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Dynamic price competition

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Abstract

We consider the model of price competition for a single buyer among many sellers in a dynamic environment. The surplus from each trade is allowed to depend on the path of previous purchases, and as a result, the model captures phenomena such as learning by doing and habit formation in consumption.

We characterize Markovian equilibria for finite and infinite horizon versions of the model and show that the stationary infinite horizon version of the model possesses an efficient equilibrium where all the sellers receive an equilibrium payoff equal to their marginal contribution to the social welfare.

JEL classification: D81; D83

Keywords: Dynamic competition; Marginal contribution; Markov perfect equilibrium; Common agency

1. Introduction

In this paper, we consider a model of Bertrand price competition for a single buyer among many sellers in a dynamic environment. We analyze the existence and efficiency of equilibria in models where the stage game payoffs to the buyer as well as the sellers may depend on the history of past purchases. Examples of dependence of this type include learning by doing for the sellers and habit formation for the buyer.

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Bertrand price competition provides an attractive modeling approach for markets with differentiated commodities as it places the bargaining power in the hands of the players on the long side of the market. This results in a nontrivial sharing of the surplus arising from trades between the buyer and the sellers. If the buyer has a unit demand, the equilibrium in the static game is efficient, and the sharing of economic surplus can be studied independently of any economic distortions. We extend the static model to a general dynamic environment. Issues such as surplus sharing and efficiency then require more careful analysis. If current choices have an impact on future surpluses, the intertemporal aspects of surplus sharing gain in importance. Consider for example an industry where an entrant has a technology that will achieve lower costs of production than the incumbent's technology, but whose initial costs are quite high. It may well be that the seller must sell at prices below costs in the initial periods in the expectation of future profits. The ultimate success of the entrant depends on the degree to which the costs and benefits of the initial periods can be shared between the participants in the market.

In the model of this paper, a finite number of sellers offer differentiated products to a single buyer with unit demand over a discrete time horizon of either finite or infinite length. At the beginning of each period, the sellers choose simultaneously prices for their products and the buyer chooses the seller to supply the product (or possibly she chooses not to buy in that period). Because of assuming unit demands, we have also the alternative interpretation of the model as one where a number of firms compete in spot wage contracts for a given worker over time. [1] All the players discount future with the same discount factor δ. In order to allow for dynamic elements in the model, we allow the surplus from each trade to depend on the sequence of trades made in the previous periods. In the job matching model, such dynamic features arise naturally from learning on the job and participation in training programs. Hence the scope of the model is much larger than the simple repetition of the static price competition game across many periods.

The finite horizon model is analyzed first. By a simple example, we show that the existence of a pure strategy equilibrium cannot be taken for granted. If the surplus resulting from a purchase from seller i depends on the history of sales by sellers other than i, the model has a direct intertemporal externality. Hence there is really no reason to expect that a model with (spot) prices as the only feasible transfers would be well behaved with respect to the efficiency of the equilibrium allocation. The restrictive element in price competition is that seller i can offer (positive or negative) transfers to the buyer only in conjunction with a purchase of the product of seller i. Yet with externalities, it is conceivable that seller i would sometimes like to induce the buyer to purchase from j and would be willing to support the purchase of product j with a subsidy. To rule out this class of problems, we assume that the surplus generated by the purchase of a given seller's product depends only on the number of past purchases from that seller. This is consistent with the examples of habit formation and learning by doing and it also accommodates job-specific learning in the job matching model. Surprisingly, the equilibria in this case may be inefficient as well and there may be a multiplicity of them.

[1] Models of this type include [10,12] in a competitive market and [5] in a duopsonistic labor market.