Station Heterogeneity and Asymmetric Gasoline Price Responses

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Overview

Like many other countries, fluctuating pump prices in Germany have long been a subject of intense public debate due to the associated impact on consumers' disposable income and purchasing power as well as the excess burden on small- and medium-sized companies that rely on fuel. Broadly, the public discourse ranges from discussion of price increases during holiday and vacation seasons (especially in summer) to suspicions of price coordination, abuse of market power, and asymmetric price adjustments. Some of these concerns, particularly, asymmetric adjustment of pump prices to input cost fluctuations have been examined extensively in the literature. However, constrained by data availability, earlier studies often assessed the inter-temporal price variation using pump prices aggregated across geographically diverse fuel stations. The findings are inconclusive, with some studies showing that pump prices respond swiftly to crude oil or wholesale price increases than decreases – a phenomenon characterized as the *rockets and feathers* pattern – while others find the opposite (see Eckert, 2013; Periguero-García, 2013; Cook and Fosten, 2019, for a review of the literature). The mixed results – even for the same market – can be attributed to data aggregation and the estimation techniques employed.

When reviewing the literature, two forms of data aggregation become apparent: temporal aggregation and spatial aggregation. On the one hand, because of intra-day pump price volatility and short-run input cost changes, low-frequency price data – for instance, weekly or monthly data – may inadequately reflect the frequency of price decisions (Asane-Otoo and Dannemann, 2022). On the other hand, spatial aggregation ignores station-specific heterogeneity, such as differences in pricing strategy and local market competition. Moreover, it may also fail to account for spatial differences – e.g., market structure and population density – among local markets accurately and could compromise the validity of estimations (see, for example, Granger, 1980; Pesaran and Smith, 1995; Pesaran and Chudik, 2014).

In this paper, we argue that due to the highly localized nature of the retail gasoline market and the observation that market power is geographically constrained, findings based on aggregated data or regression techniques that draw inferences based on average estimates for a *representative* station are likely to be inaccurate. Moreover, any effective policy intervention to address anti-competitive pricing or abuse of market power requires an understanding of price dynamics at the individual station level. Accordingly, our analysis centers on individual stations and market features that determine their pricing bahaviour. That is, we do not seek to answer why asymmetric pricing exists in the German retail gasoline market but rather which stations engage in this pricing behavior and whether certain local market features increase the tendency of price asymmetry.

Data & Methods

The analysis draws on a unique data set covering virtually all stations with exact time stamps for all price quotes. We observe daily retail and wholesale prices across 13,756 fuel stations over a period of 7 years from January 1, 2014 to December 31, 2020. In Germany, retailers or brands are entirely responsible for all pricing decisions, and the degree and frequency of price changes are not regulated. To examine retail price changes on an inter-day basis, daily averages are calculated since there may be multiple observations for a station per day. In our analysis, average retail prices are nominal consumer prices at the pump in euros (cents) per liter. In contrast to previous studies, we rely on *station-specific wholesale gasoline prices* as the relevant input cost. We compute the station-specific wholesale price using detailed information on 8 regional wholesale markets and distances from individual stations to specific refineries or depots. Employing station-specific wholesale gasoline prices instead of international crude oil prices improves previous studies since they more accurately reflect the marginal cost and account for the heterogeneous transport cost of gasoline from refineries or depots to stations.

The analysis is in twofold: First, to investigate whether retail prices (r) at the station level adjust asymmetrically to in input cost changes ($\triangle wp$), we use an asymmetric error correction model (AECM) specified as follows:

$$\triangle r_t = \alpha + \phi^+ \xi^+_{t-1} + \phi^- \xi^-_{t-1} + \sum_{m=1}^{M} \left(\beta^+_m \triangle r^+_{t-m} + \beta^-_m \triangle r^-_{t-m}\right) \tag{1}$$
$$+ \sum_{n=0}^{N} \left(\lambda^+_n \triangle wp^+_{t-n} + \lambda^-_n \triangle wp^-_{t-n}\right) + \psi \triangle \overline{r}_{(-i),-1} + \delta' \boldsymbol{D} + \gamma' \triangle \boldsymbol{H} + \pi' \triangle \boldsymbol{W} + \tau' \boldsymbol{Y} + \tau t + \varepsilon_{ist}$$

ξ_{ist} is the estimated error term from the cointegrating equation, $\xi^+_{ist-1} = max\{\xi_{ist-1}, 0\}$ and $\xi^-_{ist-1} = min\{\xi_{ist-1}, 0\}$. For each variable v in equation (1): $\triangle v^+ = max\{\triangle v, 0\}$ and $\triangle v^- = min\{\triangle v, 0\}$. Note that

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a plus (minus) as superscript to a coefficient is indicative of an increase (decrease) change in the associated variable. This approach allows us to evaluate the presence of the rockets-and-feathers phenomenon – i.e., whether station-specific wholesale price increases are transmitted more swiftly than a corresponding price decrease. The coefficients (ϕ^+ and ϕ^-) associated with the error correction terms are therefore the long-run adjustment parameters. They reflect the speed of the adjustment process towards the long-run equilibrium. For example, positive deviations of retail prices from equilibrium in the previous period ξ^+_{ist-1} – due to a decrease in wholesale price – should return to the equilibrium in the current period at the rate of ϕ^+. Therefore, if $|\phi^+| < |\phi^-|$, then the mean reversion of retail prices to equilibrium is faster when retail prices are below their long-run equilibrium level – implying a wholesale price increase – and slower when otherwise.

To account for other determinants of price changes, we include a vector ($\boldsymbol{D}$) of day-of-the-week-specific dummies, a vector ($\boldsymbol{H}$) of public and the start of school holidays, and a vector ($\boldsymbol{W}$) of weather related variables – precipitation, snow depth, and heating and cooling degree days (HDD/CDD). We also include a vector ($\boldsymbol{Y}$) to denote month and year dummy variables that control for seasonalities and common year- or month-specific effects. This includes the negative demand shocks during the COVID pandemic lock-downs in 2020. Local competition is denoted by the day-to-day changes in duration-weighted average prices ($\triangle\overline{r}_{-i}$) of neighboring stations within 5 km. This variable also takes into account potential cross-section dependence among stations in a local market.

Second, since competition in gasoline retailing is highly localized, the level of competition may depend largely on market-specific characteristics such as density and spatial distribution of nearby competitors, market structure, and population dynamics. We construct variables that reflect these market characteristics and conduct a cross-sectional analysis to provide insights into the pricing pattern determinants across the 13,756 fuel stations. The dependent variable in our cross-sectional regression is the difference between the absolute values of the long-run adjustment parameters in equation (1), weighted by their inverse standard error.

Main Results

Using an asymmetric error correction model for each station, we find that 53% of stations respond asymmetrically to wholesale gasoline price changes by swiftly passing the price change to consumers when it decreases the retail margin than when it increases it. The remaining 47% of stations respond symmetrically to wholesale gasoline price changes or pass on wholesale price decreases faster to consumers than increases. Our finding suggests that asymmetric pricing is a feature of individual stations and not unique to specific brands or sub-regional markets. This finding contrast recent findings for Germany that suggest that asymmetric pricing is the norm rather than exception and the *rockets-and-feathers* phenomenon is very prevalent in the German retail fuel market. Local market characteristics such as the concentration of major or same brands and the pricing behavior of rival stations are critical determinants. We find that higher density of stations in a local market assures competitive pricing behavior. Fuel stations with low number of competing neighboring firms are more likely to engage in the rocket and feathers pricing pattern than stations with higher number of competing neighbors. We also show that a high concentration of major brands or same-brand stations reduces price competition in the local market and the pricing behavior of stations correlates positively with the pricing patterns of competitive neighbors.

Conclusions

Anti-competitive pricing in the retail gasoline market is attributed mainly to market inefficiencies, e.g., market power and information asymmetry. This paper examines the prevalence of anti-competitive pricing in the German retail gasoline market following the price transparency regulation in 2013. Specifically, we investigate whether retail fuel prices adjust more swiftly to input cost increases than decreases – a phenomenon characterized as the *rockets and feathers* pricing pattern. Previous studies have investigated this pricing pattern by employing data aggregated across stations and time or adopted estimation techniques that ignore parameter heterogeneity across stations. However, to provide a comprehensive understanding of asymmetric price responses, it is crucial to conduct the analysis at the station level, where pricing decisions are actually implemented.

Our finding suggests that asymmetric pricing is a feature of individual stations and not unique to specific brands or sub-regional markets. Local market characteristics such as the concentration of major or same brands and the pricing behavior of rival stations are critical determinants. The results show that despite the competition-enhancing price transparency regulation, market power exploitation is one reason behind these results. The fuel market is vertically integrated such that major brands do not only own a large share of refineries but also operate more than half of stations. This confers market power, which they can exploit to their advantage. Given the localized nature of gasoline retailing, the regulator should pay more attention to market entry regulations and how future mergers and acquisitions can alter local market conditions since these factors are critical to stations' pricing behavior. Overall, our findings offer a comprehensive view of the retail gasoline market in a major OECD country following the implementation of price transparency regulations, thereby allowing us to generalize our findings to typical national retail gasoline markets.

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