation among agents is allowed. As a result, although a Nash equilibrium may be easy to reach, it may not be stable in the sense that there may exist a group of agents which can be improved by forming a coalition. Thus it is natural to adopt strong Nash equilibrium to allow all possible cooperation (coalitions) among agents. Although strong Nash equilibrium may result in a more stable equilibrium outcome, it requires more information about the communication network and other agents' characteristics in order to eliminate those outcomes that can be upset by coalitionary action. To have a solution concept combining the properties of Nash and strong Nash equilibria, it is desirable to construct a mechanism which doubly implements a social choice rule by Nash and strong Nash equilibria so that its equilibrium outcomes are not only easy to reach, but also hard to leave. Also, by double implementation, it can cover the situation where agents in some coalitions will cooperate and in some other coalitions will not, and thus the designer does not need to know which coalitions are permissible. Consequently, it allows the possibility for agents to manipulate coalition patterns. Recently, Corchon and Wilkie (1996) provided an incentive-compatible mechanism which doubly implements Ratio equilibrium allocations in Nash and strong Nash equilibria, and Tian (1997) provided a feasible and continuous mechanism which doubly implements LCSE allocations in Nash and strong Nash equilibria.

However, the notion of Ratio Equilibrium allows each firm to produce only a single public good, and it therefore cannot be applied to economies where a firm