Implementation of social optimum in oligopoly

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Abstract

This paper presents a decentralized mechanism implementing socially optimal output choices by non-cooperatively acting oligopolists. A decentralized mechanism is a vector of balanced transfers among firms determined as a function of firms' output choices. The mechanism is devised by a regulator with a full knowledge of demand and without any knowledge of the firms' cost functions. Restricting the set of admissible demand and cost functions such that the firms always have an incentive to produce, it turns out that the socially optimal solution is implementable insofar as the demand function is a polynomial of at most \((n - 1)\)th degree, \(n\) being the number of firms in the industry.

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1. Introduction

Can a mechanism be devised so as to ensure optimal output choices by oligopolistic firms? The answer is clearly positive when both the demand and cost functions, as well as levels of output chosen by the firms, are known to a central authority implementing the outcome. If, however, cost information is unknown, an assumption which will be maintained throughout this paper, then methods of the implementation literature (see Groves and Ledyard, 1987, for a recent survey of the relevant literature) must be called for to solve the problem. This literature deals...
with the construction of game forms – consisting of abstract individual messages and an outcome function – such that all equilibria of these game forms attain social optimum.

A possible deficiency associated with direct application of this approach in the present context is that firms determine their own levels of output only in an indirect way. Furthermore, by changing their messages, firms can affect each other’s output. Viewing this as a non-desirable property of a mechanism, we are interested in the possibilities of ‘decentralized’ implementation in which each firm chooses a level of output on its own. More precisely, we are concerned with constructing a vector of balanced transfers among the oligopolists such that firms making their output decisions non-cooperatively attain optimality at the Nash equilibria. Formally, then, we restrict the set of admissible implementation mechanisms by confining both the space of messages and the outcome function. One can interpret this restriction by saying that each firm’s admissible message should belong to an interval of non-negative numbers, and this message constitutes, in fact, the firm’s level of output. Each firm’s transfer in this interpretation is determined as a function of all firms’ messages. In other words, firms are allowed to sign contracts which determine transfers, but not quantities produced. Economic justification for our approach is that letting each firm determine its own output level by limiting the ability of other firms to interfere with its decisions seems natural. While transfer mechanisms do not impair the firms’ sovereignty in making their production decisions, in many other mechanisms this sovereignty is not respected.

Restricting the set of admissible demand and cost functions such that the firms always have an incentive to produce, the main result of this paper is that every polynomial inverse demand function of at most \((n-1)\)th degree (\(n\) being the number of firms in an industry) is consistent with Nash implementability via transfers.

1.1. Notes on the related literature

1.1.1. (i) General Nash implementation literature

This paper applies methods of Nash implementation literature to a particular economic context of oligopolistic competition. As such, it is related to the basic contributions of Hurwicz (1979) and Maskin (1977). Since the objectives to be implemented are usually single valued, this paper is related even more closely to Roberts (1979). The latter deals with an abstract implementation problem of a single valued function when the planner is assumed to have no information whatsoever on the agents’ preferences (as opposed to the present context, where some of the environment, namely, the revenue function is assumed to be known). It turns out that in the case of unbalanced transfers only maximization of linear combinations of the agents’ utilities can be implemented, whereas with balanced transfers and sufficient richness of the domain the implementation results are negative; see also Laffont and Maskin (1980), who arrive at a similar result with