International Journal of Industrial Organization 26 (2008) 1425–1436

Contents lists available at ScienceDirect

International Journal of Industrial Organization

journal homepage: www.elsevier.com/locate/econbase

Retail gasoline pricing: What do we know?☆

Daniel S. Hosken, Robert S. McMillan, Christopher T. Taylor *

Federal Trade Commission, United States

ARTICLE INFO

Article history:
Received 23 October 2007
Revised 15 February 2008
Accepted 16 February 2008
Available online 26 February 2008

Keywords:
Retailing
Petroleum industry
Pricing
Gasoline

ABSTRACT

We use a data set consisting of a three year panel of prices from a sample of gasoline stations located in suburban Washington DC and a corresponding census of the region's stations to develop three new empirical findings about retail gasoline pricing. First, while average retail margins vary substantially over time (by more than 50% over the three years we analyze), the shape of the margin distribution remains relatively constant. Second, there is substantial heterogeneity in pricing behavior: stations charging very low or very high prices are more likely to maintain their pricing position than stations charging prices near the mean. Third, retail gasoline pricing is dynamic. Despite the heterogeneity in station pricing behavior, stations frequently change their relative pricing position in this distribution, sometimes dramatically. We then relate these three findings to relevant theories of retail pricing. While many models of retail pricing are consistent with some of our findings, we find that all have serious shortcomings.

Published by Elsevier B.V.

1. Introduction

The recent increases in the price of gasoline have focused attention on all levels of the gasoline supply chain, from refining to retail. In response to higher price and price spikes the U.S. Congress considered legislation providing civil and criminal sanctions for price gouging.[1] In contrast, states have also expressed concern about selling gasoline at too *low* a price. In response to these concerns, some states have modified or increased enforcement of "sales below cost" or *minimum* markups laws.[2]

The increased concern about gasoline pricing has led to increased interest in how retail gasoline prices are determined and how they change. Previously, large panel data sets of station-specific gasoline prices have generally not been available. Recently, credit card (i.e., "fleet card") transaction data has enabled researchers to examine the pricing behavior of a large number of gasoline stations over an extended period of time.

We use a three year panel data set of weekly gasoline prices based on fleet card transactions from 272 gasoline stations located in the Northern Virginia suburbs of Washington, DC, along with a census of the stations in the area (consisting of station locations and a wealth of station characteristics), to establish a number of new empirical findings about retail gasoline pricing and relate these findings to the existing theoretical literature on pricing behavior. Our analysis suggests deficiencies in using existing theories of pricing to describe retail gasoline pricing.

Our first finding is the retail markup for gasoline changes sizably over time and these changes are persistent. For instance, in our sample, the weekly median margin is more than 17 cents per gallon (cpg) for 26 consecutive weeks (the mean of the median is 19.4 cpg) in 1997 and 1998 before falling to less than 14 cpg a week (the mean of the median is 10.7 cpg) for 12 weeks. While the changing margins may be partially

☆ Views and opinions expressed in this paper are solely those of the authors and should not be interpreted as reflecting the views of the Federal Trade Commission, any of its individual Commissioners, or other members of the staff. Comments by Emek Basker, Matthew Lewis, Michael Noel, David Meyer, David Reiffen and Steven Tenn and excellent research assistance by Van Brantner and Elisabeth Murphy are appreciated.

* Corresponding author. Bureau of Economics, Federal Trade Commission, 600 Pennsylvania Ave, NW, Washington, DC 20580, United States. Tel.: +1 202 326 2997.
E-mail address: ctaylor@ftc.gov (C.T. Taylor).

[1] Many states have gouging statutes. Following Hurricane Katrina more than 100 gasoline stations were investigated by states for gouging. See: Federal Trade Commission (2006).

[2] Six states have recently considered this type of legislation. See FTC staff letter to Michigan Representative DeRossett, June 2004. http://www.ftc.gov/os/2004/06/040618staffcommentsmichiganpetrol.pdf.

0167-7187/$ – see front matter. Published by Elsevier B.V.
doi:10.1016/j.ijindorg.2008.02.003

explained by asymmetric price adjustment, our empirical work suggests that equilibrium margins change as well.

Second, we find that stations do not appear to use simple static pricing rules: stations do not charge a fixed markup over their wholesale costs, nor do they maintain their relative position in the pricing distribution over time. Instead, a particular gasoline station frequently changes its relative position in the pricing distribution, sometimes dramatically. From one week to the next, stations are more likely than not to change their position relative to the regional mean measured in dollars or rank relative to closest stations.[3] Stations that charge very high or very low prices in one period, however, are much more likely to charge high or low prices in subsequent periods. Interestingly, there appears to be an asymmetry in this behavior. Stations charging low prices appear to remain low-priced stations for longer periods than high priced stations. While some stations consistently charge relatively high or low prices, the only station characteristic that is a good predictor of this heterogeneity is a station's brand affiliation. Other stations characteristics, e.g., offering repair services or full service gasoline, and measures of localized competition are not consistently associated with a station's retail markup.

Third, a subset of gasoline stations change their average pricing strategy over time. Roughly 30% of stations significantly change their "typical price" (defined as a station's mean price in a year relative to the mean price in Northern Virginia in that year) from one year to the next. Between 1997 and 1998 nearly 25% of gasoline stations changed their relative position in the pricing distribution by more than 20 percentile points, e.g., moving from the 70th percentile to the 50th percentile. During our sample period, the mean station earned a margin of roughly 14 cpg. Between 1997 and 1998, 33% of stations changed their *relative* margin by roughly 4 cpg. This corresponds to a change in retail markup roughly 28% of the region's average markup. A substantial number of gasoline stations make large changes in their pricing decisions over relatively short time periods.

We relate our findings to five types of retail pricing models. The first two types are static models. The pure strategy models predict that in each period retailers will charge the single-period profit-maximizing prices which vary with localized demand, competition, and marginal costs. A second type of static model allows for mixed strategies in prices that generate equilibria in which prices and margins vary even when costs and market structure remain constant. We then describe three types of dynamic models: models of collusive behavior, models with history-dependent demand curves that lead to asymmetric price adjustment, and models of Edgeworth cycles.

While each of these models is consistent with some elements of the retail gasoline pricing we observe, none fit all the stylized facts. For example, while there is systematic heterogeneity in gasoline station pricing (consistent with a model predicting constant margins), stations frequently change their margins. Static models predicting mixed strategies in prices fail to predict the pricing persistence we observe. Our findings clearly show dynamic station pricing: pricing in week t depends on pricing week $t-1$. The existing dynamic models also do not comport well with our findings. While margins change dramatically during our sample period, there is no evidence of price wars. Similarly, models of asymmetric price adjustment or Edgeworth cycles are also not supported by our data.

The remainder of paper is organized as follows. The next section provides a brief review of the empirical gasoline pricing literature, a summary of relevant institutional detail about gasoline retailing and describes our data. Section 3 presents our empirical findings. Section 4 discusses the various models of pricing behavior most likely to be applicable to retail gasoline and relates these models to our empirical findings. Section 5 concludes.

2. Literature review, background, and data

Constrained by available data, researchers have historically examined either inter-temporal or inter-station price variation. The research on inter-temporal variation, often referred to as the "rockets and feathers" literature, uses pricing data at various levels of the industry (i.e., spot, rack and retail) usually aggregated over large geographic areas to examine the price response of gasoline at one level, e.g. retail, to a change in price at another level, e.g. wholesale. Some papers in this literature find that retail prices increase more quickly following increases to wholesale prices than decreases, (see, e.g., Borenstein et al., 1997), while others (e.g. Galeotti et al., 2003) find the opposite result. The results of this literature are mixed and seem to depend on the time aggregation of the data (daily, weekly, or monthly), the level of the industry examined (refining, distribution, or retail), and the estimation technique.

The research on inter-station price variation uses station-level data either as a single-period cross-sectional or a short panel.[4] These papers have found that much of the inter-station variation in retail price is explained by brand affiliation, measures of localized competition (e.g. localized station density), and a handful of station attributes (e.g., convenience store). Our results suggest that these findings may not be robust over time periods or locales.

Our paper belongs to a relatively nascent but growing group of papers at the convergence of these two branches of the empirical gasoline pricing literature and uses relatively long panels of weekly (or daily) station-level pricing data to examine the dynamics of station-level pricing behavior. Eckert and West (2004a,b) and Noel (2005, 2007a,b) analyze station-level dynamics, and find evidence of Edgeworth cycles in station-level retail pricing. Lewis (2007) also finds evidence of Edgeworth cycles using a panel of aggregated (to the city) retail gasoline pricing. Lewis (2005) verifies that the "rockets and feathers" pattern is present in station-level data in Southern California. Lewis (in press) is the study most similar to ours. It examines retail price dispersion using a sample of station-level pricing data from Southern California. In contrast to our paper, Lewis (in press) focuses directly on

[3] Lach (2002) finds very similar results in a sample of retail prices of consumer goods in Israel; i.e., the relative position of a retailer in the pricing distribution changes frequently.

[4] For papers examining retail gasoline pricing in a cross section or short panel see, Slade (1992), Shepard (1990, 1991, 1993), Barron et al. (2000, 2004), and Hastings (2004).