Hypermarts and Gas Stations

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Abstract

To the concern of their smaller competitors Wal-Mart, big-box stores, and other high-volume, low-price retailers have entered many retail industries globally in recent decades. In particular, big-box stores have increased in presence and market share in the U.S. retail gasoline industry. We examine the price impact of these hypermarts on traditional gasoline retailers and find it to be economically large. The presence of a hypermart reduces a mean retailers profit by over one-half. This impact is considerably larger than that induced by the presence of a typical retailer. We employ a unique data set covering a medium-sized metropolitan areas: Tucson, AZ.

Keywords: Industrial Organization; Market Structure; Firm; Firms; Pricing; Retail Gasoline

JEL Codes: L1, L2

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1 Introduction

(This version is preliminary and incomplete)

Since the last decade of the 20th century we have seen the emergence of big-box retailers, discount stores, supermarkets, and mass-merchandisers. These large retailers have exploited economies of scale and scope in an effort to provide consumers with low prices and the convenience of one-stop-shopping. At times, the emergence of these retailers has been controversial. Wal-Mart is perhaps the most notable example of these types of stores, the escalating trend of industry concentration, and the controversy that may surround it.

Hausman and Leibtag (2005) examined the increased compensating variation that has arisen from Wal-Marts expansion and find it to be sufficiently large that they conclude that the entry of Wal-Mart into a local market likely generates a substantial overall benefit to consumers. Despite their findings, a negative perception of the company remains among some members of society. Labor unions and competitors often protest proposed Wal-Mart entries, and local officials in some areas have sought to deter its entry through zoning restrictions and other legislative roadblocks.

A major reason that Wal-Marts success has been controversial is Wal-Marts entry into an area has tended to push traditional retailers, such as popular and nostalgic Mom-and-Pop stores, out of the market and into bankruptcy. Jia (2008) finds that the entrance of Wal-Mart alone explains 37 percent to 55 percent of the net change in the number of small retailers in medium-sized counties from the late 1980s to the late 90s.

Like the Mom-and-Pop stores throughout the country, gasoline retailers are now feeling the pressures of competition with Wal-Mart and other large stores. Only a decade ago, most gasoline was sold in a convenience store setting, such as a Chevron station or Shell station. Today, however, non-traditional, high-volume retailers like Wal-Mart have added a new product line—gasoline. These large stores offer low prices, but few of the amenities that are typically associated with more traditional gas stations/convenience stores. Common examples of these low pricing, high-volume gasoline retailers, in addition to Wal-Mart, are Costco, Sams Club, Safeway, and Kroger. Discount, big-box, or grocery stores selling gasoline have been termed in the retail gasoline industry as hypermarts. Hypermarts attempt to use gasoline sales as a mechanism to generate traffic into their store and subsequently increase store revenue.

As happened with Mom-and-Pop stores when Wal-Mart entered their markets, several gasoline industry players fear that the traditional gasoline retailer can no longer compete. Many retail gasoline station owners claim that their margins are being squeezed due to the low gasoline prices offered by hypermarts. Some in the industry are concerned that there will be a radical reshaping of the retail channels; one in which hypermarts command the majority of the market share and traditional retailers are left with a relatively small number of consumers who demand the convenience and setting of the gas station as we now know it.

The intent of this paper is to complement the expanding literature on big-box stores, such as Wal-Mart, by quan-

1 Hausman and Leibtag (2005) studied the entry of Wal-Mart Supercenters. Wal-Mart Supercenters sell a vast assortment of groceries as well as the typical retail products associated with the discount retailer.

2 Stone (1995) was the first to examine the impact of Wal-Mart on traditional retailers. He has been followed by Basker (2005a); Basker (2005b); Holmes (2008); Neumark, Zhang, and Ciccarella (2008); and Zhu and Singh (2009); in addition to the papers noted
tifying the price impact of these discount stores on smaller competitors. In this market, we are able to measure
the price impact of big-box stores on gasoline retailers who sell a relatively homogeneous good as their primary
product and, therefore, we can avoid the complications of creating representative bundles of goods. Since gasoline
sales are the primary source of revenue for firms in my dataset and since gasoline is largely the same across firms,
we can achieve relatively clean identification of the magnitude of the price impact big-box stores have on their
smaller competitors. Furthermore, since gasoline retailers operate in very localized markets, we can analyze the
geographic extent of a big-box stores impact in relation to the extent of smaller retailers impact on each other.
We develop a spatial competition model with two markets and we compare the effects of the entry of a big box
store on the retail gasoline market to the scenario in which all gas stations are independent. The hypermart has
an intrinsic spillover in its profit function between gasoline sales and in-store sales. If the spillover is sufficiently
large, it is optimal for the hypermart to choose lower prices than other gas stations. When lowering its price of
gasoline, the hypermart not only increases its market share of gasoline sales, it also increases its market share
of in-store sales from costumers looking to minimize the cost (price and time) of their shopping. In essence, by
lowering its price of gas, the hypermart trades profits at the gas station for more profits elsewhere in the store.
Traditional gasoline retailers do not have this same spillover and thus are at a competitive disadvantage.
The paper then uses a unique, comprehensive datasets from Tucson, AZ. We examine the cross-sectional impact
of hypermarts on competitors prices. We find that hypermarts do in fact place statistically and economically
significant downward pressure on the prices of nearby gas stations. The results show that if a gas station is located
within 1.5 miles of a hypermart, its price is depressed by about 1.25 cents, all else equal. If this gas station is
located within 0.5 miles from the hypermart, its price is reduced about 2.1 cents. From industry data on firm
profitability, we conclude that a price reduction of this magnitude would cut an average gas stations profit between
50 to 75%, depending on the distance to the hypermart.
Overall, given the magnitude of the price impact, it appears that the fears of some traditional retailers, like Mom-
and-Pop stores before, are being realized. The impact of big-box stores, discount stores, and mass-merchandisers
on smaller competitors is remarkable.
The rest of the paper proceeds as follows: In section 2, we develop a spatial competition model where we compare
the effect of a hypermart on prices to the case of independent ownership. In section 3 we describe the general
aspects of the gasoline market in the United States. In section 4, we analyze and estimate the model for Tuc-
son’s market. In section 5 we discuss the economic significance of the presence of hypermarts in this type of market.

above.

For example, Basker (2005b) examined the price impact of Wal-Marts entry on 10 products, such as aspirin, cigarettes, shampoo,
and toothpaste.

According to FRMC, Inc., gasoline sales account for approximately 70 percent of a typical gas stations total sales.

Most gas stations do have convenience stores attached. However, it is likely that the dollar size of the spillover between a gas
station and its convenience store is substantially less than for a hypermarts gas station and its in-store sales. As suggestive evidence,
gasoline sales account for about 70 percent of a traditional gasoline retailers total sales. On the other hand, gas accounts for less than
5-10 percent of total sales for hypermarts.
2 Model

Consider a city shaped as circle of length 1, where consumers and firms are located. Two different goods are sold, groceries (good $s$, sold by firms $\{S_i\}_{1,\ldots,n}$) and gas (good $g$, sold by firms $\{G_j\}_{1,\ldots,m}$). We assume that $S_1$ is located at the start of the circle (that is, either at 0 or 1) and we denote $\sigma = (\sigma_1, \ldots, \sigma_n)$ and $\gamma = (\gamma_1, \ldots, \gamma_n)$ to be the vectors of locations for types S and G, respectively.

The demand is given by a unit measure of consumers distributed under a function $f$ around the circle. Each individual consumer will demand only good $S$ with probability $q_S$, only good $G$ with probability $q_G$, and both goods with probability $1 - q_S - q_G^6$. Since there is an infinite number of consumers, these probabilities represent the fraction of each type of demand. There is no outside option and we assume these fractions are fixed, independently of the prices. This might not hold for many types of goods since consumers usually have a reservation price such that they can choose not to buy them. In this case, since we are trying to apply the model to the market of gas and groceries, these are goods that most consumers cannot substitute, because they have to eat and commute, unless the commuting services are an available outside option. If consumers had a reservation utility to decide whether to consume at all, those that are farther from the sellers would be the ones deciding not to purchase gas or groceries. Gas is not a perfectly inelastic good since car users can avoid unnecessary driving, but its consumption is relatively stable for small variations of price. Endogenizing demands as a function of price would add unnecessary structure to a model whose solution cannot be obtained for a general case and numerical examples with static demands could be computationally cumbersome in some scenarios.

Even though our later estimations focus only on the market of gas, since the pricing strategy of a hypermart involves all the markets where they compete, a model illustrating the effect of an entry of these Big-Box stores in the supply of gas at retail level should take into account the double nature of this spatial competition, and the increase in demand from consumers who are willing economize by buying both goods in a single stop.

We assume that for each good, consumers have a demand that is binary (0 or 1). For a consumer at location $k$ demanding only good $x$ from a firm of type $X \in \{S,G\}$ she will pick a store such that

$$\min_{X_i \in X} C^k(p_{X_i}, d_{X_i,k}) = -p_{X_i} - 2c(d_{X_i,k})$$

Where $p_{X_i}$ is the price set by firm $X_i$ and $c(d_{X_i,k})$ is the cost to move from $k$ to $X_i$, which is increasing on the distance $d_{X_i,k}$. If the consumer demands both goods, her problem becomes

\footnote{We assume that both $q_S, q_G$ are fixed and independent on relative prices. A more complex model would endogenize them as some one stop consumers might become two stop consumers as they would try to preempt future unplanned purchases by buying gas from H}
\[
\min_{S_i \in S, G_j \in G} C^K(p_{S_i}, p_{G_j}, d_{S_i,k}, d_{G_j,k}) = -(p_{S_i} + p_{G_j}) - \left(c(d_{S_i,k}) + c(d_{S_i,G_j}) + c(d_{G_j,k})\right)
\]

, which implies choosing the grocery store and the gas station such that her total cost of shopping is minimized. That is, the multi-good consumers problem is one of a choice over a menu of sellers, with each item associated to prices and distances. On the aggregate level, each firm’s demand is two-fold: on one side supplying those consumers who demand only one-good \( D_{X_i}(\vec{p}, \sigma, \gamma) = \int_{\Sigma_{X_i}} f(k) dk \) and on the other supplying the demand from consumers who purchase both goods \( D_{X_i}^{xy}(\vec{p}, \sigma, \gamma) = \int_{\Sigma_{X_i}} f(k) dk \). From the consumer’s decision equation above, it is easy to see that both demands are increasing in the same type neighbors’ prices, since it will move the indifferent consumer. On the other side, the other type’s prices affect the demand in a more complex way. For example, take firm \( G_j \), located between firms \( S_j \) and \( S_{j+1} \), with no other gas station located closer to any of those groceries store. If \( G_j \) is relatively equidistant to both suppliers of good \( s, D_{GS}^S(\vec{p}, \sigma, \gamma) \) would be independent to the relation between \( p_{S_j} \) and \( p_{S_{j+1}} \) since consumers between groceries store can switch where to buy good \( s \) but that decision wont change the distance traveled to \( G_j \). But as this firm is located closer to a grocery store (suppose without loss of generality that \( d_{S_j,G_j} \) is very small), multi-product consumers in the neighboring area in the circle would find more appealing to bundle on those two firms (that is, either \((S_j, G_j)\) or the alternative option available. In this case, we can observe complementarity between close neighbors \( \frac{\partial D_{GS}^S(\vec{p}, \sigma, \gamma)}{\partial p_{S_j}} < 0 \) and substitutability with the ones farther away \( \frac{\partial D_{GS}^S(\vec{p}, \sigma, \gamma)}{\partial p_{S_{j+1}}} > 0 \).

The difference between gas and regular shopping is that a significant part of their demand come from unplanned purchases and that is why gas stations tend to locate in high traffic areas. While this applies to any type of good, it is specially true for gas as part of their costumers are simply commuters who put gas in their vehicles while traveling. Therefore we will add an extra component to the demand for gas:

\[
D_{G_i}(\vec{p}, \sigma, \gamma) = q_{G}D_{G_i}^{G}(\vec{p}, \sigma, \gamma) + (1 - q_{S} - q_{G})D_{G_i}^{GS}(\vec{p}, \sigma, \gamma) + D_{GT}^{G}(p_{G_i})
\]

Where \( D_{GT}^{G} \) is the premium in unplanned purchases due to location. This effect will be stronger on retailers than for pumps located close to the hypermart as the formers pick the location of their pumps where they can sell more gas\(^7\). For simplicity, will assume that all the demand for shopping goods is planned: \( D_{S_i}(\vec{p}, \sigma, \gamma) = q_{S}D_{S_i}^{S}(\vec{p}, \sigma, \gamma) + (1 - q_{S} - q_{G})D_{S_i}^{SG}(\vec{p}, \sigma, \gamma) \). Thus, for firms \( S_i, G_j \) their maximization problem becomes:

\(^7\)We will assume that a gas station located in the same place as the hypermart doesn’t get this premium, as this location was chosen initially because of its conditions to attract grocery shoppers and later included its own gas station. Although these hypermarts do get costumers whose demand is unplanned, we will assume that this \( D_{GT}^{G} \) is only added to retail gas stations, whose location were picked with the sole purpose to maximize their profits in selling gas.
This is a problem of \( m + n \) equations and \( m + n \) prices. We denote the solution as \( \vec{p}^C = (p^C_{S_1}, \ldots, p^C_{S_n}, p^C_{G_1}, \ldots, p^C_{G_m}) \)

### 2.1 Commeth the Hypermart

Suppose that firm \( S_1 \) starts selling good \( g \) in addition to good \( s \) at the same location (we will denote this multi-product firm as \( H \) hereafter). There are two ways to represent this using the environment described above. Either the number of firms selling \( g \) increase to \( m + 1 \), or one of the retail gas stations is replaced by the gas pumps at the hypermart. Since the goal of the paper is to measure the effect on the price of other firms of a hypermart selling gas as opposed to an independent gas station doing it in the same location, we will opt for the later representation.

Then, we will assume that \( \sigma_1 = \gamma_1 = 0 \), and that the entry of a hypermart only implies consolidation in ownership of both firms located at the origin. Then, firm \( H \)'s maximization problem becomes

\[
\max_{\vec{p}_S, \vec{p}_G} p_{S_1} D_{S_1}(\vec{p}, \sigma, \gamma) + p_{G_0} D_{G_0}(\vec{p}, \sigma, \gamma)
\]

We will assume that 0 is an good location to sell groceries but not necessarily an optimal one to sell gas, so the Hypermart has no extra demand from unplanned purchases like the 'Mom-and-Pop gas stations. The first order conditions for firm \( H \)'s maximization problem are:

\[
\begin{aligned}
&\left( q_s D^S_{S_1} + (1 - q_s - q_g) D^G_{S_1} \right) + p_{S_1} q_s \frac{\partial D^S_{S_1}}{\partial p_{S_1}} + p_{G_0} q_g \frac{\partial D^G_{S_1}}{\partial p_{G_0}} + \left( p_{S_1} + p_{G_0} \right) \left( 1 - q_s - q_g \right) \frac{\partial D^G_{S_1}}{\partial p_{G_0}} = 0 \\
&\left( q_g D^G_{G_0} + (1 - q_s - q_g) D^S_{G_0} \right) + p_{S_1} q_s \frac{\partial D^S_{G_0}}{\partial p_{S_1}} + p_{G_0} q_g \frac{\partial D^G_{G_0}}{\partial p_{G_0}} + \left( p_{S_1} + p_{G_0} \right) \left( 1 - q_s - q_g \right) \frac{\partial D^S_{G_0}}{\partial p_{G_0}} = 0
\end{aligned}
\]

If firms \( S_1, G_1 \) were independent, their profit functions would be as the ones described before, that gives the following first order conditions:

\[
\begin{aligned}
&\left( q_s D^S_{S_1} + (1 - q_s - q_g) D^S_{S_1} \right) + p_{S_1} \left( q_s \frac{\partial D^S_{S_1}}{\partial p_{S_1}} + (1 - q_s - q_g) \frac{\partial D^G_{S_1}}{\partial p_{S_1}} \right) = 0 \\
&q_g D^G_{G_0} + (1 - q_s - q_g) D^G_{G_0} + p_{G_0} \left( q_g \frac{\partial D^G_{G_0}}{\partial p_{G_0}} + (1 - q_s - q_g) \frac{\partial D^S_{G_0}}{\partial p_{G_0}} \right) = 0
\end{aligned}
\]

If we compare both scenarios, they differ in \( p_{G_0} \left( q_g \frac{\partial D^G_{G_0}}{\partial p_{G_0}} + (1 - q_s - q_g) \frac{\partial D^S_{G_0}}{\partial p_{G_0}} \right) \) and \( p_{S_1} \left( q_s \frac{\partial D^S_{S_1}}{\partial p_{S_1}} + (1 - q_s - q_g) \frac{\partial D^G_{S_1}}{\partial p_{S_1}} \right) \), which are non-positive since \( \frac{\partial D^S_{S_1}}{\partial p_{S_1}}, \frac{\partial D^G_{S_1}}{\partial p_{S_1}} \) are equal to zero (since being a one-good or two-good consumer is not
a choice) and the other components depend on the spillover effect on multi-good shoppers. Then, given that the array of competing sellers locations is the same in both cases (which means that their best response functions are unchanged), this will induce to lower prices for firm H compared to the case in which sellers are independent, and therefore, it would result in an equilibrium with lower prices. This is because of the spillovers on the demand of the other good by multi-product consumers. That is, as the hypermart decrease the price of one of the goods, not only the demand for that good will increase, but the demand for the other would do the same as some two-good consumers would find more appealing to do their shopping in that location. The, the marginal profit will reach zero at a lower price than on the baseline scenario since its curve should be at least as high as the one with independent firms for all values of \( p_{GH} \).

Notice that the effects on prices and profits from the multi-product seller should be lower for firms that are more distant from the origin. Firms compete directly only with their immediate neighbors. As the hypermart is formed, if the cross effects of multi-product demand is non-zero, it will set prices lower than if both sellers were independent (without spillovers, both equilibria should be the same). Its closest neighbors in each market will respond by lowering its price but observing its other neighbor’s price that is still higher and the effect on the unplanned demand. This reaction will depend on the relative price drop as well as the effect of the other good’s price on its demand. But as we move away from the origin, all the distortions would come as a reaction from the original change, and since the neighboring groceries stores and gas stations don’t coordinate their prices to gain market share, the hypermart’s distortion would dissipate with distance.

Solving a closed form solution for the general problem proved to be intractable, even when we simplify and parameterize most of the variables and we set the firms in a symmetric way around the circle. Nevertheless, the results observed in the data can be observed for most values in the setups arranged in the examples below. Consumers with planned demand will have a uniform distribution over the circle. From now on, we will assume that transportation cost is quadratic on the distance, \( c(d_{X,k}) = (d_{X,k})^2 \). The same type of results would hold under any strictly increasing transportation costs, but given that consumers are distributed uniformly in the circle, this specific form would give us linear demands on prices for firms and closed form solutions for the model. Firms will be arrayed in equidistant locations (a Nash Equilibrium of the location’s game). Finally, the additional demand for the retail gas stations will be given by the expression \( D_{GTi}^G(p_{Gi}) = P_{Gi} z (A - P_{Gi}) \), where \( z \) denotes the importance of this type of demand over the total.

\[8\] Nevertheless, this doesn’t mean that necessarily we should always observe that \( P_{GL} \) would be smaller than its immediate neighbors. In the simulations below, we could see that when \( q_S/q_G \) approaches to 0, almost all the demand of the hypermart for groceries come from multi-product shoppers and therefore most of the price reduction strategies come from good observing that \( P_{GL} > P_{G2} \) in equilibrium. But this is an unrealistic scenario since it would mean that consumers demanding only groceries are a negligible part of the population.

A monotonic relation can always be observed when retail sellers are homogeneous (symmetric distance intra and inter markets). In example 2, some gas stations are located close to a grocery store while some others are not. This will eventually lead to different effects in both types but the monotonicity would be preserved among firms with similar characteristics.
2.2 Example 1

Suppose that there are six firms of each type and each firm is located so close to a firm selling the other good that for any multi-product consumer would be too costly to purchase one good in one location and buy the other in any other firm that is not the closest to her, as in figure 1. That is, multi-good consumers face the options \((S_1, G_1), ..., (S_6, G_6)\). It would be too costly for them to buy each good from different parts of the city. This is an extreme case where all gas stations have a positive demand from multi-good shoppers and their loss of demand from having their relative price too high compared to the hypermart is partially covered from the impossibility for some consumers to buy gas elsewhere if they are already shopping at their closest grocery store.

We simplify the game making each pair of firms \(S_i, G_i\) to be located at the same distance from the origin, but
each other separated by a distance $\epsilon$, which represents the extra traveling cost of not having both goods in the same location. When $\epsilon$ is negligible and there is no extra sales from unplanned purchases, the only difference between the firms at the origin and the rest is the joint ownership at the origin. We can observe that all gas stations depend greatly on price set by the corresponding grocery store. That is, for firm $G_i$ if any of the neighbors $S_{i-1}, S_{i+1}$ lower their prices, its demand would decrease since multi-good shoppers would find less attractive to shop both goods in that location and would move to the location that had lower relative prices for the bundle. Figure 2 shows the relation of $q_G$ with the other relevant variables of the model. On each row we move $q_S$, $z$ and $\epsilon$ with $q_G$ respectively, while the other variables are fixed at their respective middle level.

Figure 3: Figure 3

Figure 2 shows the resulting equilibrium when the hypermart is selling both goods. It shows that for all the range of values of the parameters, we observe that $p_G$ is lower than its competitors; and this difference decrease the farther these firms are from the origin (in each graph of the third column, we see three layers with a monotone relation. The one below corresponds to the closest firms to the hypermart. The other two preserve that monotonic relation on distance$^9$). We also observe that the price of gas for the hypermart would decrease the bigger the size of multi-good shoppers.

With respect to the expected values, the only exception is the market share for gas, where for values of $z$ large enough, the hypermart’s share is below $1/n$. This is due to the weight of the bonus demand due to location that

$^9$Note that in each of those graphics we observe only three surfaces when there are five firms. This is because firms are symmetrically located around the circle, which means that $p_{G_2} = p_{G_6}$ and $p_{G_3} = p_{G_5}$
retail gas stations have. Even though these unplanned purchases account for a large portion of their sales, in this case it only represents the additional gallons sold by these retailers due to better location for selling gas. For low values of $z$, the hypermart sells more gallons than its competitors, but for a relative small margin. Since the model doesn’t endogenize $z, q_S$ or $q_G$ as a function of the relative prices, and the menu of combinations of grocery stores and gas stations that multi-good agents can access (without an excessive cost) have the smallest possible substitutability between items, the gains from spillovers between goods is the smallest for the hypermart.

Figure 3 compares two-good hypermart with 'all Mom-and-Pop' stores environment. As expected, the gains resulting from the hypermart trying to capture the two-good shoppers will drive all gas selling firms’ prices and profits down compared to the initial setup. The stronger effect on those firms that are closer to the origin\textsuperscript{10}. In section 4, we will see that this is the same effect observed in the data. However, since we don’t include a cost function to this model, we don’t see a change in profits as steep as the one in the data. We can also see that the hypermart increases its market share on both goods. The fourth column shows how firm H gained market share of good S compared to $S_1$. Then, if the goal of the Big Box store is to increase the number of shoppers to their grocery store, competing in the retail gas market, would do that job.

2.3 Example 2

This array has the same number of gas stations but half the number of groceries store. We assume that firms $G_2, G_4, G_6$ only compete for the one-good consumers and the unplanned purchases\textsuperscript{11}, while $G_3, G_5$ would have also two-good consumers.

Figure 5 shows two main differences with the previous example. First, the price of gas set by the hypermart decreases with $q_G$. This is expected since a higher $q_G$ would lead to higher competition on a bigger size of the total demand. On the contrary, in the previous example, the same effect on $q_G$ would decrease the profit from lowering the price coming from multi-product shoppers. The other difference is that, although all retailers sell

\textsuperscript{10}Note that given the symmetry of the circle, we don’t need to include all the firms in these results
\textsuperscript{11}This is an oversimplification from the original model since the quadratic function for the cost would make a multi-stop trip more desirable than buying everything on the same location, even when the total distance is larger.
gas at a higher price than the hypermart, \( P_{G_4} < P_{G_3} \). But this is due to firm \( G_3 \)'s demand from multi-product shoppers. That is, a portion of its demand is not as elastic as the one for one-good consumers, and therefore, its reaction to the hypermarts' low price is not going to be as steep as for the isolated retailers. Nevertheless we are still observing that among homogeneous firms \( G_2, G_4 \), the price would still decrease more with closeness to the origin. Additionally, in this new environment we can observe that unless in extreme circumstances, the share of the hypermart on good g would be much higher than \( 1/6 \)\textsuperscript{12} since some gas stations don’t supply multi-product shoppers.

When comparing how this scenario would change if both divisions at the hypermart had separate ownership (Figure 6), we can see that the effect is larger on those gas stations that have a grocery store in the same location. The rest of the graphics look very similar to the ones in example 1.

\textsuperscript{12} that is, either when the demand coming from additional unplanned costumers is too high or when the proportion of two-good costumers is too low.
3 Industry Overview

Hypermarts currently have a substantial and increasing presence in the retail gasoline industry. There is also plenty of evidence, both quantitative and narrative, that hypermarts find it profitable to sell gasoline for prices lower than the prices at traditional gas stations and, therefore, it is likely that hypermarts will have a substantial long-run impact within the retail gasoline industry.

Table 1

<table>
<thead>
<tr>
<th>Year</th>
<th>Total # of Gasoline Retailers</th>
<th># of Traditional Retailers</th>
<th># Hypermarts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>175,941</td>
<td>174,801</td>
<td>1,140</td>
</tr>
<tr>
<td>2002</td>
<td>170,016</td>
<td>167,582</td>
<td>2,434</td>
</tr>
<tr>
<td>2005</td>
<td>168,987</td>
<td>165,469</td>
<td>3,518</td>
</tr>
<tr>
<td>2006</td>
<td>167,476</td>
<td>163,423</td>
<td>4,053</td>
</tr>
</tbody>
</table>

Source: Total Number of Gasoline Retailers: National Petroleum News.\(^\text{13}\)
Number of Hypermarts: EAI, Inc.

Table 2 shows that the retail gasoline industry has been experiencing contraction. In 2000, there were nearly 176,000 outlets selling gasoline in the US. This number has fallen nearly 5 percent to approximately 167,500 outlets in 2006. Meanwhile, hypermarts have recently been expanding their operations rapidly. In the year 2000, there were 1,140 hypermarts in the US. In 2002, the number grew 113 percent to 2,434. In 2006, the number had risen to over 4,000 locations, a total increase of over 250 percent from 2000. The general trend of industry contraction combined with rapid hypermart entry suggests that traditional retailers have faced a relatively difficult start to the new millennium. Traditional retailers experienced a decrease of almost 11,500 stations at the same time hypermarts were growing.

Each hypermart location sells a large volume relative to traditional gasoline retailers. In 2006, the typical hypermart location sold over 250 thousand gallons per month.\(^\text{14}\) In contrast, average sales of traditional retailers were estimated by the National Association of Convenience Stores (NACS) to have been only 110 thousand gallons per month. Table 3 breaks out the number of hypermarts by type (i.e. grocery store, discount store, and mass-merchandiser/club store) and compares the volumes in 2006 at these stores and at convenience stores, the most common form of traditional retailer. Most hypermarts are grocery stores, such as Kroger or Safeway. The biggest hypermarts in terms of average volume sold per station per month are the mass-merchandisers or club stores like Costco and Sams Club. Of note, Wal-Mart was responsible for over 1,300 of the hypermarts in 2006.

\(^{13}\)Estimating the number of gasoline retailers can be difficult. The National Petroleum News estimate includes all outlets that sold gas to the public. This includes very low-volume retailers such as marinas. According to the National Association of Convenience Stores (NACS) there were approximately 112,000 convenience stores selling gasoline in 2006. A convenience store is more what one typically thinks of when they think of a gas station. However, there are many traditional gas stations that do not have convenience stores and thus would not be included in NACS count.

\(^{14}\)Estimate according to EAI, Inc.
contributing to all three hypermart store types between its Wal-Mart stores, Neighborhood Markets, and Sams Clubs. Given that an average hypermart location sells two to three times the quantity of gasoline as that of a gas station, hypermarts compose a meaningful percentage of the retail gasoline industry market share even though they are far fewer in number.

Table 2

<table>
<thead>
<tr>
<th>Store Type</th>
<th>Number</th>
<th>Mean Gallons Sold/Store/Month (000’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocery Stores</td>
<td>2,164</td>
<td>197,000</td>
</tr>
<tr>
<td>Discount Stores</td>
<td>1,045</td>
<td>238,000</td>
</tr>
<tr>
<td>Mass-Merchandisers/Clubs</td>
<td>844</td>
<td>430,000</td>
</tr>
<tr>
<td>All Hypermarts</td>
<td>4,053</td>
<td>253,000</td>
</tr>
<tr>
<td>Convenience Stores</td>
<td>112,000</td>
<td>108,000</td>
</tr>
</tbody>
</table>

Source: Hypermarts: EAI, Inc.
Convenience Stores: NACS.

Figure 7 illustrates the increasing market share of hypermarts over time. In 1998, hypermarts were virtually non-existent, accounting for less than 1 percent of industry sales. By 2002 hypermart market share had risen to 5.8 percent and continued rising to 12.2 percent in 2006. Hypermart market share has increased an average of 1.4 percentage points per year with the largest increase from 2002 to 2003 when it rose by 1.9 percentage points.

As the model in Section 2 suggests, hypermarts price lower than traditional gas stations. Industry studies by EAI, Inc. have found that hypermarts sell gas at prices that are three to ten cents less per gallon. This ability to price low is an important benefit because consumers are shown to be sensitive to price differentials across stations. A consumer survey conducted by NACS in 2007 indicated that 47 percent of consumers said they would be willing to make a left-hand turn across a busy street to save 3 cents per gallon; 35 percent said they would drive five
minutes out of their way to save the same amount; 25 percent said they would drive ten minutes to save 3 cents; and an astonishing 11 percent said they would drive ten minutes out of their way to save only one penny per gallon.\textsuperscript{15} While these survey numbers are imprecise, they suggest that when hypermarts price only a few cents lower than their competition, they may be able to attract a meaningful percentage of new customers. To this, we must add the possibility of economizing time by buying groceries and gas at the same location.

In the years before the hypermarts boom, traditional gasoline retailers have made only about 1 percent of sales in pretax profit and about $30,000 in pretax profit per station per year.\textsuperscript{16} Given both the small profit margins and dollars earned in the industry, significant downward pressure on gas station prices as a result of hypermart presence could noticeably alter the retail gasoline industry make-up in a similar way the entrance of Wal-Mart altered the discount retailing industry in the 1980s and 90s.

\section{Tucson Market}

The overall aim of this paper is to analyze the effect of hypermart entry on traditional gas station prices. An ideal experiment to estimate the impact of big-box, grocery, and discount stores on retail gasoline competitors would be to collect data on prices for every gas station in the US and then see how proximity to hypermarts affects price. Of course this is an infeasible task\textsuperscript{17}. Therefore, we followed the standard procedure in the literature and collected gasoline data for a city.\textsuperscript{18}

\subsection{Data}

The greater Tucson area has a population of just over 900,000 residents with a geographical area covering 600 square miles and 29 zip codes.\textsuperscript{19} A comprehensive dataset of prices, characteristics, and locations were collected for every gas station in the city’s metropolitan area.\textsuperscript{20} In 2005, there were 227 gas stations and eight hypermarts

\textsuperscript{15}See NACS 2007 Consumer Fuels Report. NACS followed up the survey to see if people were actually as price sensitive as they claimed. NACS concluded that people were less sensitive. The survey data suggest at least that people perceive themselves to be extremely sensitive to differentials in gasoline prices.

\textsuperscript{16}These figures are from FRMC, Inc. a consulting firm to gasoline retailers. FRMC, Inc. maintains a proprietary dataset covering industry profitability.

\textsuperscript{17}And it would’ve required to add more variables to the model since different regions would have different characteristics and regulations that can affect prices and locations of these gas stations.

\textsuperscript{18}For examples, see Shepard (1993), Barron, Taylor, and Umbeck (2000) and (2004), and Johnson and Romeo (2000).

\textsuperscript{19}These estimates were obtained from the US Census Bureau.

\textsuperscript{20}Station prices and characteristics were recorded within a 14 hour period on March 12, 2005. It was important to gather prices on the same day to account for fluctuations in input prices. If station prices were gathered over time, it is likely to be the case that station As price differs from station Bs price simply because they have different marginal costs. It is reasonable to assume that marginal costs are similar for all stations in a particular city on a given day. It would not, however, be reasonable to assume that marginal costs are similar for all stations on a given day when the stations are located in different geographical regions. If the latter is the case, then the researcher would have to control for the regional differentials in marginal cost. Moreover, taxes would also have to be taken into account.
for a total of 235 observations. Generally, the evidence from surveys and industry narratives suggests that hypermarts price lower than traditional gas stations in order to attract more customers into their store. Table 3 shows average prices for hypermarts and gas stations in Tucson. The average price for regular gasoline at a hypermart on March 12, 2005 was $1.97. The average price for regular gasoline at a traditional gasoline retailer was $2.01. These statistics are consistent with the EAI study that found most hypermarts price anywhere from three to ten cents below traditional gas stations.\(^{21}\)

Table 3 also differentiates between branded gas stations and unbranded gas stations. There are 111 branded gas stations with an average price of regular gas of $2.03 and there are 116 non-branded stations with an average price of $1.99. These statistics show that hypermarts tend to choose the lowest prices, followed by non-branded stations and then by branded stations.\(^{22}\)

<table>
<thead>
<tr>
<th>Mean Price of Regular Gasoline: Tucson, AZ</th>
<th>Mean</th>
<th>s.e.</th>
<th>95% C.I.</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hypermarts</strong></td>
<td>$1.973</td>
<td>$0.007</td>
<td>$1.957</td>
<td>$1.988</td>
</tr>
<tr>
<td><strong>All Gas Stations</strong></td>
<td>2.011</td>
<td>0.003</td>
<td>2.005</td>
<td>2.016</td>
</tr>
<tr>
<td><strong>Branded</strong></td>
<td>2.029</td>
<td>0.005</td>
<td>2.020</td>
<td>2.038</td>
</tr>
<tr>
<td><strong>Non-Branded</strong></td>
<td>1.993</td>
<td>0.002</td>
<td>1.988</td>
<td>1.998</td>
</tr>
</tbody>
</table>

\(^{21}\)Hypermarts often discount gasoline prices for members. For example, a customer who is a member of Kroger might save 3 cents per gallon off the posted price when he or she swipes his or her membership card at the pump. For most hypermarts memberships can be obtained free-of-charge by filling out a short, one-time application. Club stores, like Costco and Sams Club, however typically restrict gasoline purchases to members only. For these stores, consumers must purchase annual memberships in order to buy gasoline. Sometimes club stores will allow non-members to purchase gasoline at a higher price. For example, one Sams Club in a dataset from Nashville (not used in this paper) allows non-members to purchase gasoline for 5 cents more per gallon. When calculating the price of gasoline at hypermarts as in Table 4, we used the member price since this is the price most consumers pay. We are primarily interested in the effect hypermarts have on the prices of nearby, competing stations. Using the member or non-member price at hypermarts has a negligible effect on the coefficients of interest in Section 4.2; differences in member and non-member prices are largely captured in the hypermart dummy. A new trend for hypermarts (in the last two or three years) is to tie at-the-pump discounts to in-store sales. For example, a Kroger might give a consumer 10 cents off per gallon on his or her next fill-up if the consumer spends more than $50 on a single purchase inside the store. In these instances, discounts are conditional on purchases elsewhere in the store. While common now, "bundle" discounts were rare in this dataset. I did not include these discounts when calculating the price of gasoline at hypermarts. However, the emergence of bundle discounts further motivates how hypermarts use low gasoline prices to encourage consumers to make in-store purchases.

\(^{22}\)Branded stations are defined as gas stations associated with a major oil company's brand. Examples would be Shell stations or Exxon stations. Non-branded or unbranded stations are stations unassociated with a major oil company. Many non-branded stations operate dozens to hundreds of stations across the country, while others operate just one. Generally companies operating several non-branded stations are referred to as private-branded. Examples of large private-brands are Sheetz, Wawa, The Pantry, and Quik Trip.
Table 5 breaks-out station prices, lowest to highest, by their respective brands. Arco prices the lowest of all the brands at $1.97. Interestingly, Arco and Diamond Shamrock choose similar prices (a few hundredths of a cent lower actually) to the hypermarts according to their unconditional means. Chevron is perceived as a premium brand in the Tucson market with an average price of $2.07 per gallon. The Other category includes all the non-branded stations except Circle K. We listed Circle K as itself because it represents over one-third of all gas stations in Tucson. The non-branded stations generally price higher than the hypermarts but lower than most of the major oil company brands.

On the whole, gasoline is a relatively homogeneous good. Price differentials exist across stations in part due to differences in perceived quality and brand loyalty. Another main reason why price differentials are observed is that gasoline stations are spatially differentiated. A spatially differentiated products model suggests a competitor is forced to respond to the presence of competition, such as a hypermart, by reducing its price. A testable implication is that a station’s price should be lower when there are more competing gas stations around it. Thus, to capture the price pressure placed on a station by a hypermart, it is important to control for the presence of other traditional retailers in order to disentangle the two confounding effects.

Table 4

<table>
<thead>
<tr>
<th>Mean Price of Regular Gasoline by Brand: Tucson, AZ</th>
<th>Mean</th>
<th>s.e.</th>
<th>95% C.I.</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arco</td>
<td>$1.969</td>
<td>$0.003</td>
<td>$1.961</td>
<td>$1.977</td>
</tr>
<tr>
<td>Diamond Shamrock</td>
<td>1.971</td>
<td>0.001</td>
<td>1.968</td>
<td>1.975</td>
</tr>
<tr>
<td>Hypermarts</td>
<td>1.973</td>
<td>0.007</td>
<td>1.957</td>
<td>1.988</td>
</tr>
<tr>
<td>Conoco</td>
<td>1.983</td>
<td>0.008</td>
<td>1.964</td>
<td>2.001</td>
</tr>
<tr>
<td>Other</td>
<td>1.993</td>
<td>0.005</td>
<td>1.982</td>
<td>2.004</td>
</tr>
<tr>
<td>Circle K</td>
<td>1.993</td>
<td>0.003</td>
<td>1.988</td>
<td>1.999</td>
</tr>
<tr>
<td>Citgo</td>
<td>2.030</td>
<td>0.000</td>
<td>2.030</td>
<td>2.030</td>
</tr>
<tr>
<td>76</td>
<td>2.030</td>
<td>0.012</td>
<td>2.001</td>
<td>2.058</td>
</tr>
<tr>
<td>Exxon</td>
<td>2.043</td>
<td>0.010</td>
<td>2.021</td>
<td>2.067</td>
</tr>
<tr>
<td>Mobil</td>
<td>2.043</td>
<td>0.003</td>
<td>2.036</td>
<td>2.051</td>
</tr>
<tr>
<td>Shell</td>
<td>2.060</td>
<td>0.010</td>
<td>2.040</td>
<td>2.084</td>
</tr>
<tr>
<td>Texaco</td>
<td>2.060</td>
<td>0.009</td>
<td>2.035</td>
<td>2.085</td>
</tr>
<tr>
<td>Chevron</td>
<td>2.074</td>
<td>0.010</td>
<td>2.054</td>
<td>2.094</td>
</tr>
<tr>
<td>All Stations</td>
<td>2.009</td>
<td>0.003</td>
<td>2.004</td>
<td>2.016</td>
</tr>
</tbody>
</table>

A common way in the literature to capture the effect of competition from nearby gas stations is to count the number of gas stations within a pre-specified Euclidean radius of a particular station (see Barron, Taylor, and Unbeck (2000), (2004)). This may not be the best measure. For one, using a Euclidean radius measure doesn’t take waterways, freeways, or other impediments into account. For example, one gas station may be located on

23It should be stated that Arco is a unique brand. Its corporate office has made it an explicit objective to have the lowest price. The major reason they are able to achieve this objective is that the majority of their stations do not allow the use of credit cards at their pumps. Of the eleven Arco stations in the Tucson dataset, only one permits the use of credit cards.
one side of a river and another gas station may be located on the other side. If the nearest crossing of the river is two miles away, it is unreasonable to assume that the two stations are heavily competing even though they are reasonably close in a line-of-sight direction. As a result, we use road distance\(^{24}\) as a more appropriate measure.\(^{25}\) Proximity to other gas station competition is defined as the number of gas stations within a pre-specified driving distance of particular station. For estimation, we separately counted the number of stations within 0.5 of a road mile, the number between 0.5 and 1.5 road miles, and the number between 1.5 and 2.5 road miles.

Next, we counted the number of hypermarts within 0.5 road miles, the number between 0.5 and 1.5 road miles, the number between 1.5 and 2.5 road miles, and the number between 2.5 and 3.5 road miles, of a particular gas station and used these as a measure of proximity to hypermarts.\(^{26}\) These are the key variables of interest.

We use a larger range (up to 3.5 road miles as compared to up to 2.5 miles) when calculating proximity to hypermarts than when calculating proximity to other gas stations. The reason for this is two-fold. First, it was reported earlier that the average hypermart sells over two times the volume of gasoline as does a traditional store. Hence, a hypermart is attracting a larger customer base. Second, the key business strategy of a hypermart is the bundling of a large retail store and gasoline. People who frequent hypermarts often are there not just to buy gas, but also to go to the store. Hypermarts provide customers with the ability to economize on trips. It is reasonable that a typical person is willing to drive a farther distance to a supermarket or mass-merchandiser than to a gas station. When faced with the option of getting gas at a cheaper price and at the same time being able to get some shopping done, we argue that a typical consumer is going to be more willing to drive an extra distance.

Table 6 lists the summary statistics of the competition measures and the other control variables. We would expect to observe the greatest price pressure when two stations are located very close to one another. On average, there are 0.68 gas stations within one-half of a road mile of a particular gas station. The largest number of stations found within one-half road miles of a station is four gas stations, while other stations have zero competitors within that distance. As we expand the distance band, more competitors are present because each band has a greater area. The average distance to the nearest gas station is 0.57 road miles. Turning to hypermarts, there are on average 0.03 hypermarts within one-half road miles of a given retail location and the average distance to the nearest hypermart is 4.68 road miles. These statistics show that the majority of gas stations in Tucson are not close to hypermarts.

In addition to collecting data on locations, nearby competition, and specific brands of stations, we also collected other station characteristics. Dummy variables were constructed if a store had a convenience store, a franchise food establishment,\(^{27}\) a car wash, or a repair shop. The summary statistics for these variables can also be seen in

\(^{24}\)Hastings (2004) also used road distances.

\(^{25}\)I was able to collect the specific location of each station. I then used the mapping function on Mapquest to calculate the distance from each station to every other.

\(^{26}\)We limit the distance bands for hypermarts to 3.5 road miles. We experimented with larger bands and found no significant impact at longer distances. Other researchers tend to find limits on price impacts of traditional retailers at 1 to 2 miles.

\(^{27}\)Franchise food establishments are gas stations where the station is physically combined with a franchise store. Common examples of franchise food establishments are Subway, McDonalds, and Dominos Pizza. Gas stations and franchise foods combine together to take advantage of economies of agglomeration.
Table 6. Of the 235 gasoline outlets in Tucson, 209 had a convenience store, 18 had a franchise food establishment, 14 had car washes, and 19 had repair shops. The mean number of pumps at each station was just over eight.

### Table 5

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>s.e.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td># Gas Stations &lt; 0.5 mile</td>
<td>0.68</td>
<td>0.050</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td># Gas Stations 0.5 – 1.5 miles</td>
<td>3.61</td>
<td>0.159</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td># Gas Stations 1.5 – 2.5 miles</td>
<td>7.63</td>
<td>0.266</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td># Hypermarts &lt; 0.5 mile</td>
<td>0.03</td>
<td>0.011</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td># Hypermarts 0.5 – 1.5 miles</td>
<td>0.14</td>
<td>0.025</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td># Hypermarts 1.5 – 2.5 miles</td>
<td>0.32</td>
<td>0.039</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td># Hypermarts 2.5 – 3.5 miles</td>
<td>0.39</td>
<td>0.040</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Convenience Store</td>
<td>0.89</td>
<td>0.021</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Franchise Food</td>
<td>0.08</td>
<td>0.017</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Car Wash</td>
<td>0.06</td>
<td>0.016</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Repair Shop</td>
<td>0.08</td>
<td>0.018</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td># of Pumps</td>
<td>8.26</td>
<td>0.237</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>Median Income (thousands of dollars)</td>
<td>35.67</td>
<td>0.805</td>
<td>19.34</td>
<td>78.03</td>
</tr>
<tr>
<td>Population Density (thousands of people)</td>
<td>2.61</td>
<td>0.016</td>
<td>0.02</td>
<td>5.38</td>
</tr>
<tr>
<td>Traffic Flow (thousands of cars per day)</td>
<td>46.52</td>
<td>1.594</td>
<td>3.1</td>
<td>107.25</td>
</tr>
</tbody>
</table>

Relevant demand side variables were also calculated using data from the US Census Bureau at the zip code level. Specifically, median income and population density were taken from the 2000 population census. The assumption is that wealthier and more densely populated zip codes should have higher prices.\(^{28}\)

One other demand side variable was constructed in an attempt to capture the amount of driving that is taking place around a station. We calculated the average 24-hour traffic volume\(^{29}\) of automobiles on the street where each station is located.\(^{30}\) This variable improves upon using a dummy variable if the station is located on a major

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\(^{28}\)Measuring demand based on zip code characteristics has some drawbacks. Take median income for example. Suppose a gas station is located near the boundary of a particular zip code. It is likely the case that the neighboring zip codes median income differs meaningfully from the zip code that the gas station is in. If this is the case, then the zip code measure may not actually represent the true median income of consumers who visit the station. One way to get around this problem is to choose a pre-specified radius around a station and then measure the median income of the population within that radius. This approach has the same drawbacks as mentioned earlier. Often there are rivers, freeways, or other barriers that make it difficult for a consumer to get to a particular gas station even though the consumer resides within the specified radius. Hence, the radius technique is not a perfect measure either. To complicate matters, it is quite often the case that a consumer purchases gasoline on the way to or from work or other destinations. If the consumer works a long way from his or her house, then the gas station could be in a very different part of town than where the consumer lives. When this situation applies to a large proportion of the population, neither the zip code measure nor the radius measure will perform well. However, without the luxury of being able to observe the specific characteristics of every individual who frequents a particular gas station, certain simplifications and approximations must be made.

\(^{29}\)The data was provided by the Pima County Department of Transportation. Tucson is located in Pima County.

\(^{30}\)If a station was located on a street corner, then the traffic volume for that station is the sum of the traffic volume on the two perpendicular streets.
street as often found in the literature.\textsuperscript{31} Furthermore, this variable allows each station to have its own unique traffic volume. One would expect that a station located on a street with more traffic flow is more able to sustain higher prices than a station located on a street with low traffic volumes, all else equal\textsuperscript{32}.

### 4.2 Estimation

With the data we have collected, we estimate the following equation:

\[ P_{Gi} = \beta_0 + \beta_1 N^G_i + \beta_2 N^H_i + \beta_3 K_i + \beta_4 \Delta_i + \beta_5 \Gamma_i + e_i \]

where \( P_{Gi} \) is the price of regular gasoline at each station, \( N^G_i \) is a vector that separately counts the number of gas stations and, \( N^H_i \) the number of hypermarts within the respective distance bands of each station\textsuperscript{33}, \( K_i \) is a vector of each stations characteristics, \( \Delta_i \) is a vector of measures of demand, \( \Gamma_i \) is a vector of dummy variables indicating the brand for each station, and \( e_i \) is a disturbance term\textsuperscript{34}. Each \( \beta_j \) represents a vector of coefficients.

Table 7 displays the results of the regression for Tucson. The first variables listed in the table are the most important. The coefficient on the number of hypermarts located within one-half road mile of a station is -0.021 and is statistically significant at the 1 percent level. This means that a stations price is 2.1 cents lower for each hypermart that is located within one-half mile of it. The average price for a gas station in Tucson is $2.01. Therefore, adding a hypermart nearby would reduce the average stations price from $2.01 to less than $1.99. This effect is not only statistically significant but it is economically significant.

\textsuperscript{31}See Eckert and West (2004), Eckert and West (2005a), and Eckert and West (2005b)

\textsuperscript{32}Besides the data for Tucson, we had a similar sample for the city of Nashville. The number of gas stations were bigger and the proportion of hypermarts over the total was also larger. It included most variables except for traffic. The results of the estimation were inconsistent with the economic intuition (a hypermart had stronger effect on firms between 0.5 and 1.5 road miles than on those closer than 0.5 miles). To test if missing the traffic variable had an effect on the estimation, we re-run the model for Tucson, omitting that variable and we observed a similar change in the estimation. A possibility for this is because hypermarts tend to be located in high traffic areas which also tend to be areas of relatively high prices. The hypermarts serve to reduce those prices from their otherwise high level. Without the hypermart, prices would be higher than average. But with the hypermarts prices appear average compared to other prices in the city. Controlling for traffic flow (high demand) makes the average prices look like the below average prices that they are. Thus, it is important to control for traffic flow. Perhaps though, this odd non-uniformity is unrelated to omitted traffic flow data.

\textsuperscript{33}There are three variables in \( N^G_i \) (the number of gas stations within 0.5 road miles; 0.5-1.5 road miles; 1.5-2.5 road miles) and four in \( N^H_i \) (the number of hypermarts within 0.5 road miles; 0.5-1.5 road miles; 1.5-2.5 road miles; and 2.5-3.5 road miles).

\textsuperscript{34}The standard errors have been corrected for arbitrary heteroskedasticity.
Table 6

Regression of Regular Price of Gasoline: Tucson, AZ

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Robust s.e.</th>
<th>t-stat</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td># Gas Stations &lt; 0.5 mile</td>
<td>-0.0039</td>
<td>0.0021</td>
<td>-1.87</td>
<td>0.064</td>
</tr>
<tr>
<td># Gas Stations 0.5 – 1.5 miles</td>
<td>-0.0015</td>
<td>0.0009</td>
<td>-1.78</td>
<td>0.076</td>
</tr>
<tr>
<td># Gas Stations 1.5 – 2.5 miles</td>
<td>0.0007</td>
<td>0.0006</td>
<td>1.04</td>
<td>0.298</td>
</tr>
<tr>
<td># Hypermarts &lt; 0.5 mile</td>
<td>-0.0211</td>
<td>0.0082</td>
<td>-2.58</td>
<td>0.011</td>
</tr>
<tr>
<td># Hypermarts 0.5 – 1.5 miles</td>
<td>-0.0127</td>
<td>0.0063</td>
<td>-2.00</td>
<td>0.047</td>
</tr>
<tr>
<td># Hypermarts 1.5 – 2.5 miles</td>
<td>-0.0044</td>
<td>0.0041</td>
<td>-1.09</td>
<td>0.279</td>
</tr>
<tr>
<td># Hypermarts 2.5 – 3.5 miles</td>
<td>-0.0038</td>
<td>0.0041</td>
<td>-0.92</td>
<td>0.361</td>
</tr>
<tr>
<td>Hypermart</td>
<td>-0.0249</td>
<td>0.0105</td>
<td>-2.38</td>
<td>0.018</td>
</tr>
<tr>
<td>Arco</td>
<td>-0.0237</td>
<td>0.0068</td>
<td>-3.50</td>
<td>0.001</td>
</tr>
<tr>
<td>Chevron</td>
<td>0.0748</td>
<td>0.0053</td>
<td>14.12</td>
<td>0.000</td>
</tr>
<tr>
<td>Conoco</td>
<td>-0.0077</td>
<td>0.0107</td>
<td>-0.72</td>
<td>0.474</td>
</tr>
<tr>
<td>Citgo</td>
<td>0.0299</td>
<td>0.0060</td>
<td>4.95</td>
<td>0.000</td>
</tr>
<tr>
<td>Diamond Shamrock</td>
<td>-0.0201</td>
<td>0.0063</td>
<td>-3.19</td>
<td>0.002</td>
</tr>
<tr>
<td>Exxon</td>
<td>0.0479</td>
<td>0.0103</td>
<td>4.66</td>
<td>0.000</td>
</tr>
<tr>
<td>Mobil</td>
<td>0.0440</td>
<td>0.0066</td>
<td>6.68</td>
<td>0.000</td>
</tr>
<tr>
<td>Shell</td>
<td>0.0642</td>
<td>0.0108</td>
<td>5.93</td>
<td>0.000</td>
</tr>
<tr>
<td>76</td>
<td>0.0244</td>
<td>0.0115</td>
<td>2.13</td>
<td>0.035</td>
</tr>
<tr>
<td>Texaco</td>
<td>0.0620</td>
<td>0.0093</td>
<td>6.65</td>
<td>0.000</td>
</tr>
<tr>
<td>C-store</td>
<td>-0.0046</td>
<td>0.0081</td>
<td>-0.57</td>
<td>0.572</td>
</tr>
<tr>
<td>Franchise Food</td>
<td>0.0111</td>
<td>0.0126</td>
<td>0.89</td>
<td>0.377</td>
</tr>
<tr>
<td>Car Wash</td>
<td>0.0033</td>
<td>0.0153</td>
<td>0.22</td>
<td>0.827</td>
</tr>
<tr>
<td>Repair Shop</td>
<td>0.0160</td>
<td>0.0072</td>
<td>2.22</td>
<td>0.027</td>
</tr>
<tr>
<td>ln(# of pumps)</td>
<td>-0.0031</td>
<td>0.0055</td>
<td>-0.56</td>
<td>0.575</td>
</tr>
<tr>
<td>Median Income</td>
<td>0.0003</td>
<td>0.0003</td>
<td>1.10</td>
<td>0.272</td>
</tr>
<tr>
<td>Population Density</td>
<td>0.0029</td>
<td>0.0015</td>
<td>1.95</td>
<td>0.052</td>
</tr>
<tr>
<td>Traffic Flow</td>
<td>0.0002</td>
<td>0.0002</td>
<td>1.00</td>
<td>0.178</td>
</tr>
<tr>
<td>Constant</td>
<td>1.9831</td>
<td>0.0141</td>
<td>141</td>
<td>0.000</td>
</tr>
<tr>
<td># of Observations</td>
<td>235</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F(26,208)</td>
<td>35.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>0.6402</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root MSE</td>
<td>0.0276</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is more, the price impact of a hypermart is larger than that of a traditional gasoline retailer. The effect of an additional gasoline retailer within one-half mile reduces a given stations price by 0.4 cents with a p-value of 0.06. We conducted an F-test to see if the difference between a hypermarts impact on a stations price was different than a traditional retailers impact. The difference between the coefficients is statistically significant at the 5 percent level.\(^{35}\)

According to Table 7 adding a hypermart between 0.5 - 1.5 road miles of a gas station reduces that gas stations price by 1.2 cents, all else equal. In contrast, adding a traditional gas station in that distance band only decreases a stations price by 0.2 cents. The coefficients are statistically significantly different at the 7 percent level.\(^{36}\) As

\(^{35}\)The F-test is a test of linear restrictions. The null hypothesis is that the coefficient on the number of gasoline stations equals the coefficient on the number of hypermarts. The test statistic is $F(1,208) = 3.82$ with a corresponding p-value of 0.052.

\(^{36}\)The test statistic is $F(1,208) = 3.34$, with a corresponding p-value of 0.069
one adds a competitor, whether a hypermart or a traditional gas station, at a distance greater than 1.5 miles from a competitor, the impact becomes statistically insignificant.

The hypermart dummy is also statistically significantly different from zero. The regression indicates that a hypermart prices 2.5 cents lower than non-branded stations—the baseline. Even more, the hypermart dummy is more negative than both the Arco dummy and the Diamond Shamrock dummy, although the effect is not statistically significant. Earlier we saw that Arco and Diamond Shamrock priced lower than the hypermarts in the unconditional mean. This finding is weak evidence that, after controlling for differences in demand and station characteristics, hypermarts price the lowest of all brands and certainly price lower than most brands in Tucson.\footnote{The coefficient on the hypermart dummy is statistically smaller than the coefficients on all other brand dummies except the Conoco brand dummy}

The regression fits the data reasonably well with an R-square of 0.64. Also, having a repair shop increases a station’s price by 1.6 cents and being in a more densely populated area increases its price. Most station characteristics are not statistically different from zero, although the signs are reasonable.

5 Economic Significance of Hypermart Entry

On the whole, the results presented in this paper suggest that hypermarts decrease the prices of nearby competition by approximately 2.1 cents. Indeed, price impacts of this magnitude are economically meaningful to retailers. Data from FRMC, Inc. show that an average gasoline retail outlet in 2006 sold 1,300,000 gallons of gasoline (about 108,000 gallons per month). On sales of those gallons the typical retail station made $170,500 gross profit dollars (13.12 cents per gallon), which contributed to $35,000 in total station pretax profit (0.76 percent of sales). If a hypermart were to open near an average gas station, the results suggest the station’s margin would fall by about 2.1 cents from 13.12 to 11.01 cents per gallon. This in turn would decrease fuel gross profit dollars to $143,130 and total store pretax profit from $35,000 to $7,630. That is, when being forced to compete with a hypermart cuts an average stations profit in more than 3/4. And this only takes into account the effect on prices. The entry of a hypermart will draw a large share of customers. Our model in Section 2 shows that those gas stations closer to the hypermart are the ones who would see a larger drop in their demand. Which means that the overall pretax profit should decrease more than $7,630, to values closer to the break-even point.

For firms that are at a longer range, between 0.5 and 1.5 road miles from a hypermart, we found that the price is pushed down by 1.27 cents. This brings the gross profits to $154,000 and the net profits to $18,500, which represents one half of the average value. Even though the effect is lighter than for gas stations at a closer range, it is significant on the scope, as a much larger number of gas stations within these larger radius.

Nevertheless, the data available shows a picture at a certain point of time. In this case, we can’t observe the status of gas stations before these Big-Box stores expanded their sales to gas. A more comprehensive approach of the effects in the market should include a dynamic study of the number of traditional gas stations in some radius from a new hypermart. The data in Section 3 shows a decrease in the number of these traditional gas stations
at the same time that the number of hypermarts grew. It is yet to see if there is a relation between distance to a new hypermart and probability of leaving the market. Moreover, our data shows the overall effect for the whole metropolitan area, but one would expect that if the hypermart entry is the cause for some firms to leave the market, the effect of this entry in the price of existing gas stations should be higher for new hypermarts than for those that are already established, where the softer competition should ease the pressure on prices. As hypermarts continue to expand and capture more market share many nearby retailers will be driven to unprofitable conditions, not just marginal ones. If a traditional retailer is located near two (three) hypermarts, the results show that the downward effect on profit can doubled (tripled). Being located near two or more hypermarts makes it very difficult for an average retailer in that situation to remain profitable, even using the lower bound price impact estimate. Being located near more than one hypermart is not an implausible scenario. In Tucson 6 percent of all retailers are located within 2 miles of two hypermarts. These firms must be much more efficient in their operations than the average station or will have to move to remain solvent. Taken as a whole, price impacts of this magnitude will place substantial pressure on traditional retailers and will force some to exit the market.

6 Conclusion

The long run trends toward big-box, grocery, discount, and club stores have led to significant changes in the retail landscape in the United States. A trend since the turn of the century has been for the large, multi-product stores to begin selling gasoline. Traditional retailers in the gasoline industry fear that they will face the same declines in their prospects experienced by Mom-and-Pop stores when Wal-Mart comes to town. Gasoline industry analysts have maintained that hypermarts price low and thereby force nearby gas stations to respond by reducing their prices to unprofitably low levels. The rapid growth of hypermarts has caused trepidation for traditional gasoline owners as many fear they will be unable to compete in a world where hypermarts command a more substantial portion of industry market share. In this paper, we examine these trends theoretically and empirically. We develop a model that shows how the spillover effects from selling gasoline influence the profit maximizing price for gasoline for the big-box firm relative to the price for a firm selling just gasoline. If the spillover is sufficiently large, it is profit-maximizing for the hypermart to price its gas lower than the optimal price for traditional gas stations. This result is especially useful in explaining why hypermarts price lower than most gas stations in the US. It is also consistent with the literature that shows certain products can be sold as loss-leaders by multi-product firms. Empirical analysis for the metropolitan area of the city of Tucson, AZ, shows the size of the impact of hypermarts on pricing in retail gasoline markets. We collected information on prices and other features from a complete sample of gasoline retailers (235 gas stations). In both cities we find hypermarts price lower than other stations.

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38Our model includes the effect of nearby competition in the variables in $N^G$
39My model does not require gasoline to be sold below cost. For representative loss leader articles see Hest and Gerstner (1987); Chevalier, Kashyap, and Rossi (2003); Nevo and Hatzitaskos (2005); and DeGraba (2006)
the analysis that takes into account the geographic spread of markets, we find that as the number of hypermarts increases, prices are forced downward for nearby retailers. On average, if a gas station is located within 0.5 road miles of a hypermart, the station’s price is pushed down about 2.1 cents, and if it’s located between 0.5 and 1.5 miles, the price is lowered by 1.2 cents. This effect of a hypermart is substantially greater than the effect of the addition of a traditional gas station in the areas.

Overall, it is estimated that retailers operate on small net profit margins. Therefore, gas stations have very little room for their prices to be pushed down any farther. As hypermarts continue to enter some retailers will be forced to exit the market. This occurrence in the retail gasoline industry is representative of a larger trend. Societies globally are experiencing an increase in low priced, one-stop-shopping big-box stores and mass-merchandisers. As the transformation takes place, some smaller firms are left struggling as they adapt to more competitive business environments. We have identified the short-run impacts (within the year) of the introduction of hypermart gasoline stations. Given the large number of big-box stores, groceries, and discount shopping sites located in prime shopping areas, it seems likely that hypermarts will continue to expand further into the gasoline industry, creating more pressures on traditional gasoline retailers to find new ways to cut costs, differentiate their products, or exit the industry.

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8 References


