

# **Competition and Cooperation in Retail Gasoline Markets: An Empirical Study**

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## **Competition and Cooperation in Retail Gasoline Markets: An Empirical Study**

*Abstract: Local retail gasoline markets offer a relatively low cost opportunity to test a number of hypotheses from the industrial organization literature regarding the interdependence of pricing choices. Is there tacit collusion among retailers? Or does the strong correlation of prices represent the natural workings of a highly competitive market (i.e. the law of one price)? Is there evidence of price leadership? Do customers perceive gasoline from competing brands as differentiated products? Is there greater price dispersion among spatially differentiated outlets? Are there persistent price differences between independent and branded stations? We argue that repeating these tests at the local level may be a useful exercise for undergraduate industrial organization classes.*

### INTRODUCTION

In recent years surging prices have drawn the retail gasoline market directly into the public eye. News broadcasts now regularly feature segments reporting average prices for the country; websites document variations in prices within cities; and legislators are debating repeals of gasoline taxes to ease consumer pains. While the increased public attention has caused outcries about high prices, the discourse rarely includes analysis of pricing policies, strategies, and conventions within the retail gasoline market.

This paper investigates a number of questions from the industrial organization literature regarding pricing in the retail gasoline market. Is there tacit collusion among retailers or does the strong correlation of prices represent the natural workings of a competitive market (the law of one price)? Is there evidence of price leadership? Is there greater price dispersion among spatially differentiated outlets selling the same brand? Is there any evidence of persistent price differences between independent and branded stations? What effects do state regulations have on pricing decisions? In addition to being a case study, this exercise may also be useful in exploring these issues in undergraduate industrial organization classes.

The study draws upon price data collected in a case study of retail outlets in Stevens Point, WI since the fall of 2007. Stevens Point is home to a University of Wisconsin system campus and is located in central Wisconsin with a population of roughly 25,000. Adjoining communities increase the regional population by another 10,000 individuals. The city is located at the crossroads of the major north/south interstate artery to the north-central portion of the state and a major east/west artery. The data was collected from 11 stations selected for their geographic dispersion as well as ownership/affiliation. The stations are located in four distinct geographic zones located along four major routes to the city center and represent a mix of national franchises and independently owned and operated stations. The variation in stations will provide evidence for a number of questions concerning the industry.

The balance of the paper will proceed as follows. First, it reviews a number of hypotheses from the classic industrial organization literature that will be investigated. Second, the paper discusses methods of analysis and the results from these tests. Lastly, the paper examines limitations with current analyses and discusses ideas for future research.

## RELEVANT INDUSTRIAL ORGANIZATION ISSUES

The high degree of price visibility and the geographical proximity of outlets make local retail gasoline markets ideal candidates for testing the interdependence of pricing choices. Within a given geographic market, the market structure of gasoline retailing has been “described as a differentiated chain oligopoly” (Scherer, 1996, 124). However, to the degree that consumers view gasoline as a homogeneous good, price interaction between two adjacent competing retailers (say, across the street from each other) may be better characterized as an infinitely repeated Bertrand game. (Our research looked exclusively at prices for “regular unleaded” gasoline.) In any one period, the retailer that charges a lower price captures the vast majority of sales, given the same location. In a static one period game, the Nash equilibrium pair of prices under this duopoly setting would approach marginal cost, a classic prisoner’s dilemma outcome. Repeated interactions, however, create the opportunity for firms to retaliate in future periods in response to current defections by rivals. In this dynamic setting (infinite period game), the expected loss of future profits from defection (assuming relatively low discount rates) allows for cooperation (collusion) to become a Nash equilibrium strategy (Cabral, 2000). Analyzing the behavior of gasoline retailers in local markets provides an opportunity to explore a number of theoretical issues relating to the interdependence of pricing choices. Do oligopolistic market conditions lead to collusive equilibriums? Or does the uniformity of prices reflect competitive market outcomes? Do firms employ mechanisms to facilitate cooperation? What role does location play in affecting price decisions? Are there persistent price differences between branded and independent stations?

### *Tacit Collusion*

A collusive outcome does not necessarily imply direct communication among firms. A market in which few firms sell a homogeneous product and pricing decisions are readily observable is one in which there is a strong recognition of mutual interdependence. “When only a few firms populate an industry, they must recognize that the industry structure causes interdependent behavior. Each firm knows that its optimal price is a function of the prices charged by rivals and that those rivals and that those prices, in turn, are functions of the prices it selects. Under these circumstances, it would be silly to expect the firms to ignore the obvious and blithely act as though they were totally independent” (Kaserman and Mayo, 1995, 201-202). This environment is conducive to tacit collusion where there exists coordination of actions without explicit communication. As stated above, recognition of mutual interdependence in a dynamic setting can lead firms to agree to supracompetitive pricing. Evidence of a strong correlation of pricing decisions may be a strong indicator of tacit collusion.

Yet such a correlation is subject to an alternative interpretation. Convergence to a single price may represent a competitive equilibrium. Parallel price changes often reflect the workings of a competitive market as firms adjust to changing market conditions or changes in wholesale prices. An analysis of correlation of prices alone illustrates the challenges for economists in distinguishing tacit collusion from “normal” competitive behavior.

### *Price Leadership*

The practice of price leadership may be evidence of tacit collusion among retailers. At a particular time of day, the price leader “posts prices at levels that will benefit both itself and other sellers, and the other stations will follow suit without actually discussing the matter. Pricing in this case becomes interdependent and cooperative through an accepted time sequence...” (Scherer, 1996, 127). Markets for homogeneous products with few sellers that face inelastic demand at competitive price levels tend to be conducive to collusive price leadership (Kaserman and Mayo, 1995, 201). Yet, evidence of price leadership does not necessarily imply that participants are engaging in tacit collusion. Price leadership also may be a mechanism that facilitates the competitive process. In some markets, a price leader “may serve the industry as a barometer of overall market conditions. Consequently, rivals follow its lead not because of collusion or coercion but only because its price accurately reflects market conditions. In other words, the barometric firm’s price serves as useful information for the other firms in the industry.” (Kaserman and Mayo, 1995, 200). Again, issues of interpretation persist.

### *Price Dispersion*

If prices are dispersed in the market there are a few possible explanations for the outcome which can be tested. Even if consumers view competing brands as homogeneous goods, retailers’ products are differentiated to the degree that their stores’ locations differ. In terms of finding information about the prices charged by stations in a geographic area, customers will be forced to incur search costs. If these search costs exceed the expected gains from finding lower priced outlets, outlets charging different prices may be an equilibrium outcome (Cabral, 2000, 219). In this case, the level of “price dispersion” in a market can be the result of search costs consumers face when they are imperfectly informed about price. The degree of price dispersion may signal the importance of location as a source of product differentiation. Of course, persistent differences in prices among retailers also may indicate heterogeneous preferences of consumers over different brands of gasoline. If a significant number of consumers perceive quality differences among brands, price differences between brands may persist in equilibrium.

### *Independent vs. Branded Gasoline*

An alternative explanation of price dispersion could be due to the affiliations of the particular stations. In our study, there are two firms (accounting for three stations in all) that sell unbranded gasoline. Branded gasoline differs from unbranded gasoline in that branded gasoline contains additives that are absent in unbranded gas. “For example, in

order to be called ‘Chevron’ gasoline at the retail station, the gasoline must contain the additive Techron™. A similar requirement holds for Shell, Texaco, Exxon, and most of the other brands available on the market. Under these requirements, a branded retail station must sell the branded gasoline its sign displays” (Hastings, 2004, 318). Retailers that sell branded gasoline have captive suppliers as they are either vertically integrated or operate under strict exclusive dealing arrangements with upstream branded refiners. Unlike branded stations, independent gas stations can choose to buy gasoline from any unbranded wholesale refiner (Hastings 2004). Given the absence of additives/brand-name recognition and the ability to shop for low price wholesalers, one might predict that prices charged by independent stations would be consistently lower than branded stations.

### *The Unfair Sales Act: Wisconsin’s Minimum Markup Law*

Unfortunately, the interpretation of price differences may be complicated in Wisconsin as price dispersion may be effectively reduced or eliminated due to the effects of Wisconsin’s minimum markup law. This proposition has some support in prior research from the late 1990s which found evidence of reduced competition in Wisconsin markets (Brannon and Kelly, 1999). Purportedly to prevent predatory pricing, the Unfair Sales Act mandates that gasoline retailers implement a minimum markup of 9.18% over “the ‘average posted terminal price’ at the terminal nearest the retail sale in question...” (FTC, 2003). Not only does the law require a minimum markup, it also determines the base price that all retailers must use in determining the markup. Thus, the minimum legal prices of all retailers will be the same in a particular geographic market, regardless of the actual wholesale prices paid by individual gas stations. To the degree that it prevents price reductions below a price floor, the law effectively creates a legalized cartel. The key question here is whether the prices that would normally emerge in a setting that facilitates tacit collusion would typically exceed the legal minimum prices mandated by the law.

## AN EMPIRICAL ANALYSIS OF GAS PRICES

To test the theories we gathered data from 11 retail gasoline stations within four geographically distinct segments of Stevens Point, WI which are shown in Figure 1. Five of the stations are located along Division St. which is the main route to downtown from Interstate 39 in the north. Along Division, from north to south, we collected prices from Kwik Trip, Shell, Quick Mark, BP, and Citgo. Of this group, Kwik Trip and Quick Mark are independent stations which sell unbranded gasoline. To the northeast along Highway 66 we collected prices from another Kwik Trip and another BP. Highway 66 also represents a major thoroughfare into downtown from the northeast. Along Highway 10 which is the main east/west artery through downtown we collected information from Citgo and Mobil in the west, and Citgo and BP in the east. The variation across location and brand should allow us to test various explanations of price dispersion.

The information that we gathered was price per gallon for regular unleaded gasoline, hypothesizing that regular unleaded would be the most homogeneous of the products. To keep the information on prices as consistent as possible we gathered all prices on weekdays at roughly the same time in the morning. The data spans two time periods: first

from September 17 to December 21, 2007, and second from January 21 to March 14 2008. Constructed in this way the data are independent of possible weekend pricing decisions, as well as the effects of the holidays.

### *An Investigation of Price Dispersion*

The first proposition to examine is whether or not we see price dispersion within the market. The presence of price dispersion may be due to a variety of factors that make it an equilibrium outcome either naturally or due to strategic behavior. On the other hand, the absence of price dispersion may be evidence of tacit collusion or the workings of a competitive market.

The most direct way to test for price dispersion is to examine the time series of prices for each station. This information is presented in Figure 2 for the eleven stations examined in the study. Examining the price information the most striking conclusion is that there does not seem to be a great deal of price variation across the different retail outlets. While there is some variation in the prices from day to day as could be expected, there does not appear to be any systematic variation for any particular station. In fact, there is a great deal of regularity in the price data with 75.5% of daily observations showing absolutely no variation at all across the stations. Calculating the daily coefficient of variation (standard deviation divided by mean) we get an average value of 0.167 over the time period which is distinctly less than the value of 0.74 calculated in a similar study of Wisconsin pricing decisions which concluded that the Wisconsin market displayed “a lack of competitive pressures” (Brannon and Kelly, 1999, 7). At least over this time period there does not seem to be much price dispersion across stations.

We also examine other possible dimensions of price dispersion, although the overall high degree of similarity in the price data suggests that these will not be a factor either. Mean daily gas prices by geographic area are presented in Figure 3, mean gas prices by brand are presented in Figure 4, and mean gas prices by independent or brand affiliation are presented in Figure 5. Once again, while there is some fluctuation in prices there is remarkable similarity across all of the different categories and no price dispersion is evident.

As a final investigation we ran some basic regressions to see if there was any pattern of dispersion not discernible by visual analysis. The first set of models regressed the gasoline price on a measure of crude oil prices the day before to capture input price effects, and sets of indicators capturing the same station, area, brand, and affiliation status effects as previously examined. We also included the day of the week to see if there was a pattern along that dimension. The models should capture whether there is any systematic difference in prices in a specific direction based on any of the elements. As could be expected the lagged crude oil price was highly significant, with a dollar increase in crude prices increasing retail gasoline prices by about 0.8 cents. However, once again the results found no evidence of any systematic price dispersion along any of the dimensions, or on day of the week.

The second set of models looks to see if there is dispersion in any direction based on the elements. For these models the dependent variable is an indicator for whether or not the price was different from the rest of the stations. This model should capture whether a particular station, area, etc. is more likely to be different from the rest no matter the direction of the difference. The idea would be that perhaps a specific station, area, brand, or affiliation simply follows a different pricing strategy than the rest. However, this model found no significant effects for any of the elements either.

All of the results suggest that at least in our market, over these time periods, there does not seem to be much price dispersion along any of the proposed dimensions. This can be clearly seen in the graphs as there are 12 distinct “equilibriums” of two days or more over the time periods. The question to be investigated further is whether these periods of identical prices are evidence of tacit collusion or are competitive equilibrium outcomes.

### *An Investigation of Price Leadership*

To attempt to differentiate between tacit collusion effects and competitive equilibrium effects we investigated the pricing information to see if a price leader could be identified. If there was a clear sequence of pricing decisions this would be evidence that the stations were looking at competitors’ prices for a signal of where to place their own price. Once again, the most direct way to investigate the topic is to examine the time series of prices to see if one station, area, brand, or affiliation consistently adjusted their prices earlier than the others. If this was the case, the prices would have the same basic shape over time, but would be shifted forward in time based on their leadership role.

To answer the question Figures 2 through 5 can once again be used, now looking for variation across a time period or two rather than variation across stations within a time period. Looking at the results, we see that not all stations change prices at exactly the same time, and that we do see some moving before others. However, the first mover does not seem to follow any distinguishable pattern across any of the four elements. Instead one station or area will move first in one time period, and move second in a different time period. The adjustment seems to be relatively random rather than systematic.

We do investigate the price leadership issue using regression analysis as well. To do so we define an indicator for whether there was a first mover, or movers, in the pricing decision. We define the presence of a first mover as when all prices were the same the time period before, and then one or more stations changed prices the next time period, while some stations kept price the same. Regressing this indicator on the sets of elements we should see if any of them increase the likelihood of being in the first mover category.

These models matched the results from the graphic analysis and failed to find price leadership behavior along any of the elements. The lack of price leadership behavior suggests that perhaps the circumstances of identical prices that we recorded may actually be competitive outcomes as stations are simply adjusting simultaneously to the same price.

## *An Investigation of the Unfair Sales Act*

Despite the lack of evidence for a price leader the case is still not strong for the price similarities being due to a competitive process. If competition was the guide to prices, one might expect that the independent stations with lower wholesale prices would consistently post lower prices than their branded competitors. In fact, none of our investigations turned up evidence of this type of behavior. An alternative interpretation of these two facts is that tacit collusion is taking place, but that the price leader is not a particular station or area of the city, but rather the state of Wisconsin itself.

If the legally required markup of 9.18% over the wholesale price is less than the prices that would be set with tacit collusion or by the competitive market, the regulation would act like a non-binding price floor and we would expect to see the evidence we looked for previously. On the other hand, if the legally required markup is greater than the price which would be chosen with tacit collusion the industry would not need a price leader but could simply rely on the legal regulation to set prices for all stations. Given that the wholesale price on which the markup is based is freely available information each station could independently adjust to the appropriate price as defined by the “leader”. At the same time, if the price is above that which tacit collusion would set, one would expect that the markup price would also be above the competitive outcome price. In this situation the regulation would set a binding price floor which would keep independent firms from lowering their prices in accordance with their lower costs.

The remarkable consistency of prices over the course of 22 weeks with no evidence of price leadership or independent/branded price variations seems to suggest that the law is having an effect on pricing behavior. Whether the lack of dispersion is truly “collusion” or “competition” is difficult to determine in this situation. The state may be playing the role of default price leader, or may be simply limiting downward movement of prices. Either way the result is a lack of price dispersion, and given the binding nature of the effective price floor, higher prices overall.

## CONCLUSIONS AND FUTURE RESEARCH

While our data and analysis suggest that the state of Wisconsin may be playing the role of price leader and facilitating a type of tacit collusion with the Unfair Sales Act, the current analysis has issues which limit interpretation of the findings. First, our analysis has a relatively small sample selected from only one community limiting applicability to the entire state. While Stevens Point prices behave in this manner, other markets may have adopted different pricing strategies in the presence of the Unfair Sales Act. Second, we do not have a control group to see if the price consistency is a result of the law or is simply a change in the overall structure of retail gasoline since prior research was conducted. If the fundamental nature of retail gasoline has changed we will incorrectly be placing blame on legislation.

Future research could incorporate a control group relatively easily by gathering information from the neighboring states of Minnesota or Illinois. Recent discussions of



repealing the Act also provide a potential natural experiment in the future which would allow us to explicitly test the effects of the law. These controls would help to identify whether the consistent prices were due to collusion or competition.

At the very least, the current study can be used as an example of a class project for an undergraduate industrial organization course. Students could be charged with collecting various sets of price information throughout the semester to compile a relatively extensive data set. The data could then be examined in the process described to illustrate the issues discussed in class. Whether the results reveal strategic pricing behavior or not, the analysis itself would help students learn techniques to analyze economic data.

Figure 1: Station location in Stevens Point, WI



Figure 2: Gas Prices by Station

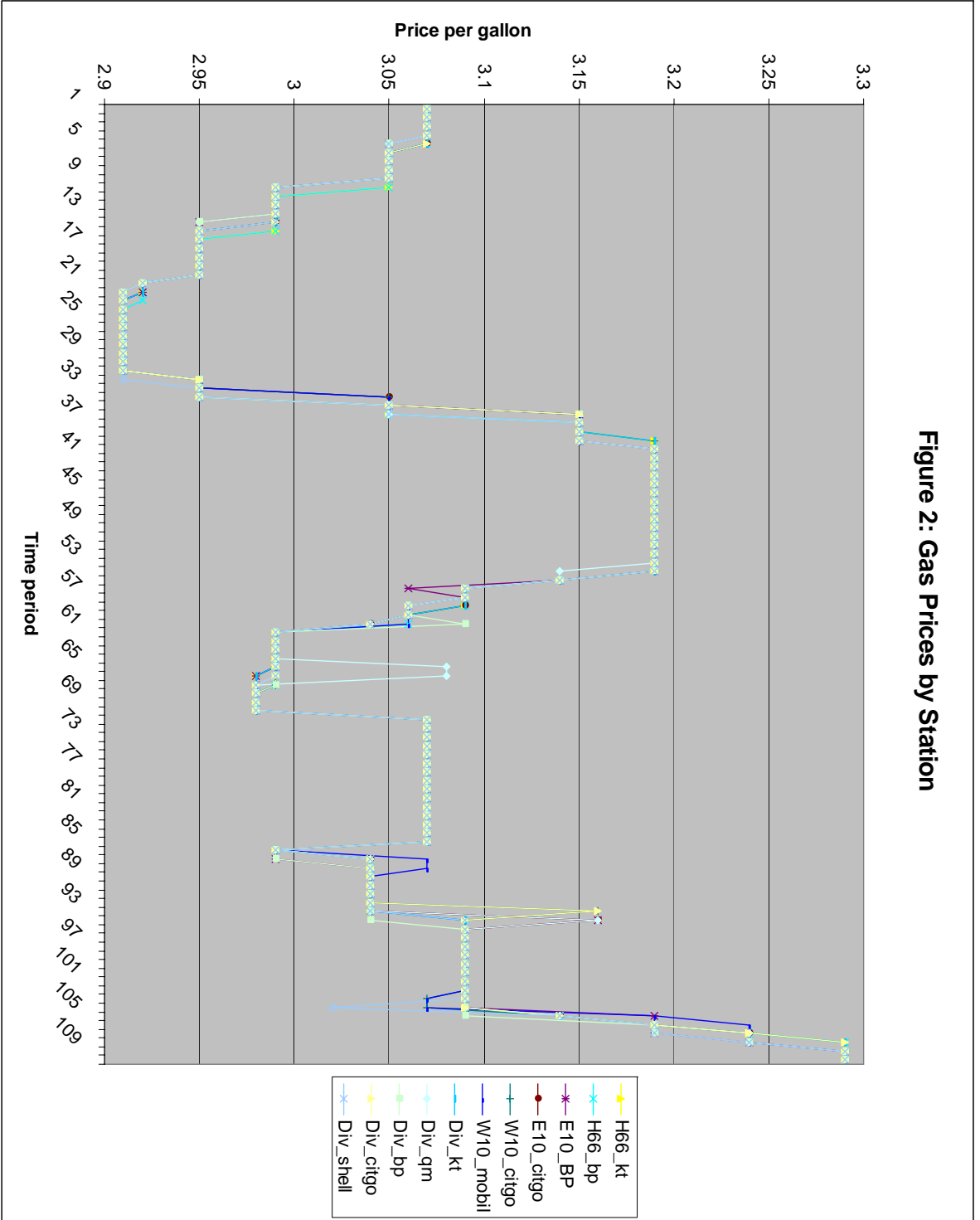


Figure 3: Mean Gas Prices by Area

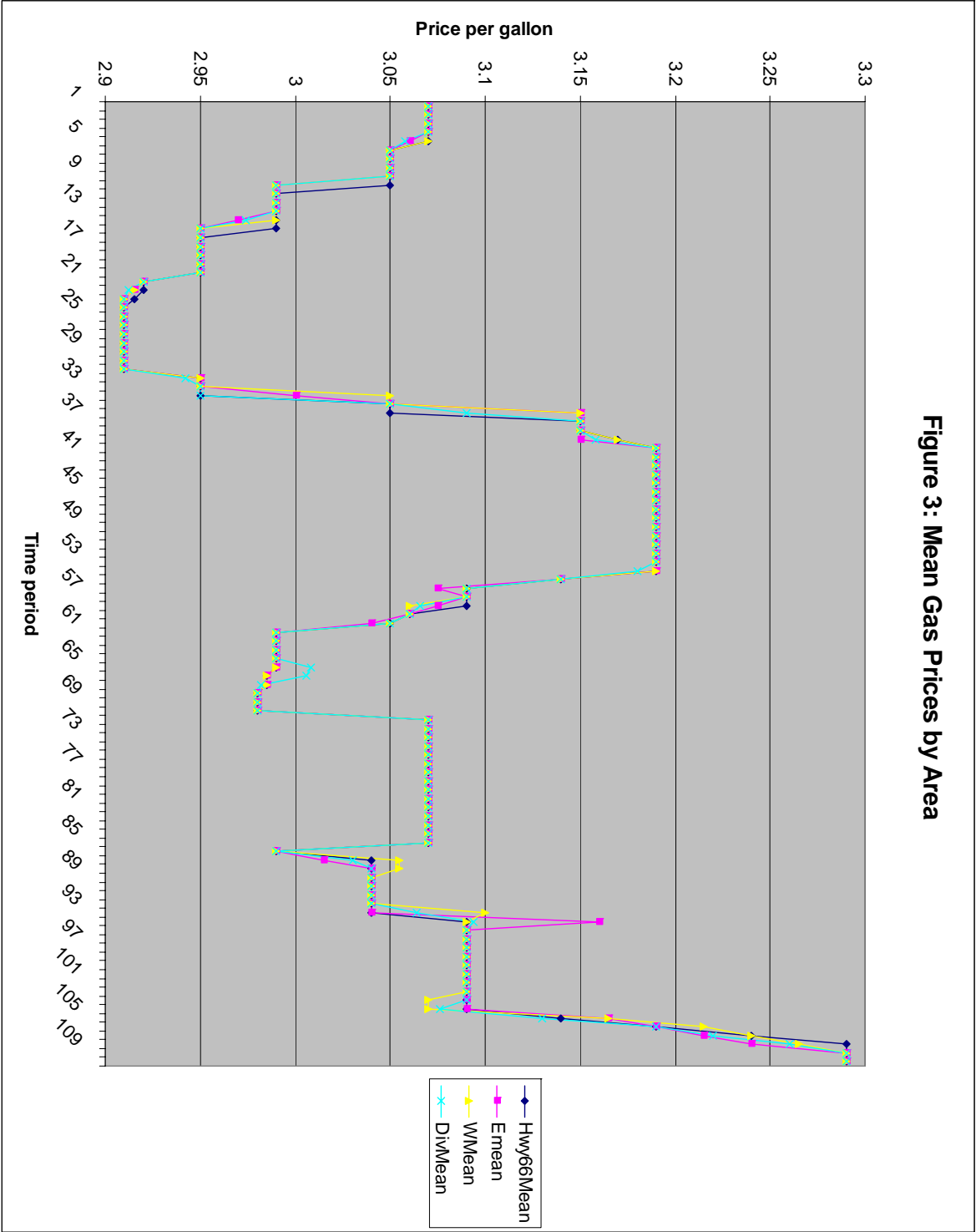


Figure 4: Mean Gas Prices by Brand

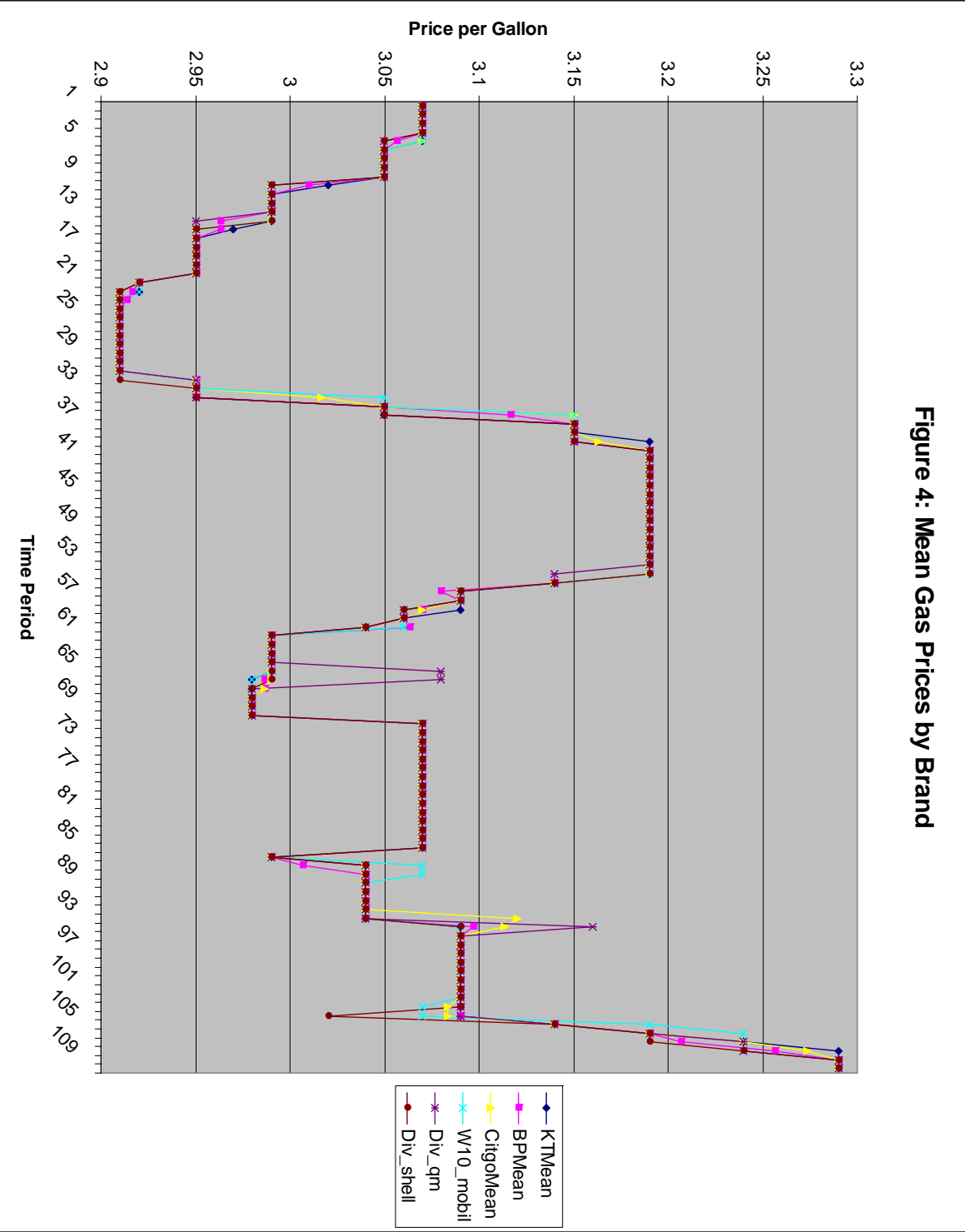
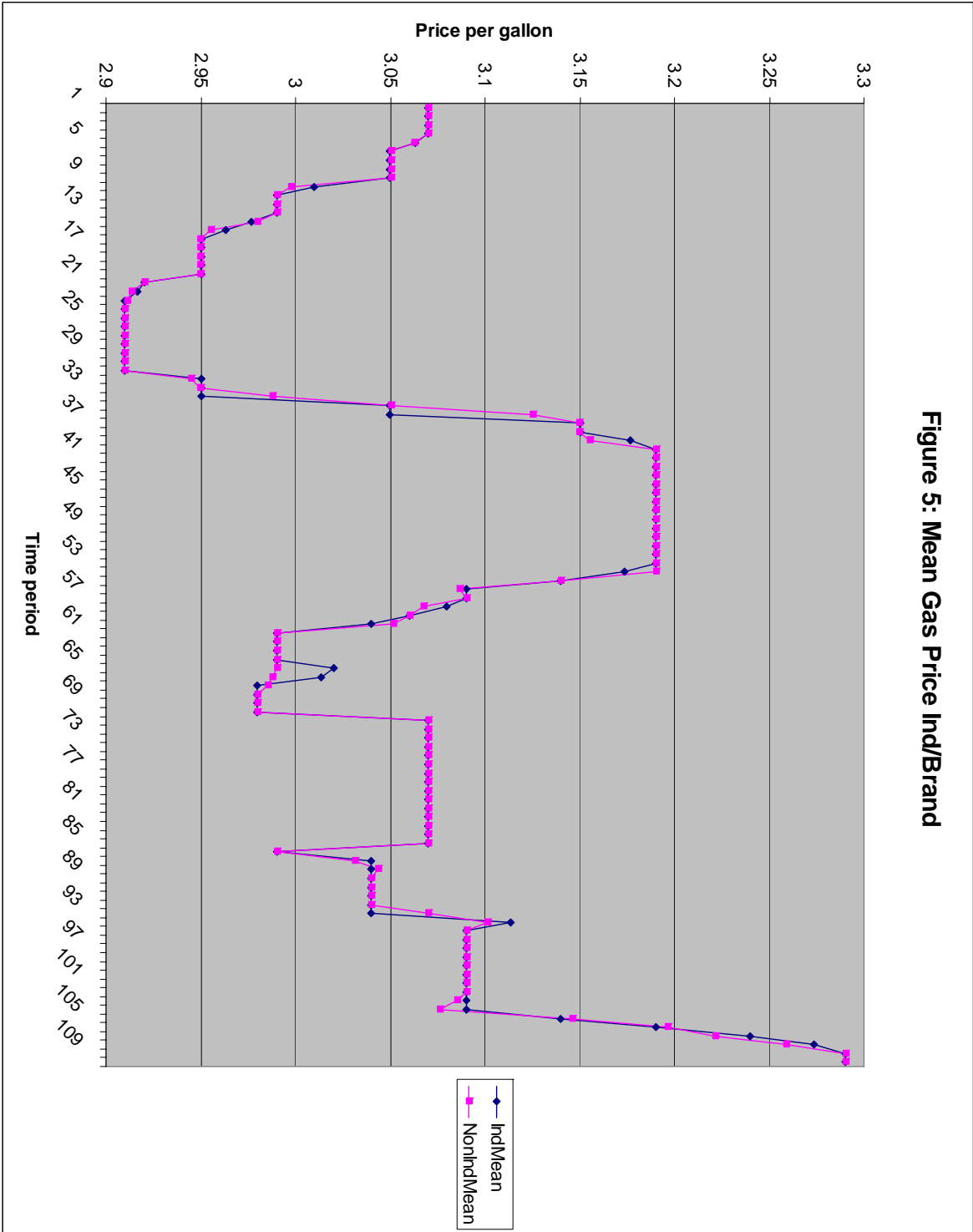


Figure 5: Mean Gas Price Ind/Brand



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