gasoline markets

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Abstract

Gasoline retail markets have traditionally attracted a lot of attention from researchers and policy makers. This entry reviews a set of questions studied by Industrial Organisation (IO) economists related to this market. The discussion is organised around three themes. The first reviews papers concerned with the transmission of cost shocks and the cyclical properties of gasoline prices. The second theme includes a variety of papers testing for market power, and providing evidence in favour of price discrimination, tacit collusion, differentiation and vertical restraints. Finally, the last section is devoted to papers evaluating the consequences of economic and environmental regulations in gasoline markets.

Keywords

gasoline; retailing; oligopoly; pricing; regulation; vertical relations

Article

Within the petroleum industry, gasoline markets have been a focus of intensive research. The availability of large datasets, combined with a complex and diverse industrial structure, has motivated many important empirical and theoretical articles. This entry will focus on the retail segment of the petroleum industry, which also includes extraction, refinery and distribution.

Despite often being portrayed as the archetype of a perfectly competitive market, economists and policymakers have long been intrigued by the behaviour of gasoline prices. It is not uncommon to observe prices jumping sharply in a coordinated manner, or crude oil price shocks being passed through asymmetrically to consumers. Gasoline price wars have attracted a great deal of attention as well, sometimes triggering price control regulations from governments in the USA and around the world. The recent wave of vertical mergers has led the US senate to conduct a comprehensive analysis of the industry, as summarised by Senator Carl Levin's report in 2002. Consumers are also greatly concerned about gasoline price movements, as it occupies a between 4.5% and 12.4% of households' disposable income, especially for poorer households (Gicheva *et al*., 2007).

This entry will attempt to summarise the academic research studying gasoline markets. The discussion is organised around three themes: (i) incomplete pass-through and retail price cycles, (ii) evaluation of market power, and (iii) regulation.

Incomplete pass-through and retail price cycles

Like many commodity goods, gasoline prices are known to adjust slowly to cost changes. What is more intriguing is the fact that gasoline prices commonly adjust faster to cost increases than cost decreases. This phenomenon, known as *rockets and feathers*, was first documented by Bacon (1991) in an analysis of the UK gasoline market. Peltzman (2000) documents similar asymmetries in a wide array of retail markets.

Among the most detailed studies, Borenstein *et al*. (1997) demonstrate the existence of a large asymmetric pass-through in US markets: retail prices are on average 0.55 cents *higher* two weeks after a 1 cent increase in the price of crude oil, but are only 0.18 cents *lower* after a 1 cent decrease. They also show that more than half of this asymmetry is due the adjustment of wholesale prices, while the remainder is due to a small but significant asymmetric adjustment of retail prices.

The most likely explanation for the upstream asymmetry is related to the interplay of production adjustment costs and storage capacity at the refinery level (see Borenstein and Shepard (2002)). At the retail level, several theories have been proposed. It is clear for instance that asymmetric adjustments are more prevalent in concentrated retail markets (Deltas, 2008), and Borenstein *et al*. have argued that tacit collusion can cause the retail price asymmetries.

Information frictions between consumers and firms have also been proposed to explain the phenomenon. Tappata (2009), for instance, builds an oligopoly pricing model with search frictions in which consumers endogenously choose a lower search effort when costs are expected to be high. This leads to a relatively inelastic demand after an unexpected decline in wholesale prices. Yang and Ye (2008) and Lewis (2005) also provide related search-based theoretical and empirical analysis of asymmetric pass-through.

A related phenomenon has gained a lot of attention. In many cities gasoline prices follow easily predictable asymmetric cycles akin to *Edgeworth cycles* (Edgeworth, 1925): price increases are fast and large (relenting phase), and are followed by a sequence of small decreases (undercutting phase). The existence of these cycles and the fact that they differ from asymmetric pass-through was first documented by Castanias and Johnson (1993) in US markets, and later by Eckert (2002) and Noel (2007a) in Canada. See also Noel (2009) for a discussion of incomplete pass-through in markets with Edgeworth cycles.

Several authors have documented interesting connections between the structure of local markets and the cycles' attributes. Noel (2007a, 2007b) in particular showed that competitive markets tend to have short-lived cycles (or no cycle at all), while small isolated markets often exhibit long periods of price stability and month-long cycles.

The causes and welfare consequences of these cycles are not well understood. Most authors have rationalised their presence using the dynamic pricing game of Maskin and Tirole (1988), which shows that an *Edgeworth cycle* can emerge as a non-cooperative Markov-perfect equilibrium.

The model matches well many features of gasoline price cycles (see Eckert (2003) and Noel (2007b)). On the other hand, two key assumptions—(i) consumers react instantaneously to price differences and (ii) firms are unable to simultaneously adjust their prices—are at odds with several features of gasoline markets. In particular, it is widely acknowledged that retailers are able to adjust their prices

frequently, while consumers are thought to be less informed than firms. Hosken *et al.* (2008) and Lewis (2008) provide comprehensive analysis of gasoline price dispersions and dynamic price adjustments in US markets.

Moreover, two recent price-fixing cases discovered in Australia and Canada revealed that some features of Edgeworth cycles can be explicitly coordinated by retailers (see Wang (2008), and Clark and Houde (2010)). Related to this, Wang (2009) provides an interesting analysis of an Australian policy that forces retailers to simultaneously change their prices only once a day. Consistent with explicit collusion, the results show that price increases are heavily coordinated when firms can freely adjust their prices. After the policy change, however, although prices still follow Edgeworth-like patterns, firms behave according to a mixed strategy consistent with a war of attrition game.

Evaluation of market power

Despite the fact that gasoline is a homogenous product for which prices are easily observed, many authors have argued that firms are able to exert a certain degree of market power.

A first group of papers have looked into the market power assumption by testing for price discrimination. Two examples are particularly interesting. Borenstein (1991) uses the slow decrease in the supply of leaded gasoline during the 1980s to show that retailers selling leaded gasoline were increasingly able to extract rents from consumers as the number of available options shrunk.

Shepard (1991) tests for price discrimination by comparing prices at self- and full-service stations. Her sample includes of a significant fraction of stores offering both types of product, which helps to isolate price discrimination motives from unobserved cost differences. By comparing prices at mixed and traditional stations, she tests the hypothesis that a multi-product firm with market power is better able to price-discriminate than a single-product firm. Her results are conclusive: retail prices for full-service gasoline are significantly higher at multi-product stations. Interestingly, multi-product stations also tend to distort full-service margins more than self-service margins, consistent with a model of second-degree price discrimination.

A second group of authors have studied retail margins from a tacit collusion perspective. Slade (1987, 1992) studied the behaviour of retailers in Vancouver during price wars and developed a test discriminating between a static pricing model and *supergame* strategies. Her results easily reject the static pricing model and uncover interesting asymmetries between major and independent retailers. Majors are acting as price leaders responsible for coordinating price increases, while independents are more likely to initiate price wars.

Borenstein and Shepard (1996) provide a more indirect test, looking at the dynamics of margins and demand. They show that gasoline margins respond positively to expected future demand, consistently with the "price wars during booms" prediction of Rotemberg and Saloner (1986).

A third line of research uses observed mergers to quantify the market power of vertically integrated chains. Hastings (2004) is a leading example of this approach (see also Hastings and Gilbert (2005), Simpson and Taylor (2008) and Taylor *et al.* (2007)). Her identification argument relies on the idea that retail mergers that are negotiated nationally create sharp changes in market structure that are exogenous to

local market conditions. Her results suggest that stores competing directly with independent retailers post significantly lower prices, consistent with vertical restraints and brand loyalty interpretations.

More recently, a few authors have used a structural approach to quantify market power in gasoline markets. Houde (2009) estimates an empirical model of spatial differentiation that incorporates the fact that consumers are mobile within the market, unlike the classic address model proposed by Hotelling (1929). The distance between consumers and firms is defined as the time deviation from home-to-work commuting paths, and elasticities of substitution are directly related to the road network structure and traffic flows (rather than physical distance alone). The results indicate that firms enjoy relatively little market power, especially compared to a model in which consumers are located at a single point. Moreover, retail margins would decrease by about 7% if stores were setting their prices independently.

Hastings (2008) uses a similar approach, but focuses on the availability of rich store-level data on wholesale prices. She first documents that stores are paying different wholesale prices, despite being part of the same brand network. She then simulates a uniform wholesale price regulation. The results suggest that wholesale price discrimination has a pro-competitive effect in this market.

Regulation

Gasoline markets often operate under constraining regulations. Two classes of policies have frequently been discussed: below-cost sales and divorcement regulations.

Below-cost sales regulations are currently in place in nine US states and three Canadian province and the debate is ongoing in many jurisdictions. In some cases below-cost regulations date as far back as the great depression, where many state governments institute "fair-business practice" laws applied to all retail markets. The advocates of these policies typically associate aggressive pricing with predatory and loss-leader strategies. Antitrust authorities typically view such legislations as unnecessary, and they point out that state governments may be too easily convinced by accusations of predation made by lobbying groups representing non-integrated chains of gasoline stations.

Several researchers have evaluated the impact of those policies on prices using cross-sectional data and found significant price increases (see in particular Fenili and Lane (1985), Anderson and Johnson (1999), and Johnson and Romeo (2000)). Recently, Carranza *et al*. (2009) re-examined this question using a store-level panel dataset in Canada. They found that a policy change in the province of Québec led to a long-run decrease in margins and station productivity that can be largely explained by endogenous changes in the composition of markets. Similar results are also found by Skidmore *et al*. (2005).

Divorcement acts have been implemented in six states to prevent the vertical integration of major oil refiners in the retail sector. They have typically been justified by theories pointing to anticompetitive motives for vertical integration. However, most empirical papers evaluating those policies suggest that banning vertical integration in general leads to higher prices. See in particular the papers by Barron and Umbeck (1984) and Blass and Carlton (2001). Shepard (1993) and Slade (1996) also provide interesting analysis of contractual arrangements in gasoline markets,

which suggest that vertical integration might be more efficient than separation in some context.

Finally, a small number of researchers have recently studied the impact of environmental regulations on the organisation and performance of gasoline markets. Brown *et al*. (2008) and Muehlegger (2006), for instance, look at the impact of gasoline content regulations on wholesale prices, using reduced-form and structural methodologies respectively. Both found that the imposition of heterogenous content regulations across different geographic markets led to greater market segmentation and higher prices. Ying *et al*. (2010) compare the public and private provision of insurance for hazard risks of gasoline underground storage tanks. Insurance premiums under public systems are typically uniform and provide little incentive for station owners to upgrade their technology, potentially creating significant moral hazard risks. Yin *et al*. indeed found that Michigan's transition to private market liability insurance led to a 20% decline in accidents relative to adjacent states providing public insurance coverage (i.e. Illinois and Indiana).

Conclusion

As the previous discussion has demonstrated, gasoline markets have generated an impressive amount of academic research. Many topics are still open and richer datasets are increasingly becoming available, which should lead to even more analysis.

It is fair to say that the literature on market power and dynamic pricing should be better integrated. In particular, we learned from the former that consumers are heterogeneous along several dimensions (e.g. income, commuting, information), which leads to price differences across markets and stores. This heterogeneity could play a role in explaining the causes and consequences of asymmetric pass-through and price cycles, but the dynamic pricing literature has largely ignored the consumer side of the market from their analysis.

Similarly, structural and reduced-form methods have been used to document and measure the importance of differentiation and vertical contracts in explaining profit margins. However, little research has been conducted to study firms' decisions to differentiate themselves (e.g. retail network configuration, choice of amenities, etc.), and design vertical contracts. Large and precise datasets are now available concerning the location of stores and road networks, allowing researchers to study models of product differentiation empirically. Similar information on the terms of contracts between franchisees and upstream suppliers is much harder to obtain, but would be crucial for better understand the role of vertical restraints in this market.

Finally, although this article has focused mainly on the downstream segment of the petroleum industry, it should be noted that much less research has been devoted to studying market power in the upstream segments. In many respects the refinery sector is analogous to the retail sector but is significantly more concentrated. Even so, we know relatively little about the impact of upstream market structure (e.g. localisation and ownership of refineries) on market outcomes such as wholesale prices and capacity utilisation.

See Also

- market power and collusion in laboratory markets
- vertical integration

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