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Buyer power in bilateral oligopolies with advance production: Experimental evidence☆

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ABSTRACT

We conduct experiments based on the oligopoly model by Kreps and Scheinkman (1983) to assess the impact of demand side concentration on market outcomes. Both buyers and sellers in our markets are humans. The number of firms is fixed at three in all treatments. Only the number of buyers is varied and total demand is split equally among them. We observe that firms set lower prices in markets with only few buyers, namely one or two. Price dispersion is higher in markets with few buyers. Aggregate demand withholding decreases with the number of buyers. This results in lower profits for firms and higher profits for buyers in markets with few buyers.

1. Introduction

Since the late 1950s experimental research examines the impact of market characteristics on outcomes in oligopoly markets.[1] The influence of many market characteristics has been tested, among them competition of sellers, communication protocols, duration of interaction and the shape of demand and supply.[2] The strategic interaction of sellers in oligopoly markets received by far the most attention. Mostly buyers are assumed to be passive price-takers in those experiments and hence simulated by an aggregate demand function. While this embraces markets where the supply side is faced with an atomistic demand side, obviously there are markets where few buyers are in a more favorable situation enabling them to exert market power. The number of articles in experimental economics that considers both market sides is relatively small, among them Franciosi et al. (1995) and Tyran and Engelmann (2005).

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[1] For early examples see Sauermann and Selten (1959), Hoggatt (1959) and Fouraker and Siegel (1963).
[2] See for a survey on recent research Potters and Suetens (2013) and Engel (2007) for a meta-analysis of 150 market experiments.

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In this paper we examine the effects of demand side competition on outcomes. For this purpose we use a model with advance production as our starting point, the model by Kreps and Scheinkman (1983). In contrast to the classic models in industrial organization (Cournot, 1838; Bertrand, 1883) the sellers face sequential decisions about two strategic variables, quantity *and* price. In the model by Cournot firms only choose the quantity to produce and in Bertrand's model they set a price. In both models markets always clear and no produced units remain unsold.[3] While Kreps and Scheinkman also predict clearing markets for their model, buyers in models with advance production can withhold demand and firms have to bear the production cost of their unsold units. When sellers and buyers interact repeatedly, buyers can use their power to lower prices. These features add more realism for many market contexts, for example markets for perishable goods.

We design laboratory experiments based on the model by Kreps and Scheinkman (1983) where we vary the number of buyers from one to seven while we leave all other market parameters constant across treatments. The predictions of the model do not change with the treatment variable. In each market the number of sellers is fixed at three and both market sides are taken by humans. The cost structure is particularly simple and equal for all three producers. Total demand is identical across the different treatments. In treatments with more than one buyer the demand curve is split up equally among buyers. Buyers and sellers stay in fixed groups for 50 periods. Each period has the same structure: initially producers set their quantities, then they learn the total quantity in the market and set their price. Subsequently buyers are queued in a randomly determined order and can make their purchases.

With our experimental design we tackle the following research questions: (i) Do aggregate market outcomes change with the number of buyers?; (ii) How do firms set prices and does their decision depend on the treatment variable?; (iii) Do buyers strategically withhold demand and how does the demand structure affect the buyers' behavior? Because the decisions of the firms are separated in a production and a pricing decision, we examine the firms' pricing decisions given their previous production decision to answer the second question. Similarly, to answer the third question we consider the buyers' decision given the actual behavior of the firms. We examine behavior of buyers conditional on what has been done before to take into account that firms may have failed to coordinate on predicted quantities or prices that would be optimal given non-optimal quantities.

We find that aggregate predictions for prices and produced quantities describe the outcomes for more than two buyers quite well. We also find that not all units sell and that firm profits are much lower than predicted, particularly in markets with one or two buyers. We identify two reasons for this: firms set lower prices when only few buyers are in their markets and buyers reject units profitable to them when they do not compete with other buyers.

2. Related literature

Our paper combines two aspects of research in experimental industrial organization that have been considered separately in the literature: one is concerned with advance production, the other tackles the effect of buyers' fairness considerations and the influence of the demand structure on market outcomes.

Davis (1999) conducted triopoly experiments that are terminated randomly after 35 periods with simulated demand to compare Bertrand competition with the Kreps–Scheinkman model. As predicted he observes higher prices and lower output in the Kreps–Scheinkman setting than in the Bertrand setting. In contrast to the Bertrand experiments, convergence to the predictions is not achieved in the experiments with advance production. Muren (2000) examines experimental triopoly markets based on the Kreps–Scheinkman model in order to assess the impact of experience on market outcomes. Buyers were simulated and sellers interacted for ten periods. Some subjects were reinvited approximately two weeks after their first participation. Muren finds that the inexperienced subjects behave more rivalistic than the experienced. Brandts and Guillen (2007) examine seller competition in oligopolies with advance production and use the number of firms as treatment variable. They conducted experiments where firms simultaneously set quantities *and* prices for a perishable product in the same stage.[4] Demand was simulated and followed a 'box' schedule where any amount up to a maximum quantity is bought up to a constant maximum price. Most markets evolve either to monopolies as a consequence of bankruptcies or to collusion at the monopolistic price. Consumer surplus is higher in treatments with three rather than two firms, but efficiency is lower. Goodwin and Mestelman (2010) compare Kreps–Scheinkman with Cournot duopoly experiments and confirm that inexperienced subjects in the Kreps–Scheinkman settings face more problems selecting capacities consistent with the predictions than the inexperienced subjects in the Cournot experiments. With experience the differences disappear, though their experiments lasted for only twelve periods (after two unpaid practice periods). Heterogeneous goods markets are considered by Anderhub et al. (2003). They test the viability of the prediction of duopolies with long-run capacity competition and short-run price competition. They report capacity choices that are more competitive than predicted but set prices are surprisingly close to equilibrium.

The impact of demand structure in experimental markets received less attention. Ruffle (2009) surveys literature on the buyers' ability to extract price discounts from the suppliers in theoretical and experimental research. Kachelmeier et al. (1991a) examine fairness considerations in experimental double auctions and find that information disclosure about the

[3] The reason for market-clearing in Cournot (1838) is a mythical Walrasian auctioneer, discussed e.g. in the introduction of D'Aspremont et al. (1991), whereas production is to demand in Bertrand (1883).

[4] Note the difference to the Kreps–Scheinkman model where the two decisions are separated into two stages.