Efficient spatial competition

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Abstract

Game-theoretic models of spatial competition usually assume that firms set prices after their choices of locations. Rather than make this assumption, this paper uses the core to model the competition between the firms. Two conditions are shown to be sufficient for efficient spatial competition. The first is that the firms' location choices satisfy a no-externalities condition. The second is that the second-stage game satisfy a separable-value condition, namely that the value (gains from trade) can be created on a buyer-by-buyer basis. This approach yields two further benefits. First, efficient location can be stable in situations with arbitrary distributions of buyers, arbitrary willingness-to-pay functions, and completely general location spaces. Second, efficiency in location games can be shown to be related to the Second Welfare Theorem.
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1. Introduction

Most game-theoretic models of spatial competition use a two-stage, noncooperative game. In the first stage, each firm chooses a location, often interpreted as a product-positioning decision. In the second stage, the firms then compete in a pricing game. In virtually all of these two-stage models, the buyers are assumed to be price-takers. They can choose from which firm to purchase, but they must take the quoted prices as fixed. This paper follows the standard approach of using two stages, with the firms simultaneously choosing locations in the first stage. But in the second stage, this paper does not specify a price-setting procedure. Instead, the price competition is modeled by the core of a cooperative game. This use of the core provides a model of price competition in which

the buyers, as well as the firms, are actively involved in the determination of prices. Consequently, it provides an analysis in which it is not necessary to assume that firms have price-setting power.

There are three motivations for investigating a model in which firms are not assumed to have price-setting power. The first is to determine sufficient conditions under which firms will choose socially-efficient locations, i.e. locations which maximize the economic value created in the transactions between buyers and firms. One type of sufficient condition for efficiency in location (spatial competition) games has been identified in three earlier papers. Using a price-setting model, Lederer and Hurter (1986) show that if firms have the power to perfectly price-discriminate, then there is an equilibrium in which they choose efficient locations. A similar result is obtained by Hamilton et al. (1991), with an extension in Hamilton and Thisse (1992). Like Lederer and Hurter, these latter two models give price-setting power to the firms, but they restrict the prices that the firms can charge to those that are supported by a core outcome. This restriction is designed to model a buyer's ability to actively seek out prices from firms. They show that the most favorable prices supported by the core are consistent with the perfectly discriminating prices of Lederer and Hurter. Since the perfectly discriminating prices enable each firm to extract its full surplus, both papers suggest that surplus extraction is a sufficient condition for efficient location-choice to be stable.[1]

Like Hamilton et al. (1991) and Hamilton and Thisse (1992), the current paper considers core outcomes, but it uses the core outcomes for a different purpose. Whereas Hamilton et al. and Hamilton and Thisse use the core to restrict what pricing strategies are possible, the current paper uses the core in place of pricing strategies. Core outcomes are treated as primitives, interpreted as the consequences of free-form transactions between firms and buyers. With this alternative use of the core, two conditions are shown to be sufficient for efficient spatial competition. The first is that the firms' location choices satisfy a no-externalities condition. This is usually met by assuming that a buyer's evaluation of a given firm's product does not depend upon the location of any of the other firms. The second condition is that the second-stage games have a separable-value structure in which the value created can be computed on a buyer-by-buyer basis. Typically, this condition is met by assuming that each firm can supply the whole market, and that marginal production costs are constant. The main result of this paper shows that if the no-externalities and separable-value conditions are met, any efficient profile of location choices will be an equilibrium.

Two consequences of the main result will be emphasized. The first is an explanation for why, in price-setting models of spatial competition, perfect price discrimination generates efficient equilibria. Since perfect price discrimination in these models gives each firm its marginal contribution, each firm will act as if it were in a perfectly competitive market.[2] Brandenburger and Stuart (2003), in a game-theoretic version of the Second Welfare Theorem, show that perfect competition, in the presence of no externalities,

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[1] Osborne and Pitchik (1987) use the mixed-strategy equilibria result of Dasgupta and Maskin (1986) to find an equilibrium that is very close, but not equal, to the social optimum. Their result assumes linear transportation costs and requires the firms to randomize over the prices that they set.

[2] The relationship between perfect competition and players receiving their marginal contributions is addressed in Makowski (1980) and Ostroy (1980).