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How does income inequality affect market outcomes in vertically differentiated markets?☆

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ABSTRACT

The distribution of consumer incomes is a key factor in determining the structure of a vertically differentiated industry when consumer's willingness to pay depends on her income. This paper computes the Shaked and Sutton (1982) model for a lognormal distribution of consumer incomes to investigate the effect of inequality on firms' entry, product quality, and pricing decisions. The main findings are that greater inequality in consumer incomes leads to the entry of more firms and results in more intense quality competition among the entrants. More intense quality competition raises the average quality of products in the market as firms compete for the shrinking share of higher-income consumers. With zero costs of quality improvements and an upper bound on the top quality or when costs of quality are fixed and rise sufficiently fast, greater heterogeneity of consumer incomes also reduces firms' incentives to differentiate their products. Competition between more similar products tends to reduce their prices. However, when income inequality is very high, the top quality producer chooses to serve only the rich segment of the market and charges a higher price. The conclusion is that income inequality has important implications for the degree of product differentiation, price level, industry concentration, and consumer welfare.

1. Introduction

In this paper I study decisions of firms operating in a vertically differentiated market. The products offered in such a market differ in quality. The consumers are perfectly informed of the products' characteristics and have the same ranking over the products, preferring higher quality products to inferior ones. Thus, if prices were the same, the consumers would all choose to buy the top quality good. In this type of market the demand is directly affected by the properties of consumers' income distribution. If consumers have different incomes and thus, different willingness to pay for higher quality products, firms can profitably split the market by offering products differentiated in qualities at different prices. Therefore, in vertically differentiated markets, income inequality among consumers becomes a key factor in determining the product varieties offered by the firms.

The purpose of this paper is to study the effect of income inequality on market outcomes in vertically differentiated markets, with particular interest in the range of qualities on offer. Many countries have experienced significant increases in income inequality over the past several decades.[2] The welfare implications of higher income inequality have been analyzed by looking at the consumer expenditures data and measuring the corresponding change in consumption inequality (Krueger and Perri, 2006; Jappelli and Pistaferri, 2010). Data on expenditures do not take into account the changes in quality of products consumed, and these are endogenous to the consumer demand and depend on the distribution of consumer incomes. This paper uses a stylized model to demonstrate that firms' decisions on product characteristics are affected by the degree of inequality and these choices have important welfare implications.

The line of research linking income distribution of the consumers to the industry structure dates back to Gabszewicz and Thisse (1979), and has been cultivated by them (Gabszewicz and Thisse, 1980) as well as by Shaked and Sutton (1982, 1983, 1987). These authors demonstrate that the interplay of the industry cost structure and demand conditions, which are the outcome of the underlying income distribution, determines the degree of concentration and the maximum number of firms in vertically differentiated markets (Shaked and Sutton, 1987). They have almost nothing to say, however, about what kind of products these firms would be producing.

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[2] See Caminada and Goudswaard (2001) and Atkinson (2003).

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Endogenous quality choices in duopolies with uniform distributions of consumer preferences for quality are analyzed by Motta (1993), Lehmann-Grube (1997) and Aoki and Prusa (1997). Motta (1993) studies two types of duopolistic markets, one with price and the other with quantity competition. He finds quality differentiation in equilibrium in both Bertrand and Cournot setting, with larger quality spreads under Bertrand. This result holds under two different cases of fixed and variable costs of quality improvement. Lehmann-Grube (1997) demonstrate that in duopolistic markets the top quality firm makes a higher profit for any convex fixed-cost function of quality, and under the scenarios of simultaneous or sequential choice of qualities. Aoki and Prusa (1997) study the effect of simultaneous versus sequential quality choices on the equilibrium quality levels under the assumption of quadratic fixed costs of quality.

Multiproduct competition has been analyzed by De Fraja (1996), who considers a vertically differentiated industry with an exogenous number of firms that simultaneously choose both qualities and quantities of their products, and a general distribution function for consumer preferences with upper and lower bounds on incomes. Johnson and Myatt (2003) study optimal quality choices of a multiproduct monopoly in response to entry by another firm and how these choices are affected by the properties of the distribution of consumer preferences for quality. The authors, however, do not endogenize the number of firms in the market.

The paper most closely related to this one is Benassi et al. (2006). These authors analyze the effect of income concentration on product differentiation and obtain solutions for quality and pricing decisions of duopolistic firms. To obtain analytical results they assume that consumer incomes are distributed with a trapezoid distribution, and that the market is not covered. The authors find that more concentrated income distributions lead to more product differentiation. In this paper I propose to further this research agenda by modifying the existing models to make them applicable for studying the effects of changes in the consumers' income distribution on the firms' entry decisions and the optimal choices of product attributes and prices for a lognormal income distribution function. I solve the model numerically to obtain the equilibrium number of firms in the market, the qualities they produce, and the prices they charge.

The baseline theoretical model is based upon Shaked and Sutton (1982). Firms compete in a three-stage non-cooperative game by making entry, product quality and pricing decisions. Each firm, if it enters, supplies a single product variety, and consumers can choose to purchase at most one good. The outputs of the model are the number of firms in the market, product qualities and prices, and the major input is the income distribution of the consumers. Shaked and Sutton (1982) assume that the income distribution is uniform and obtain analytical solution for a duopoly. Changes in the degree of income inequality can be modeled with a uniform distribution by shifting its endpoints. However, the support of the distribution would change, also altering the nominal scale of the market. Since the demand functions depend on nominal incomes, the uniform distribution cannot be used to analyze the purely redistributive effects of changes in income inequality on firms' decisions.[3] This paper models the distribution of consumer incomes with a lognormal distribution, which has been found to provide an accurate fit of real-life income distributions among other candidates for parametric estimation (Pinkovskiy and Sala i Martin, 2009).[4]

The most valuable insight from the present analysis is that income inequality among consumers affects the intensity of competition. The result that greater income inequality enables more firms to enter the industry with positive market shares dates back to Gabszewicz and Thisse (1979) and has been replicated in most of the works that followed. In this paper I am also able to demonstrate that income inequality impacts the degree of product differentiation in the market. Low degree of heterogeneity in consumer incomes intensifies price competition in the last stage of the game, thus, in order to soften it, firms differentiate their products more when income inequality is lower. Greater inequality in consumer incomes reduces the incentive to differentiate and intensifies quality competition among firms for the shrinking middle and higher-income sections of the market. Thus, when income inequality is higher, firms locate their products in higher ranges of the quality spectrum, closer to each other, raising the average product quality and decreasing the degree of product differentiation. Competition between more similar products tends to reduce their prices. However, when income inequality is very high, the top quality producer chooses to serve only the rich segment of the market, and the low price elasticity of demand of these consumers allows him to charge a higher price.

The model predicts that aggregate consumer welfare is higher in economies with greater income inequality. Higher intensity of quality competition in these economies induces lower-quality firms to raise the quality of their products and offer these products at lower prices. Thus, the majority of consumers are better off when income variability is high. Greater income inequality also decreases the degree of product differentiation; therefore, on a quality-adjusted basis, consumption inequality may be lower in economies with a higher degree of income inequality.

The main results of the paper are derived under the assumption of the costless quality choice when there exists an upper bound on the best quality that can be produced. This simplifies the analysis and makes it possible to study product differentiation as the outcome of a purely demand-driven strategic behavior. However, this assumption is limiting since it makes the quality choice of the top quality producer trivial. Thus, I also compute the model for the case when the cost of quality improvement is fixed and quadratic and show that the results hold when the burden of quality improvement falls primarily on fixed costs and these costs rise sufficiently fast in quality. The assumption of quickly diminishing returns, especially at very high levels of quality, is realistic for many industries where quality improvements are achieved via investments in R & D.[5]

The paper is organized as follows. After describing the model in Section 2, I outline the solution method in Section 3. The discussion in this part also includes the issues of existence and uniqueness of equilibria. Section 4 of the paper gives the results of the model. Section 5 concludes.

2. The model

The analysis here follows very closely that of Shaked and Sutton (1982). The economy is inhabited by two kinds of agents: consumers and firms. The firms produce distinct, substitute goods, that are differentiated by quality. Consumers are heterogeneous in income and have preferences over the goods produced by the firms, with the ordering of preferences being identical for all consumers. They can choose to purchase only one good, basing their decision on the choice of qualities they face and prices, or make no purchase. These decisions generate demand functions for the firms, who face a more complicated oligopolistic competition problem.

Each of the firms produces only one good. They compete in a three-stage non-cooperative game. In the first stage each of the firms chooses whether it would enter the market. In the second stage, upon observing the number of entrants, firms that have entered the

[3] Similar argument is made in Benassi et al. (2006) to motivate the use of trapezoid income distribution.

[4] The authors also review other literature that has tested the validity of lognormal distribution. Alternative distributions have included generalized beta functions, truncated versions of the lognormal density and lognormal mixtures.

[5] For example, see Alexander et al. (1995) for evidence of diminishing returns to R & D in the pharmaceutical industry. Some discussion of other cost of quality structures and their implications for the results is provided in the concluding part of the paper.