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An empirical investigation of the determinants of asymmetric pricing☆

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ABSTRACT

This article empirically investigates the cause of asymmetric pricing: retail prices responding faster to cost increases than decreases. Using daily price data for over 11,000 retail gasoline stations, I find that prices fall more slowly than they rise as a consequence of firms extracting informational rents from consumers with positive search costs. Premium gasoline prices are shown to fall more slowly than regular fuel prices, which supports theories based upon competition with consumer search. Further testing also rejects focal price collusion as an important determinant of asymmetric pricing.

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1. Introduction

A robust body of economic literature has focused on the retail gasoline industry. The attention stems from the market being influenced by factors rigorously studied by microeconomic theorists: search costs, tacit collusion, and Edgeworth cycles to name a few. The primary focus of this article is asymmetric pricing: the tendency for firms to adjust retail prices more quickly in response to cost increases than decreases. I verify the existence of the phenomenon using a new, high-frequency, micro-level data set. Perhaps more importantly, I provide new empirical insight into asymmetric pricing's underlying cause, and in doing so establish empirical regularities of gasoline price adjustments that have yet to be documented at a micro-level across a large number of markets.

Bacon (1991) first demonstrated that retail gasoline firms respond with greater speed to cost increases than decreases, while also coining the phrase "rockets and feathers" to describe the phenomenon. Supporting the hypothesis that gasoline prices shoot up like rockets but fall like feathers are the findings of Borenstein et al. (1997)[1], whose empirical model has served as the foundation for identifying asymmetric price adjustments. Building on the work of BCG, rockets and feathers has been identified in retail gasoline markets in Canada, the United States, Chile, and a host of European countries. Asymmetric pricing, however, is not confined to the retail gasoline industry; Peltzman (2000) examines 242 diverse product markets and confirms rockets and feathers to be a common pricing phenomenon in more than two thirds of the markets.

One of the first explanations for asymmetric pricing to gain traction was that the pricing behavior stemmed from focal price collusion.[2] A number of recent studies have theoretically derived asymmetric pricing as a consequence of consumer search behavior. Lewis (2011), Tappata (2009), and Yang and Ye (2008) all present models wherein consumers have a greater incentive to search following a cost increase, and thereby firms maximize profits by responding faster to cost increases than decreases. In Tappata (2009) and Yang and Ye (2008), consumers rationally expect more gains from search when costs are low but possess imperfect information about current marginal costs. Lewis (2011) takes a more behavioral approach and posits that consumer expectations of current prices are weighted by past price realizations. Although not explicitly about asymmetric pricing, Hastings and Shapiro (2013) find that retail gasoline consumers are well described by a behavioral model whereby, following a price increase, consumers act as if they have a higher marginal utility of wealth. This behavior leads to greater price sensitivity, and likely more search, following a price increase.

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[1] Hereafter referred to as BCG.

[2] BCG and Lewis (2011) both discuss this possibility.

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This article finds evidence in favor of consumer search-based theories but no support for focal price collusion. Search-based theories predict that products whose customers have higher search costs will have prices that fall more slowly in response to a cost decrease. I argue that there is a systematic difference in the search costs of consumers who purchase premium or regular gasoline. As such, I confirm the prediction of these search theories by finding that premium prices fall more slowly than regular prices.

Additional empirical analysis supports search-based theories of asymmetric pricing, undermines collusion as a meaningful cause of the pricing pattern, and provides new insight into the relationship between the speed of price adjustment, firm price levels, and market structure. For example, I find that under certain market structures there is an inverse relationship between asymmetric pricing and the Herfindahl–Hirschman Index (HHI). While this finding stands as evidence against collusion as a meaningful determinant of the pricing phenomenon, viewed independently of theoretical motivations, the result improves our understanding of firm pricing behavior. Similarly, analysis of price dispersion, price levels, and their relationship to the speed of price adjustment further evidences the underlying cause of asymmetric pricing and demonstrates new empirical traits of dynamic pricing behavior.

This paper builds on previous work by Verlinda (2008) and Lewis (2011) to empirically test specific theories of rockets of feathers in gas markets. Both Lewis (2011) and Verlinda (2008) employ once-a-week price data for select markets in Southern California. Lewis (2011) finds more support for its reference-based search model than the search models in Tappata (2009) and Yang and Ye (2008) and focal price collusion. Conversely, Verlinda (2008) estimates a relationship between asymmetry, the location of rivals, and the visibility of posted prices that it argues to be consistent with tacit coordination and weakly inconsistent with search-based theories. The results in this article depart from Verlinda (2008) and are consistent with Lewis (2011), although I do not distinguish between particular search theories. Having daily, firm-level data spanning a large number of geographically diverse markets, however, allows me to more generally describe the relationship between asymmetric pricing and local market characteristics, as well as the pricing pattern's underlying cause.

I employ one year of daily retail gasoline price observations for more than 11,000 gas stations located on both coasts of the United States. Using this data, I establish the existence of asymmetric pricing with a high degree of precision and find that five days after an initial change to the spot price of unleaded gasoline firms incorporate 46% of a positive change into their final price, but only 22% of a negative change; the difference in the speed of retail price adjustment persists for more than ten days. Many previous empirical studies have verified the presence of asymmetric pricing in the gasoline industry.[3] BCG uses price data on four distinct links of the gasoline supply chain – crude oil, spot wholesale, local rack, and retail[4] – and finds evidence of asymmetry at every link except for the transmission from spot to local rack. It is more typical in the literature, however, to test the speed at which spot crude oil or spot wholesale prices are incorporated into final retail prices.[5] For example, Verlinda (2008) and Lewis (2011) both analyze the speed at which spot wholesale prices are transmitted to retail prices and find evidence of asymmetry. Chen et al. (2005) finds asymmetry in the response of retail prices to changes in both the spot price of crude oil and wholesale gasoline. There are, however, studies that fail to find evidence of asymmetry; for example, Godby et al. (2000) finds no crude to retail price asymmetry in thirteen Canadian cities and neither Bachmeier and Griffin (2003) nor Chen et al. (2005) find asymmetry in the response of spot wholesale prices to changes in spot crude oil prices.

A reason for the disparity in results in the asymmetric pricing literature is that different studies utilize data that covers unique geographic regions and is subject to different levels of aggregation. A large share of the literature uses price data that is averaged over large geographic areas, such as cities (BCG, Eckert (2002), Chesnes (2010)), states (Deltas (2008)), or countries (Galeotti et al. (2003)). Also, much of the previous analysis has relied upon data that is either averaged over time (Bacon (1991), Hosken et al. (2008))[6] or are sampled at regular temporal intervals (Verlinda (2008), Lewis (2011)). Bachmeier and Griffin (2003) find that temporal aggregation may lead to biased estimates of asymmetric pricing. By testing for price asymmetry and its cause using high-frequency, geographically diverse data, this article establishes empirical regularities with more generality than many previous studies.

The outline of the article is as follows; Section 2 discusses the data and its general properties, Section 3 introduces the econometric model and presents new evidence of rockets and feathers, Section 4 tests search-based theories of price asymmetry, Section 5 examines focal price collusion, and Section 6 concludes.

2. Data and summary statistics

The data in this article consists of daily, firm-level price observations from July 30th, 2008 through July 29th, 2009. Included in the data are observations for most gas stations in the states of New Jersey, Maryland, Virginia, Washington, as well as the Philadelphia, PA and Washington, DC metro areas. This amounts to over 11,000 unique stations. The data was culled from the website gasprices.mapquest.com whose information is provided by the Oil Price Information Service (OPIS). According to its website, OPIS collects data “through exclusive relationships with credit card companies, direct feeds, and other survey methods,” and therefore price observations are measured with a high degree of accuracy. While mapquest was scraped at daily intervals, the website did not report a new price for each station on every day. On average, they posted new price observations for 67% of stations on weekdays and 48% on weekends.[7]

Daily gasoline spot prices listed on the New York Mercantile Exchange (NYMEX) are employed as the cost variable. Reformulated gasoline delivered from the New York and Los Angeles Harbors are used for firms located in the eastern and western states, respectively. In reality, retail stations purchase gasoline at the rack price posted at local terminals, who in turn purchase their product on the spot market. BCG note, however, that terminal prices react symmetrically and almost immediately to changes in spot prices. Thus, spot prices should be highly correlated with terminal prices and suitable for use in the subsequent analysis. In accordance with the literature, I match the current day's retail price with same day's spot price,[8] which reflects the opportunity cost of holding inventory and is generally the index by which stations set their price.[9]

The spatial makeup of individual markets plays an important role in the econometric analysis.[10] For example, the number of competing stations within given distances of a firm is incorporated into some of the empirical tests. To calculate this, I first geocoded the data using ArcGIS

[3] Geweke (2004) offers a detailed summary of the asymmetric pricing literature.

[4] Generally speaking, these prices are listed from upstream to downstream. See, BCG for a more detailed explanation.

[5] The reliance upon either crude or spot over rack as a measure of cost is due to crude and spot prices being publicly available, while rack prices are proprietary.

[6] Each of the papers listed as using geographically averaged prices also use temporally averaged data.

[7] This is consistent with other studies that use OPIS data, such as Doyle and Samphantharak (2008) and Chandra and Tappata (2011).

[8] Chandra and Tappata (2011), Lewis (2008), and Verlinda (2008) also use this approach.

[9] The Association for Convenience and Petroleum Retailing explains in their, 2009 Gas Price Kit that firms set retail prices based on the “replacement cost” of gasoline: the current wholesale price.

[10] Houde (2012) finds that both market structure and commuting patterns impact retail gasoline price dynamics.