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Monopoly rents in contestable markets

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HIGHLIGHTS

- We analyze a contestable market using a model with pricing and entry decisions.
- Only one firm enters the market, and randomizes over multiple prices.
- The other firm stays out of the market in equilibrium.
- Undercutting is not profitable because of randomization.
- The entrant is able to charge high prices and collect positive rent.

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ABSTRACT

Random choices of prices and product characteristics can be used by a contestable monopolist to deter entry and fully extract the monopoly rent. We develop this idea in a model of Bertrand price competition. In equilibrium, one firm enters the market and makes choices that are unpredictable to its competitors. This prevents price undercuts and keeps other firms out of the market. The entrant firm collects the monopoly rent despite the existence of potential competitors. This result raises an alert for regulatory practices based on the conventional wisdom that contestability is associated with low prices and profits.

1. Introduction

Contestable markets are those in which the incumbent firms are permanently threatened by inactive firms willing to enter the market. The existing literature suggests that potential competitors may be as effective as actual competitors in restricting the market power of active firms. This general idea was introduced by Bain (1949) and Sylos-Labini (1956). It was further developed in a celebrated book by Baumol et al. (1982) which deeply impacted regulatory practices across the world. The following quotation from Baumol and Willig (1986, p. 22) summarizes a great deal of our current understanding on the topic:

> "when the number of incumbents in a market is few or even where only one firm is present, sufficiently low barriers to entry may make antitrust and regulatory attention unnecessary."

Based on this principle, economists have been widely concerned about legal and technical barriers that restrict the entry of new firms into a market. We contribute to this agenda by presenting environments in which apparently innocent randomness on prices and product characteristics may act as a powerful device to discourage entry and extract consumer surplus.

We study Bertrand models of price competition in which firms face fixed costs to produce differentiated goods. The structure of preferences and costs is such that there are multiple pure strategies (on prices and product designs) that generate the same monopoly profit. We derive an equilibrium in which an entrant firm randomizes across these monopoly pure strategies and all other firms stay out of the market. Price undercuts become impracticable since the contestant firms are not able to precisely anticipate which action

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will be taken by the entrant monopolist. Fixed costs pose a loss on contestant firms that undercut the *wrong* monopoly strategy. Thus, by being unpredictable to other firms, the monopolist deters entry and collects the entire monopoly rent.

Our main result is novel and not obvious from a theoretical point of view. Two related references are useful to illustrate this point. Sharkey and Sibley (1993) analyze the Bertrand model when identical stores face an entry cost and constant marginal costs to sell a given good. They derive a symmetric mixed-strategy equilibrium in which all stores enter the market with positive probability and make zero expected profits. Monopolistic profits do not arise in this single-good setting.

In another related work, Braido (2009) studies the existence of a Bertrand equilibrium for economies with multiple goods and continuous nonconvex costs. Consumers are restricted to purchase all products from the same store. An equilibrium exists under general assumptions. Moreover, when firms face identical linear costs and consumers hold the same preferences, the equilibrium displays random price dispersion and at least two stores enter the market with positive probability.[1] Our monopolistic result is also not possible in this homogeneous multiproduct setting. We show that it can arise when consumers hold heterogeneous preferences over different goods or characteristics (e.g., Section 2) or, alternatively, when the consumer can visit all stores and shop each product at the lowest price available (e.g., Section 3).

We argue that our main finding is also relevant from a practical point of view. Unanticipated choices of product characteristics and price rebates appear in most releases in fashion and electronics. This is usually intended to avoid that other potential suppliers offer the same product at a lower price. Unpredictability could be viewed as a not so innocent way to restrict competition.

The remainder of this paper is organized as follows. We introduce two different illustrations of our main point before discussing it in a general framing. Section 2 explores a simple case where consumers have heterogeneous preferences over a particular characteristic of the good. Section 3 considers an environment with two complementary goods where there are infinitely many monopoly prices. Section 4 discusses the issue in a general model with multiple goods. Concluding remarks appear in Section 5.

2. Heterogeneous consumers

Ms. White and Ms. Green plan to purchase a fancy coat. Two identical firms can produce the coat in two different models, say white and green. Each firm must invest \$3 to design the first unit of a given model. The marginal cost for producing the second unit of the same model is zero.

Preferences are quasi-linear in wealth, and each consumer is endowed with \$4. Ms. White is willing to pay up to \$3 for a white coat and up to \$2 for the green model. Analogously, Ms. Green's reservation price is \$2 for the white coat and \$3 for the green.

We write p^j_w and p^j_g for the prices of the white and green models produced by firm $j \in \{1, 2\}$. Each firm maximizes its expected profit by selecting a probability distribution over the set $\mathbf{P} \times \mathbf{P}$, where $\mathbf{P} \equiv \mathbb{R}_+ \cup \{p_{\text{out}}\}$ and p_{out} represents the decision of not offering the respective product.[2] By setting $p^j_w = p_{\text{out}}$ or $p^j_g = p_{\text{out}}$, firm j does not produce any unit of the respective model and does not bear the fixed design cost.

We use $x^j_{i,w} \in \{0, 1\}$ and $x^j_{i,g} \in \{0, 1\}$ to represent the amount of white and green coats purchased by agent $i \in \{\text{W}, \text{G}\}$ from firm $j \in \{1, 2\}$. Consumers are informed about the realization of firms' choices $p \equiv (p^1, p^2)$. The consumption set $X(p)$ that is available for each agent is given by the subset of $\{0, 1\}^4$ such that $x^j_{i,l} = 0$ when $p^j_l = p_{\text{out}}$.

Ms. White takes prices as given and chooses $x^*_{\text{W}}(p) \in X(p)$ to maximize

$$\max\left\{3\chi_{[x^1_{\text{W},w}+x^2_{\text{W},w}\geqslant 1]}, 2\chi_{[x^1_{\text{W},g}+x^2_{\text{W},g}\geqslant 1]}\right\} + \left(4 - \sum_{j\in\{1,2\}} (p^j_w x^j_{\text{W},w} + p^j_g x^j_{\text{W},g})\right),$$

where $\chi_{[\cdot]}$ is the indicator function that equals 1 when the statement in $[\cdot]$ holds. Analogously, Ms. Green chooses $x^*_{\text{G}}(p) \in X(p)$ to maximize

$$\max\left\{2\chi_{[x^1_{\text{G},w}+x^2_{\text{G},w}\geqslant 1]}, 3\chi_{[x^1_{\text{G},g}+x^2_{\text{G},g}\geqslant 1]}\right\} + \left(4 - \sum_{j\in\{1,2\}} (p^j_w x^j_{\text{G},w} + p^j_g x^j_{\text{G},g})\right).$$

Remark 2.1. Coats of the same color produced by different stores are perfect substitutes, and consumers do not enjoy having more than one coat. This is behind the $\max\{\cdot, \cdot\}$ representation of consumers' preferences. Notice also that preferences are quasi-linear in wealth. Consumers are endowed with \$4 and pay for every coat purchased (white or green from firm 1 or 2). Naturally, for positive prices, consumers will never buy more than one coat.[3]

On the production side, each firm j takes the pricing strategy of the other firm and the consumers' demand functions as given. If the realized vectors of prices is $p \equiv (p^1, p^2)$, firm j's profit is

$$p^j_w y^j_w(p) + p^j_g y^j_g(p) - 3\left(\chi_{[p^j_w \neq p_{\text{out}}]} + \chi_{[p^j_g \neq p_{\text{out}}]}\right),$$

where $y^j_w(p) = x^{*j}_{\text{W},w}(p) + x^{*j}_{\text{G},w}(p)$, $y^j_g(p) = x^{*j}_{\text{W},g}(p) + x^{*j}_{\text{G},g}(p)$, and $\chi_{[\cdot]}$ is the indicator function.

Classic monopoly For sake of clarity, let us initially consider the hypothetical case with a single firm in the market. If the firm could discriminate prices, it would offer only one color (say white) and charge \$3 from one consumer (Ms. White) and \$2 from the other (Ms. Green). Consumers earn no surplus in this context, and the firm extracts a revenue of \$5 and a surplus of \$2.

If forced to charge identical prices across consumers, the firm would offer only one color at \$2. This generates a revenue of \$4 and the monopoly rent of \$1. The consumer whose favorite color was produced obtains a surplus of \$1, while the other consumer earns no surplus. These scenarios (with and without price discrimination) are both Pareto optimal. Producing coats in two different colors is Pareto dominated in this economy.

Contestable monopoly Consider now the case in which two firms set per-unit prices for each coat model. We point out that there is an equilibrium in which one firm stays out of the market while the other plays a mixed strategy that poses equal probability over the

[1] The formal result also relies on the assumption that the monopoly profit (net of the entry cost) is positive and on the property that the monopolist profit function varies continuously with prices. The argument is as follows. Under positive monopoly profit, there is not a Nash equilibrium in which all firms stay out of the market. Furthermore, if a firm were to be alone in the market, it should necessarily select among the monopoly prices (using pure or mixed strategies). If agents ranked multiple monopoly prices with the same indirect utility function (or alternatively, if the monopoly price were unique), then any non-entrant firm could profit by undercutting the appropriate monopoly price. By doing so, it would attract all consumers and generate a positive profit (slightly smaller than the monopoly level).

[2] We require p_{out} to be any mathematical object outside $\mathbb{R}_+$ such that $0p_{\text{out}} = 0$.

[3] There are price vectors that leave consumers indifferent across different options of colors and firms. As usual in equilibrium theory, in case of multiple solutions for the consumer's problem, one is free to take any of them as the optimal choice $x^*_i(p)$.