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An alternating-move price-setting duopoly model with stochastic costs

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Abstract

This paper examines an alternating-move price-setting duopoly model, in which marginal costs are stochastic without persistence. It is shown that provided marginal costs do not fluctuate excessively, equilibria in which firms match the current monopoly price do not exist. By contrast, equilibria in which firms always match their rival along the equilibrium path do exist. In these equilibria, deviations off of the equilibrium path result in extended price wars, in which firms repeatedly undercut each other. Finally, examples in which such price wars are observed in equilibrium are constructed.

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1. Introduction

In 1964, Stigler argued that a difficulty a cartel faces is ensuring that member firms will not undercut the cartel's price, and that price wars signal a collapse of collusion. Since then, theories have been developed to understand price wars and their role in maintaining collusion. In the first stage of research, the credible threat of a price war is used to ensure that no firm in the collusive arrangement will cheat; because in these models, price wars

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are not observed in equilibrium, they are thought of as “off-equilibrium” price war theories. The next stage identified reasonable models in which price wars are observable in equilibrium. Such models include that of [Green and Porter \(1984\)](#), in which price wars occur because firms cannot distinguish between market demand shocks and deviations by rivals, and [Slade \(1989\)](#), in which firms use price wars to learn about the demand curve after a demand shock.

While many theories predict price wars, few predict wars that resemble those observed in many industries. A common feature of observed price wars is the wide range of prices set through the course of the war due to repeated undercutting. Price wars featuring an increased degree of price volatility have been documented for example in the prices of retail gasoline ([Slade, 1992](#)), bromine ([Levenstein, 1996](#)), and cigarettes ([Boudreaux et al., 1995](#)). However, the literature has provided few explanations for the wide range of prices sometimes observed in price wars, even considering wars that occur off of the equilibrium path.¹

The purpose of this paper is to consider a model in which the threat of price wars covering a wide range of prices permits the firms to maintain a collusive price level, and to discuss extensions in which such price wars are observed in equilibrium. This paper extends the infinite-horizon, alternating-move, price-setting duopoly model of [Maskin and Tirole \(1988\)](#).² In their model, two firms set the price in an alternating fashion, each taking the other’s price as fixed when setting its own. Equilibrium pricing, in which each firm matches its rival at the monopoly price, can be supported using simple strategies, in which a firm’s price depends only on its rival’s most recent price. In the event of a deviation below the monopoly price, a firm responds by dropping its price to the point that induces its rival to restore the monopoly price. Deviations above the monopoly price are ignored. Thus, this model has been viewed as a formalization of the ‘kinked demand’ explanation of price rigidities.³

This paper extends [Maskin and Tirole \(1988\)](#) by examining price-matching strategies when marginal costs vary over time.⁴ This extension is motivated for several reasons. First, the robustness of the price matching equilibria discussed above to the introduction of time-varying costs can be explored, providing insights as to the appropriateness of such a model in explaining price rigidities. Second, testable implications of such a model regarding the relationship between retail prices and marginal costs can be identified. Finally, the type of price war that can be used to support collusion in such a setting can be explored.

¹ Exceptions include [Slade \(1989\)](#) and [Staiger and Wolak \(1992\)](#), in which decreases in demand cause capacity-constrained firms to switch from collusive prices to mixed strategies, in which the lower priced firm serves the entire market. Extended price fluctuations, in which prices may decline slowly over time, have also been generated in models of sales ([Conlisk et al., 1984](#)) and models with customer loyalties ([Rosenthal and Chen, 1996](#)).

² This model has been extended in other directions. [Eaton and Engers \(1990\)](#) examine a discrete form of product differentiation. [Wallner \(1999\)](#) considers the implications of the infinite-horizon assumption, and [Eckert \(2003\)](#) examines the role of the tie-breaking rule.

³ See, for example, [Blanchard and Fischer \(1989\)](#) for discussion.

⁴ [Maskin and Tirole \(1988\)](#) also generate equilibria in which prices are not rigid, but instead exhibit regular cycles. Using numerical examples, [Noel \(2002\)](#) describes such equilibrium price cycles when marginal costs vary from period to period.

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