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DISSERTATION

An Analysis of Strategic Price Setting in Retail Gasoline Markets

Florencia Jaureguiberry

This document was submitted as a dissertation in July 2010 in partial fulfillment of the requirements of the doctoral degree in public policy analysis at the Pardee RAND Graduate School. The faculty committee that supervised and approved the dissertation consisted of Thomas Light (Chair), Martin Wachs, and David Loughran.

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Abstract

This dissertation studies price-setting behavior in the retail gasoline industry. The main questions addressed are: How important is a retail station's brand and proximity to competitors when retail stations set price? How do retailers adjust their pricing when they cater to consumers who are less aware of competing options or have less discretion over where they purchase gasoline? These questions are explored in two separate analyses using a unique datasets containing retail pricing behavior of stations in California and in 24 different metropolitan areas.

The evidence suggests that brand and location generate local market power for gasoline stations. After controlling for market and station characteristics, the analysis finds a spread of 11 cents per gallon between the highest and the lowest priced retail gasoline brands. The analysis also indicates that when the nearest competitor is located over 2 miles away as opposed to next door, consumers will pay an additional 1 cent per gallon of gasoline.

In order to quantify the significance of local market power, data for stations located near major airport rental car locations are utilized. The presumption here is that rental car users are less aware or less sensitive to fueling options near the rental car return location and are to some extent "captured consumers". Retailers located near rental car locations have incentives to adjust their pricing strategies to exploit this. The analysis of pricing near rental car locations indicates that retailers charge prices that are 4 cent per gallon higher than other stations in the same metropolitan area.

This analysis is of interest to regulators who are concerned with issues of consolidation, market power, and pricing in the retail gasoline industry. This dissertation concludes with a discussion of the policy implications of the empirical analysis.

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Chapter 1

Introduction

1.1 Motivation and Objectives

Gasoline is one of the most closely monitored products consumed by Americans. Consumers follow gas prices closely; with television, radio and print media presenting numerous reports on the topic on a daily basis, and websites associated with gas price searches proliferating in the last few years. Additionally, and perhaps as a result of its importance to consumers, the government -through its relevant agencies- also follows and regulates the gasoline industry.

At first glance, gasoline seems to have most of the necessary characteristics to make the market close to being perfectly competitive: it is a relatively homogeneous product, there are a large number of consumers and producers, and information on price is advertised visibly. But this intuition is certainly misleading. Among other reasons, gasoline sold "at the pump" is differentiated in several dimensions, like loca-

tion, ancillary services, and payment options, to name a few. And as such, one does not observe a unique equilibrium price. Product differentiation may be an acceptable explanation for the observed price differences, but some of the difference in prices could still be an expression of market power or exploitation of information asymmetries. Public agencies and the many studies devoted to the issue of understanding the causes of gasoline price variations grapple with these and other issues (Hosken et al., 2008). It is not fully clear how retail gasoline markets operate; in particular, to what extent some market participants are actually able to manipulate prices above competitive levels and to what extent observed heterogeneity in prices is associated with different consumer tastes and preferences for certain station characteristics.

One of the main reasons experts are unable to fully grasp the ins and outs of the retail gasoline market can be traced back to the fact that, until recently, detailed data were very scarce. Researchers and government authorities only had access to limited information about the market, either cross-sections at the station level or short panels, or longer panels with aggregated data. This dissertation uses a unique panel dataset that covers nearly a census of stations in selected markets across the US over many years to examine the determinants of prices in the retail gasoline market. These data allow for a detailed analysis with a focus on the impact of competition, imperfect information, and product differentiation on price.

Specifically, it quantifies how important brand and location are as explanatory drivers of price differences across stations, whether the importance of product differentiation is independent of the cost of oil, and how pricing strategies vary according to the type of fuel that is sold. Additionally, it tackles one of the main sources of

market power: insufficient information by consumers. It measures price increases when retailers have local market power, i.e. are in the presence of consumers who are uninformed about alternative suppliers.

The answer to these issues provides interesting new information for decision makers. First, this dissertation's new estimates of the effect of brand and competition on retail prices can influence the decisions of the antitrust regulators who closely monitor gasoline price behavior, and decide the fate of potential mergers. Also, estimates about the extent of price increases in cases where consumers are not informed about the price and location of competitors provide insights for guiding intervention in the studied market (rental cars around airports) and similar markets where consumers are uninformed about the local market (highways in low density areas, for example).

1.2 Background

Consumers worry about high prices and prospective increases in the price of gasoline simply because spending on gasoline represents a large proportion of their household's expenditures.[1] At the individual level, the average American spent 4.4 percent of her income buying gasoline and motor oil for transportation services in 2008,[2] an increase

[1] Also importantly, the retail market of gasoline is large in terms of employment. According to the last Economic Census, employment in the sector amounted to 926,792 employees (6 percent of the employees in the retail sector) in 2002, with a payroll that amounted to 5 percent of the total payroll. (2002 Economic Census, U.S Census Bureau, 2002)

[2] Gasoline and motor oil expenditures accounted for 5.4 percent of all annual expenditures for the average consumer in 2008.

of 67 percent over 2002 levels (Consumer Expenditure Survey, US Department of Labor, 2008).[3]

At least in the short run, consumers have only limited options with which to mitigate price disruptions, since demand is fairly inelastic (Hughes, 2006). Immediate reactions to increases in prices involve reductions in gasoline purchases, as consumers tend to drive less. In the long run, if prices are expected to remain high, people engage in more drastic responses: they start moving closer to work, changing jobs to be closer to home, and/or purchasing more fuel efficient vehicles.[4] Firms operating in the auto industry devote more research and development dollars to more efficient cars or to finding alternative fuels.

The gasoline market is without a doubt one of the highest profile markets today. Current attention has focused mostly on the dramatic rise in gasoline prices over the past few years. Calls for action directed at the government to do "something" about the increase in prices have been heard across the board.[5] The public uproar is usually associated with the belief that competition in this market is not vigorous and that prices would be lower if the government intervened to a greater extent. In fact, regulatory concerns are not only confined to variations in the price of crude oil (which indeed are highly correlated with the public outcry for action); government

[3]2002 is the last year where gasoline expenditures as a percentage of total disposable income decreased. In subsequent years the annual growth rates were 4, 11, 17, 7, 2, and 12 percent for 2003, 2004, 2005, 2006, 2007 and 2008 respectively.

[4]There is an extensive literature that addresses this issue. In the most recent meta-analysis, Brons et al. (2008) find that "in the long run, the response in demand resulting from a change in gasoline price is driven to similar degrees by responses in fuel efficiency, mileage per car and -to a slightly lesser degree- by a response in car ownership." For similar analyses, see Dahl and Sturner (1991) and Espey (1998).

[5]See for example The Wall Street Journal: "Congress Pressured on Oil Prices", June 26, 2008.

agencies have decided to step into this market in many other instances. Environmental concerns (such as oil spills and air pollution), supply shortages caused by natural disasters like Hurricane Katrina, and changes in market concentration, have all been cited by policy makers as reasons for past interventions in the petroleum market.[6]

1.3 Approach

This dissertation combines qualitative and quantitative examinations of the complex forces guiding pricing behaviors. Chapter 2 is an introductory chapter that describes how the petroleum market works, with a look at its most significant components, and the types of market failures that can occur throughout the chain of production.

The quantitative analysis follows, exploring how product differentiation and imperfect information affect pricing decisions. The dataset used in this dissertation is original and uniquely broad in its temporal and spatial dimensions. As mentioned above, one of the most important methodological problems encountered by researchers investigating pricing issues has been the lack of complete panel data (a long temporal series with broad coverage of different regions) for more than one fuel type. Previous studies have had either station-level cross-sections (or short panels) such as Slade (1992), Shepard (1993), and Hastings (2004),[7] or longer panels but

[6]Also, gasoline taxes (user fees) provide revenues that support government expenditures on roads and public transit, so rises in price cause legislative bodies to slow the rates of increase in per gallon gasoline taxes and this in turn deprives governments of revenues needed to maintain roads and to operate transit systems.

[7]Slade's (1992) dataset consists of observations of prices for ten service stations in a neighborhood in Vancouver, BC over a three month period. Shepard (1993) analyzes around 1,500 stations in a four county area in Massachusetts for the first quarter of 1987. Hastings (2004) uses data from the San Diego, California area for four dates in 1997

with only aggregated data, like Borenstein et al. (1997). More recent studies use better data, although less rich than the one used in this dissertation. [8]

In Chapter 3, the extent to which brand and location are important as product differentiation dimensions is analyzed. The main question is whether brand and location affect buying decisions. Do consumers consider that brand provides a distinct dimension to the definition of the product? Is this effect equally important across fuel types? How does the brand valuation change as the cost increases? A quantitative analysis is carried out with a unique sample of daily prices for over 7,400 stations in California during the January 2006-May 2007 period. While it would seem rather intuitive that brand matters, researchers have yet to provide a full-fledged analysis of how and to what extent it actually matters. For example, Hosken et al. (2008) find it surprising that "the only station characteristic that is a good predictor of [pricing] heterogeneity is a station's brand affiliation".

Chapter 4 provides a different quantitative study based on an estimation of local market power for gasoline stations near airports and rental car companies. An original test is applied to measure the mark-up that firms can charge to consumers when they have substantial market power derived from the presence of uninformed consumers in the marketplace. In the market for gasoline around rental car locations one can compare two types of firms that exhibit almost identical cost structures but serve two distinct types of consumers with different price sensitivity. Gasoline mar-

[8] For example, Hosken et al. (2008) use a panel of weekly prices for 272 stations in Northern Virginia suburbs of Washington DC. Chandra and Tappata (2008) use a similar dataset to the one in this dissertation, but their study is focused on market price dispersion rather than pricing at the station level.

kets located very close to rental car firms can serve to a higher proportion of the more inelastic consumers (the visitors) and thus, it is hypothesized and tested, they can charge higher prices. The main purpose of the obtained results is to estimate market power and to provide a benchmark for price increases in other markets where firms have abnormal pricing power.

Chapter 5 discusses how the results in Chapters 3 and 4 speak to policy. The discussion is hinged on the process that the FTC uses for merger investigations. To understand the potential impact of the analysis, consider the case in which the FTC approved a merger between two refineries (like the Exxon/Mobil merger in 1999[9]) and as a condition for the merger to go through, they asked the new merged firm to sell (divest) a certain number of gas stations. Implicit in that decision are considerations about the nature of competition, potential or real barriers to entry (and exit), and the definition of the product and its geographic market: is the product a commodity? Is it a differentiated good?[10]

1.4 Findings and Policy Implications

The quantitative analysis conducted in Chapter 3 confirms that both brand and location are indeed important differentiating dimensions in the retail gasoline market.

[9]For an overview of recent merger cases in the petroleum industry investigated by the FTC, see Appendix E.

[10]If the product is a *commodity*, it would be qualitatively homogeneous, which means that consumers would not be concerned about who the producer is. This would translate into a unique price in a unique marketplace (like bonds, gold, etc.). However, if the product is *differentiated*, it is not considered homogeneous in "quality" by consumers, and they would be willing to pay different prices based on who the producer is or where the product is being sold. It must be noted at this point that the differentiating characteristic is often unobservable by the researcher.

In particular, the analysis supports the idea that the closer the competitors are to a station, the lower the price that this station charges. When the nearest competitor is located over 2 miles away as opposed to next door, consumers will pay an additional 1 cent per gallon of gasoline. Additionally, the more competitors a firm has, the lower the price it charges, and this effect is nonlinear: adding a second competitor decreases prices more than a third competitor, etc. As for brand, after controlling for market and retailer characteristics, the analysis finds a spread of 11 cents (4% of the average price) between the highest priced gasoline brand and the lowest priced gasoline brand (Chevron and ARCO). The evidence also suggests that stations pricing strategies vary according to fuel type and that the pricing strategy is not the same across stations. For example, Chevron charges 3 cents more than an unbranded station for regular gasoline (1% of the average price), while it charges almost 15 cents above the price that an unbranded station would charge for Premium (which represents approximately 5% of the average price). Pricing strategies are different when wholesale costs are low than when they are high. Consumers are willing to pay a brand premium for when buying gasoline, but their willingness to pay for brand premium decreases as gasoline becomes more expensive.

The relevance of this analysis can be appreciated in the context of mergers in the retail gasoline sector. Imagine a situation in which the antitrust authority needs to evaluate the welfare implications of a merger between two upstream firms with important market presence in the retail gasoline market. If, after the merger, prices go up, is it valid to conclude that this increase in prices was caused by the fact that competition was lessened when the two firms merged? Or are prices really

capturing something else? One possibility is that after the merger, the value to the consumer of the product is higher due to brand effects. It is clearly very important that regulators are able to distinguish the different causes of price inflation because recommendations for policy actions will differ depending upon the causes.

Chapter 4 provides a test for local market power. The presumption is that rental car users (visitors) are less aware of fueling options near the rental car return location than the local consumers and are, to some extent, "captured consumers". Retailers located near rental car locations have incentives to adjust their pricing strategies to exploit this. According to the evidence found in the analysis, a firm with local market power (i.e. the closest firm to a rental car return site) can charge up to 4 more cents for every gallon of regular gasoline sold. Additionally, it is hypothesized that if the higher prices are driven by the presence of the uniformed visitors, they would only be observed for regular gasoline (the cheapest option for the consumer) and therefore, this mark-up would disappear for Medium and Premium gasoline. Indeed, in the analysis the significance of this effect vanishes for higher grade fuel types.

If one accepts the premise that firms located close to a rental car location capture almost all the uninformed consumers, this test should provide a useful benchmark of the effect size of market power for other cases in which market power is observed but is not easy to quantify. Policy makers can use this estimated effect for carrying out cost benefit analyses for possible interventions in other markets with imperfectly informed consumers. Last, it has been hard for researchers to find an example

where the price differentials are driven by differences in the amount and quality of information that the consumers have about retail options.

The discussion in Chapter 5 focuses on how the FTC carries out its antitrust analysis. The guidelines used by the FTC to evaluate mergers make assumptions about the way markets work but only roughly cover a few aspects of the idiosyncratic characteristics of gasoline retailing. The definition of a market seems to rely too heavily on geographic factors, and the results and implications are sensitive to assumptions about the nature of the demand.

Chapter 2

The Gasoline Market

This section describes the supply chain of the oil industry. It soon becomes clear that all the activities along the chain are not the perfectly competitive textbook market. The section also discusses the associated welfare implications.

To understand the different components of the cost structure and how the retail market works, it is useful to review the process of how gasoline gets from the ground to the pump. The most "upstream" activities are exploration, geological assessment of potential oil fields, drilling and operation of wells to produce a flow of crude oil. As shown in Figure 2.1) the crude oil is transported to refineries and then transformed (refined into finished products (gasoline, diesel, fuel-oil, jet fuel, liquefied petroleum gases, among others). In the case of gasoline and diesel, the fuels are transported from refineries to storage terminals and then sold to wholesalers and retailers. The fuel is shipped to gas stations and finally sold to consumers. All these activities can be grouped into four main layers: oil extraction, oil refining, distribution, and

gasoline retailing and Figure 2.2 shows the breakdown of the components of the final price of Regular gasoline, according to the Energy Information Administration, including taxes levied by government.[1]

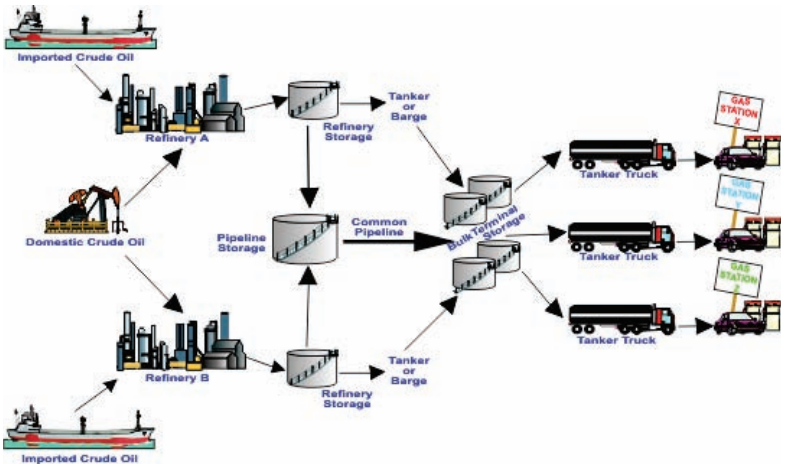

Figure 2.1: From the Ground to the Pump

The largest portion of the price of gasoline is the cost of crude oil. In June 2008, the price of crude oil averaged about $128 per barrel and accounted for about 74 percent of the national average retail price of a gallon of Regular grade gasoline. Just the previous year, in 2007, the average crude oil price was $71 per barrel[2] and the crude oil cost was 58 percent of the retail price. Federal, State, and local government taxes are the next largest portion of the retail price of gasoline. In June 2008, taxes (not including county and local taxes) accounted for about 10 percent of the cost of a gallon of Regular gasoline, 13 percentage points less than in 2004.

[1]Numbers for 2008 from "Gasoline and Fuel Update" available at http://tonto.eia.doe.gov/oog/info/gdu/gasdiesel.asp, for 2004, 2005, and 2007: "A Primer on Gasoline Prices" Brochure DOE/EIA-X040.

[2]Inflation-adjusted prices (2008 dollars).

Refining costs and profits were about 9 percent of the national average retail price of Regular gasoline in 2008. Last, distribution, marketing, and retail dealer costs and profits in June 2008 were 7 percent of the gasoline price, down from the 2004 average of 12 percent. As is evident from the graph, the margins of distribution and marketing, and refining tend to shrink as the price of crude oil increases.

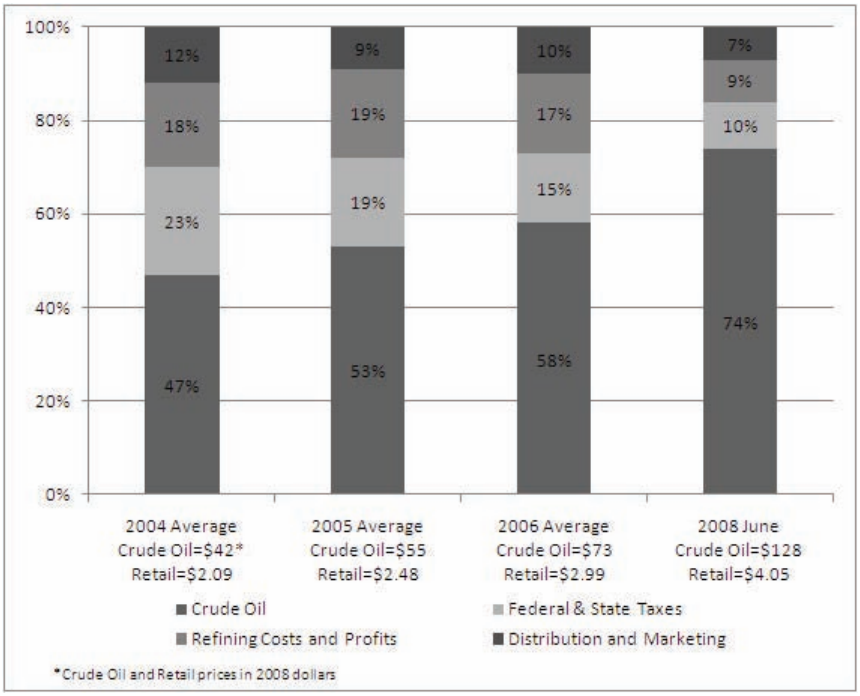

Figure 2.2: Price Components

Starting at the top of the vertical chain, crude oil is the primary input in the production of gasoline. At this stage, the product is homogeneous, and -like most commodities- there is a uniform price set in a centralized market based on the quantity supplied and demanded. However, the fact that only few countries have been endowed with this natural resource has prevented the market from acting freely. A

characteristic of markets with a small and fixed number of producers is that there are greater incentives to coordinate actions and act as if they were a monopolist. That is indeed what has happened with the Organization of Petroleum Exporting Countries (OPEC) since 1960. This group of producers affects the price of oil by setting production quotas for each member country. OPEC account for about 44 percent of the world total production of oil and it is probable that had they not restricted the supply of oil, the equilibrium price would be much lower.[3]

Higher oil prices translate into higher retail prices (see Figure 2.2). However, despite the explicit agreements from OPEC, the regulatory agencies of an importing country have limited ability to intervene in this market to make it more competitive.[4] Most of this effort is aimed at improving the competition in the downstream markets.

Down the vertical chain, the next activity is the refining of oil into fuel and related products. Oil reaches refineries in the US either by tankers (from other countries and Alaska) or by pipelines (from continental sources). The refining activity presents technological economies of scale and it is not surprising that a few large companies compete in the marketplace. Moreover, constraints in the distribution networks separate the country into regional markets. As discussed below, this effect is strengthened by regulations that make price arbitrage more difficult across states or that limit entry (or capacity expansion) by new players.[5]

[3]Note that the actual price is below the price a monopolist would charge. Even though OPEC is a case of explicit collusion, the same principles that are at work in cases of tacit collusion apply here. Thus, the total output is more than the monopoly output but less than the competitive output.

[4]The United States is the third largest oil producing country in the world, however, it is a net importer. Only 35 percent of the crude oil used by US refineries is being produced in the US.

[5]In 2007, 90 percent of the gasoline consumed in the United States was refined in US facilities.

Refineries ship gasoline to bulk storage terminals through shared pipelines (sometimes it is transported by tankers or barges). These bulk terminals often service many companies. Once the gasoline is ready to be shipped to the gas stations, it is loaded into tanker trucks, where some brands blend special additive packages into the gasoline. Last, the tanker trucks unload the gasoline into underground tanks at the station.

A refinery can sell its gas as either "branded" (with the aforementioned additives and a right to use the refiner's name)[6] or "unbranded" (the name of the refiner cannot be used). The refinery can distribute the gasoline directly to gas stations or can sell the gasoline to intermediaries (jobbers), who in turn distribute the fuel to gas stations. In cases where gasoline is directly supplied by the refinery, a station can be owned and operated by the refinery (company-op), in which case there is no transaction price. In other cases, a refinery can directly sell to an independent franchisee, who pays the dealer tank-wagon (DTW) price (not observable by other stations). Alternatively, jobbers (who may themselves own stations) supply gas stations with branded or unbranded gasoline paying the terminal price (also known as rack price).[7]

In short, the refining stage can be described as an oligopoly in which firms sell homogeneous products and have capacity constraints. Thus, economists have used a Cournot model to explain and analyze competition in this market.[8] As we know, a

[6]Branded gasoline has traditionally been linked with major oil companies, which have refining, terminal, and other assets upstream (FTC, 2005).

[7]DTW prices include transportation costs and other business costs beyond the basic rack price.

[8]Cournot models characterize environments in which firms choose production quantities and the final price is determined by the overall market supply and demand. Alternatively, Cournot

Cournot industry output is below what a competitive industry would produce. The deadweight loss is a function of the number of competitors as well as the elasticity of consumer demand. This is one of the main reasons why the FTC keeps a close eye on most merger activity that occurs in this sector. Also, since the incentives for output coordination are high, it is important that antitrust authorities investigate every "smoking gun" related to supply rationing.

The retailing of gasoline is at the downstream end of the vertical chain and appears to be relatively competitive. The "production" of retailing services does not require large sunk investments as in the case of refining and there are fewer entry restrictions.[9] Thus, a given market has a large number of players competing through prices, and there are almost no capacity constraints.[10] Consumers are fairly mobile and can shop around for gas. The main separation from perfect competition lies in the fact that once gasoline reaches a gas station it becomes a differentiated product. There is no single price in the marketplace since consumers' willingness to pay depends on factors such as location, brand, ancillary services, accessibility, availability of credit, number of pumps, etc.

Variation in price when attributed to differentiated products does not necessarily imply lower welfare. This is because consumers are heterogeneous and value differently the characteristics of the product. However, the competitive pressures decrease (relative to the homogeneous product case) and stations have local market power that

models represent situations in which firms choose prices *but* have capacity constraints (Kreps and Scheinkman, 1983)

[9]Zoning restrictions mainly.

[10]Even though the underground storage tanks have limited capacity, it takes less than 48 hours for a station owner to get a new fuel delivery

translates into positive mark-ups. Also, it is important to know the characteristics that are relevant to consumers since the more dimensions on which two products differ the lower is the competition between two firms selling those products. It is clear that location is an important factor to explain price differences,[11] but is brand? This question is investigated in Chapter 3.

A characteristic of decentralized markets in general and retail markets in particular is that consumers do not know the market price distribution. There is a large literature on costly consumer search (Reinganum, 1979; Varian, 1980; Stahl, 1989) that shows that positive search costs are sufficient to negate competitive outcomes. Reducing search cost clearly benefits consumers. That is probably one explanation for regulations that require stations to post prices so that they are visible to all drivers.[12] There is evidence that search costs play an important role in explaining gasoline price dispersion (Lewis, 2008; Chandra and Tappata, 2008).[13]

The economic importance of the sector and its lack of competitiveness in all stages of the vertical chain have kept regulators closely scrutinizing the industry. The complexity in the structure of the market increases once we take into account the different degrees of vertical integration among firms. Many companies in the oil extraction business own refineries and gas stations (e.g. Exxon-Mobil, BP, Shell)

[11]See, for example, Houde (2008). Houde argues that market power in the gasoline sector is tightly linked with the ability of stations to locate according to the driving behavior of consumers.

[12]There are other reasons that would motivate firms to post prices voluntarily. On one hand, stealing consumers from competitors is easier. On the other hand, coordinating high prices with competitors might be easier.

[13]Chandra and Tappata test the role of search costs on price dispersion. Using a test of rank reversals, their results are consistent with the theoretical predictions that search costs deter consumers from price-shopping.

and thus anticompetitive activities upstream have more spillovers downstream. A very common case is a merger between two refineries. It is clear that a merger might affect the level of competition in the refining industry if it significantly increases concentration. The direct effect in the retailing market is a higher wholesale price, but there is also a concentration effect downstream since all company-op and lessee dealers associated with the merging firms will most likely carry the same brand.

2.1 Government Intervention

This section discusses regulations affecting the retail gasoline industry. They range from taxes by which to finance automobile-related public goods to regulations of the physical properties of gasoline to protect the environment. These regulations have a direct effect on the way markets are delineated and how demand and supply interact.

As shown in Figure 2.2, taxes explain around 10 percent of the final price paid by consumers. This is due to Federal, state and local taxes. Federal excise taxes are 18.4 cents per gallon (as of August 2008). States have different combinations of excise and other taxes. In 2008, states charged 31 cents per gallon on average, so in total, the average consumer paid almost 50 cents per gallon on taxes.[14]

At the federal level, competition concerns are monitored by two agencies, the Antitrust Division of the US Department of Justice and the Bureau of Competition of the Federal Trade Commission. The goals of the antitrust regulators are to ensure

[14]Appendix A.1 presents a map of combined local, state and federal taxes for January 2008 by state. Source: www.api.org

competition in the marketplace, and they devote their resources to preventing anti-competitive behavior and anticompetitive mergers. A more detailed analysis of the process implemented by these agencies to achieve their goals is discussed in Chapter 5.

One of the most important set of regulations that affected the industry in the past three decades was built in response to environmental concerns. At the federal level, many environmental acts regulating the petroleum industry were passed during the 80s and the 90s, such as the Clean Air Act, the Clean Water Act, the Oil Pollution Liability and Compensation Act, the Resource Conservation and Recovery Act, and the Toxic Substances Control Act. These acts along with regional, state and local regulations, have set forth rules directed towards preventing and cleaning up crude oil and product spills, collecting and handling solid wastes and restricting fugitive emissions from transport and storage facilities. Also, refineries have been subjected to controls of their emissions of air and water pollutants, and technological requirements have been in place as to how to burn gas more cleanly. In sum, all these regulations have been aimed at correcting environmental externalities that the unregulated industry would generate. In the end, these rules imply higher production costs for all players in the market, which are mostly passed on to consumers, who end up paying higher prices.[15]

There are other regulations that also affect competition in the marketplace. For example, environmental programs require some areas of the country to use gasoline that is specially formulated to reduce carbon monoxide, smog and air toxics emis-

[15]Note that the short-run demand for gasoline is quite inelastic.

sions. At the Federal level, the Clean Air Act Amendments of 1990 mandated that areas of the country with the worst ozone problems should use reformulated gasoline with an oxygen content of 2 percent. States have also implemented legislation to ensure that fuels burn cleaner. California has been a pioneer, mandating that its gasoline be blended with ethanol instead of methyl-tertiary butyl ether (MTBE) since January 2004. The major implication of these distinct and area-specific gasoline requirements is that gasoline produced by refineries is no longer a homogeneous product nationwide. That means that large markets are split into thinner sub markets and therefore competition weakens. This is why sometimes supply shortages in a particular area generate large price spikes: the shortage cannot be relieved by simply shipping in gasoline from another better supplied area. The effect on prices is even worse in the case of California where the entry of new refineries has been practically forbidden.[16]

To deal with highly concentrated industries and as a result of complaints of "price gouging" some states have discussed or passed specific laws governing relationships between the upstream and downstream sides of the market. So called "divorcement laws" regulate the ability of refiners to maintain or acquire retail gas stations.[17] The

[16]A Staff Report by the California Energy Commission (CEC, 2008) suggests that most of the capacity expansions challenges (either by expanding existing facilities or building new refineries) are derived from the permitting processes: "Most refineries and storage facilities require around 15 to 20 local and state permits (depending on location), in addition to certifications and decisions on state environmental documents, as required by the California Environmental Quality Act (CEQA) and related CEQA guidelines." Furthermore, "each city, county, air quality management district, regional water quality control board, and special district has a different set of rules, regulations, and permitting processes. There is no standard procedure for determining which permit to apply for first.

[17]The state of Maryland was among the first to implement divorcement laws in 1979.

idea behind this regulation is that company-op stations would determine their prices as a multi-product firm rather than a single-product firm and therefore decrease competition (and welfare). Note that this is true only when stations operate in the same market (however the market is defined). On the other hand, divorcement laws could decrease welfare if they impede the elimination of the double mark-up that would happen if the firms are not integrated and therefore generate higher prices. The double mark-up is only an issue if both upstream and downstream firms have market power. Thus, the divorcement law assumes that the multi-product effect dominates the double mark-up effect.

Several studies have shown that there is a perverse effect of divorcement laws on retail prices. Barron (1984) found that Maryland's divorcement law raised self-service gasoline prices by 1.4 to 1.7 cents and full-service prices by 5 to 7 cents per gallon at stations that were formerly supplier-operated. In a more recent study, Vita (2000) estimated that divorcement laws in six states and the District of Columbia would decrease annual consumer welfare by approximately $112 million, emphasizing the issue raised by Borenstein and Gilbert (1993) that a relatively small distortion (2.6 cents per gallon for unleaded gasoline) would translate into "a rather sizable aggregate welfare loss in a large market".

In response to price spikes after Hurricane Katrina, the US Congress considered legislation providing civil and criminal sanctions for price gouging. In a statement to Congress presented by Deborah Platt Majoras (Majoras, 2005) the FTC strongly opposed intervention into the market, arguing that the price spikes were not a result of any anticompetitive behavior by firms, but were the results of markets actually

working and reflecting the shortages produced by the disaster. She emphasized the importance of letting the market do "its work" to maximize intertemporal welfare.

Other initiatives target directly the pricing of gasoline by station owners. Some states, as a response to the entry of supermarket chains into gas retailing, do not allow gasoline to be sold at a price below a certain cost (usually the wholesale price paid). In other cases, retailers are obligated to charge a given mark-up over the wholesale price. The idea behind this regulation is to stop firms from using gasoline as a "loss leader" and therefore protect the traditional gas stations (mainly independents). Similarly, there have been other attempts to affect retailer pricing that are hard to justify economically. Connecticut Senate Bill 1136: "mandate(s) that retailers sell gasoline based on the actual prices . . . paid for the gasoline located in underground storage tanks located on the premises of the retail gasoline station at which gasoline is sold."[18]

[18]http://www.ftc.gov/opa/2007/05/fyi07241.shtm, last accessed August 21, 2008

Chapter 3

Strategic Price Setting in Retail Gasoline Markets: The Influence of Brand and Location

In this chapter, the importance of product differentiation in the retail gasoline market is studied. The main issues addressed here are whether and how product characteristics affect the buying decisions of the consumers, and hence, the pricing strategies adopted by gas stations. In particular, this analysis in this chapter focuses on the variations of gasoline prices that can be explained by brand and location differences across stations.

First, the expected qualitative results from product differentiation theories are briefly discussed and then, a unique dataset is used to perform the quantitative analysis. Is brand a relevant dimension of the "gasoline" product? How much are

consumers willing to pay for different brands? Does this premium change as the cost of the product increases? How is competition affected by location and market density? Is the effect of brand and location equally important across fuel types? These questions are addressed using a rich dataset that consists of daily prices of gasoline for over 7,400 stations in the state of California, during a 17 month period starting in January 2006 and ending in May 2007.

3.1 Introduction

At first glance, gasoline markets might be regarded as fairly competitive, since most characteristics of perfectly competitive markets are present. Gasoline itself is a fairly homogeneous good. The product offered at different gas stations in the same area usually comes from the same bulk terminal.[1] Also, consumers are fairly mobile and can shop around for gas, and information about the price of the product is visible and accessible in the form of big signs along the road. Most markets are composed of a large number of players that compete through prices and have no capacity constraints. There are only a few barriers to entry, which are mostly derived from zoning regulations.[2]

However, once gasoline reaches a given gas station, the assumptions for a perfectly competitive market begin to break down. Now, a consumer's willingness to

[1] As described in detail in the previous chapter, refineries usually combine gasoline among themselves before shipping it by pipeline to terminals or gas stations.

[2] Local zoning regulations vary widely across the country. In most cases, gas station owners need special permits to operate their businesses. In some cases, restrictions are stricter: ranging from banning gas stations from residential (and even commercial) zones to spacing along busy highways.

pay depends upon many other factors than just gasoline. The product is not only "gasoline", but "gasoline sold at a particular station", a good that is no longer homogeneous in the eye of the consumer. Purchase decisions are made according to a station's location and accessibility, the number of pumps, the ancillary services offered by the station in question (such as the existence of other products, like food items, car wash, etc), the availability (or lack) of payment options (credit cards, fleet cards, pay at the pump), and other factors idiosyncratic to the station. As a result of the good now being "differentiated", there is not a *unique* equilibrium price in the marketplace (as it would be the case if the good were homogeneous). And this is what one observes in real life. It is evident to the keen eye that even stations across the street from each other can show surprisingly high price differentials. But then again, gas stations across the street are never identical.

A wider variation in prices translates into a change in welfare for the consumer, compared with the competitive case. But the direction of change in welfare may not necessarily be negative. The theory of monopolistic competition developed after Chamberlin (1933) shows that the consumer gains derived from diversity outweigh any apparent inefficiencies. This is so because firms have a unique product but competition in the marketplace is still intense with free entry and exit.

On the other hand, as oligopoly theories suggest, consumer welfare may be effectively negatively impacted when entry frictions make competitive pressures low. To illustrate this effect, one can think of the duopoly model described by Hotelling (1929).[3] Two firms sell a similar item to consumers, who are distributed along a

[3]For a formal treatment of this issue, see d'Aspremont et al. (1979)

linear market and need to travel to the firm's location to buy the product. This is a model of horizontal differentiation and the competition between these two firms is inversely related to the distance separating them. The product becomes homogeneous when the two sellers are located in the same place and the outcome is similar to that of perfect competition. Product differentiation is maximized when the firms position themselves in the opposing extremes of the market and, due to high market power, the prices end up far away from the marginal or average production cost. These effects become more relevant the higher the transportation costs are for consumers. If, in addition to location, the two firms differ in the quality of their products (vertical differentiation) one should expect competition to be lowered (Tabuchi, 1994).

Based on welfare considerations alone, it is of interest to policy makers to parse out and understand the characteristics that determine market power and price variations. Consider the example introduced in Chapter 1 in which antitrust authorities are trying to evaluate the welfare implications of a merger between two refineries or oil companies with important market presence in the retail gasoline market (i.e., Shell and Sunoco). If prices of gasoline go up in the stations owned by the newly merged company, would it be valid to conclude that the increase in prices was caused by the fact that competition was lessened? Or are prices really capturing something else other than more market power? One possibility would be that after the merger, the value of the product to the consumers is higher because of the associated brand change in some of the merged stations.

It is very important that regulators are able to distinguish these completely different causes of price inflation because recommendations for policy actions will differ

considerably depending upon the causes. Preventing or regulating mergers if the cause is abuse of market power, do little or nothing if product differentiation is at the root of the issue.

It has been documented in several studies of the gasoline market that location is an important factor to explain price differences. For example, Houde (2008) argues that market power in the gasoline sector is tightly linked with the ability of stations to locate according to the driving behavior of consumers.[4] The empirical analysis in Section 3.4 uses two different measures of market density to test and measure how market density affects price.

As for brand, casual observation suggests that gasoline brands are constantly being advertised in the media. This marketing strategy would not be profitable if consumers' perceptions could not be affected by it. Indeed, a survey by the consulting firm Brand Keys published in the New York Times in 2002 (Blumberg, 2002) found that 36% of consumers are loyal to one brand of gasoline, and the extent of loyalty varies significantly by brand. As Lewis (2008) states:

> While most evidence regarding consumers' gasoline buying patterns and station preferences is anecdotal, some consumers do perceive certain brands of gasoline to be superior and become loyal to stations of that brand

But what factors do these perceptions depend upon? The most straightforward explanation would be that consumers believe that there is a difference in the quality

[4]See for example Shepard (1991), Hastings (2004), Lewis (2008), Chandra and Tappata (2008).

of the product sold by each of the branded stations. Simple questions like what is the difference in quality between Shell and Chevron, and whether Chevron gasoline is actually different from an unbranded gasoline have no obvious answer. Firstly, a bulk terminal's gasoline is a combination of different refineries' production. EIA remarks "the fact that you purchase gasoline from a given company does not necessarily mean that gasoline was produced by that particular company's refineries". Even if the refinery at which the gasoline is refined is known and idyosincratic to the station, the quality of the gasoline that the station receives is not constant, because it depends among other things on the type of crude oil used, which changes on a daily basis.

The only actual difference between the gasoline sold at stations of different brands in an area is the fuel detergent additive that is blended into the truck tank before it is shipped to the station. Different brands have developed different additives claiming that they improve engine performance.[5] Regardless of each company's claim, there is not sound scientific evidence supporting the fact that additives do indeed improve the quality of gasoline, at least to the extent that the consumers perceives it to. Also, as far as conventional wisdom goes, Consumer Reports seems to imply that all gasoline is the same, explicitly advising consumers in its 2006 report to "break the same station habit", by monitoring prices all along the normal travel and buy where prices are the lowest.

Also, regulations affect the difference (or lack thereof) in quality among stations. The contents of gasoline are regulated in such a way that the gasoline sold by a

[5]For example, Chevron adds polyether amine, marketed as Techron, to its gasoline.

refiner to the different branded and unbranded stations does not differ much. The main federal legislation affecting the quality of gasoline was passed in 1995 by the Environmental Protection Agency. These regulations provided minimum detergent concentration standards, but the main target was to reduce emissions, and not necessarily engine performance, which is what the individual consumer is ultimately interested in. Later, in 2004, BMW, General Motors, Honda, and Toyota brought forth a proprietary standard for a class of gasoline called Top Tier Detergent Gasoline (TTDG). This gasoline had more stringent detergent content regulations than required by law. Gas brands could (and still can) voluntarily opt to meet these standards. To this day, there is no consistent adoption of the standards across brands. For example, BP is not a Top Tier brand, and is still recommended by Ford.[6]

But, as was delineated above, consumers do not choose to buy gasoline at one particular station just because of the (perceived) quality and price of their gasoline. In the last twenty years, stations have begun to rely heavily on ancillary services, and consumers might be guided by the complementary nature of the goods that they can buy at the stations. Retailers have been trying to differentiate themselves by imposing standards across all the stations selling their marketed brand (appearance and cleanliness of stores, for example). Others use loyalty programs, and offer rewards and promotions through them. Car wash discounts apply to consumers buying a station's gasoline. The consumer also values the availability of different payment options, such as credit cards, fleet cards (similar to credit cards, they offer additional services to fleet owners or managers, such as fleet reports and rebate programs),

[6]From http://www.toptiergas.com, last accessed in March, 2009.

and the possibility to use pay-at-the-pump services (as opposed to paying to the attendant or having to walk away from the car).

Researchers have confirmed that brand loyalty may be partially explained by complementarities in the demand function (Romley, 2003). Consumers that not only need to fill their tanks, but buy more products, may be inclined to buy at a gas station with a convenience store rather than make an additional trip to another store. In this case, a gas station that offers other products can charge an additional mark-up based on their added value. Alternatively, one can think of another type of business strategy that may explain price variation in a different direction. Some convenience stores or supermarkets may use gasoline as a loss-leader and lower their prices in order to attract their customers to buy other products at their store. The dataset used in Section 3.4 allows for the identification of these patterns.

Most studies addressing price variation in the gasoline market abstract from the issues related to brand affiliation and focus on inferring other overall relationships. In studies concentrating on the retail gasoline market, brand has been used as a control variable for price variability (Hastings, 2004). However, the basic and intuitive question of how much does selling a specific brand, such as Shell or Chevron, affect the final price has not been addressed explicitly in the literature so far. Previous studies have traditionally encountered problems testing brands separately, due to insufficient observations. That is the case, for example, of Hastings (2004), who studies the effect of vertical contract types on local retail prices, groups brands according to market presence (High, Mid, and Low Brands) "since there are not enough stations in the treatment group for some of the brands to allow for precise estimation of the

effects [. . .]" . Similarly, in a study measuring price dispersion among differentiated retail gasoline sellers and the local competitive environment, Lewis (2008) groups brands according to high and low brand categories.

The following sections provide an estimation of the additional mark-up charged by different brands, which is a combination of the different dimensions briefly discussed above. The contributions of this paper lie mainly in the extensive and daily features of the dataset that allow for the identification of each separate brand using panel data econometric techniques. The analysis in Section 3.4 supports the hypothesis that location and brand are indeed relevant dimensions differentiating products in the retail gasoline market. After controlling for market characteristics, the analysis finds a spread of 11 cents between the highest priced gasoline (Chevron) and the lowest priced gasoline (Quickstop). As for location, the closest to one another the competitors are, the lower the prices. The evidence also suggests that stations pricing strategies vary according to fuel type and that the pricing strategy is not the same across stations. Also, these strategies are different when wholesale costs are low and when they are high.

The remainder of the chapter is organized as follows: the dataset and some preliminary summary statistics for the main variables included in the analysis are discussed in Section 3.2. The econometric model to be estimated is then presented, and the expected effects of the coefficients of interest are discussed. Regression results are discussed next. Section 3.5 concludes.

3.2 Description of the Data

The dataset used in this section consists of an unbalanced panel[7] of daily prices for stations located in the state of California over a seventeen month period extending between January 2006 and May 2007. Prices are reported for four different types of fuel: Regular Unleaded, Midgrade Unleaded and Premium Unleaded Gasoline (87, 89, and 91 octane respectively), and Diesel.

Daily retail prices and station characteristics (brand and full address) were systematically collected from the Oil Price Information Service (OPIS) database.[8,9] A total of 7,460 stations are included in the sample, which results in approximately 1.2 million observations. According to the 2002 Economic Census, there are 8,250 gasoline stations in the state of California, so the sample would amount to 90% of the population had it stayed the same. The trends in the industry seem to imply that the actual population relevant for this sample is actually smaller, therefore increasing the representation of the sample.

Table 3.1 shows summarized price information (in cents) by fuel type. A wide variation in gas prices can be observed over the period. They range from 2 to 4 dollars: for Regular Unleaded, for example, the minimum observed price is 207 cents

[7]A panel is unbalanced when it is not rectangular, i.e. if the total number of stations equals N, and the number of days equals T, the number of observations is smaller than N*T due to missing observations. The main potential problem with having an unbalanced panel is the danger of selection bias. Throughout the analysis, it is assumed that the unaccounted for observations are missing at random.

[8]The data collected by OPIS were generated through credit card operations, direct feeds and other "survey methods". See http://www.opisretail.com/methodology.html for a description of their methodology.

[9]Special thanks to Ambarish Chandra and Mariano Tappata for their help collecting the raw data.

and the maximum is 425, and an average of 302 over the period. Figure A.3 in the Appendix shows the evolution of average weekly Regular Unleaded prices for a period of four years between 2005 and 2008, including the sample period. In the sample, prices peaked in May 2007 and were lowest in January 2006. Back to Table 3.1, average prices increase with octane levels, as expected. There is, on average, an 8 cent difference between Regular and Midgrade gasoline, and an additional 5 cents for Premium over Midgrade.[10]

Fuel type	Mean	SD	Min	Max
Regular Unleaded	302	33.25	207	425
Midgrade Unleaded	310	34.16	224	420
Premium Unleaded	315	35.47	218	429
Diesel	312	22.20	225	401

Table 3.1: Summary Statistics – Price (in Cents) by Fuel Type

Brand information of the sample data can be found in Table 3.2. The sample information is broken down according to its retailing brand and is ranked by presence in the sample, and the total number of stations is presented in column 3.[11] The table also shows whether the company is present in the upstream stages of the vertical chain.[12]

[10]See Appendix A.2 for a full distribution of sample prices by fuel type.

[11]Due to the unbalanced nature of the panel, the relationship between the number of gas stations and observations is not one to one. That is, because some stations do not report prices for every day in the sample, the number of observations in the f for a particular brand might not be proportional to the number of stations in California. See, for example, the cases of Costco and Regent.

[12]Upstream presence can be manifested through ownership of refineries or presence in the crude oil business, either directly or indirectly through the parent company.

There are 35 different brands in the sample, with 13 of them accounting for 95 percent of the studied stations.[13] The brands are very heterogeneous in nature, both in perceived quality and the type of retailing store.[14,15] Column three shows that some of the companies with upstream presence segment the market by using several brands to retail their gasoline (i.e. Valero and Conoco). The usual logic behind this kind of segmentation strategy suggests that firms can maximize their profits by offering a menu of "quality-cost" to consumers instead of a single product.[16] Other companies, such as ARCO have a low price focus as their marketing strategy, having eliminated, for example, all credit cards transactions.[17] Some brands are associated with convenience stores (7-Eleven, Circle K, QuikStop), and some with supermarkets or wholesale discount stores (Costco, Food 4 Less). Last, some are travel plazas or truck stops (Flying J,Pilot, Travelcenters of America).

Table 3.3 combines the brand and price information for each of the 13 most represented brands in the sample. Column 2 shows the average price of Regular Unleaded gasoline for the whole period. A dispersion of 50 cents can be appreciated between brands: average prices vary from a low of 266 cents (Citgo) to 311 cents (7-Eleven). Surprisingly, these two retailers have historically sold the same gasoline.[18] Moreover, this basic tabulation seems to imply that a convenience store, 7-Eleven,

[13]Brand names are displayed as reported by OPIS.

[14]See Lewis (2008) and Hastings (2004) for previous attempts of brand classifications.

[15]Eight percent of the sample is classified by OPIS as "unbranded" and includes independent gas stations not marketing their gasoline under traditional brands.

[16]This is a similar strategy to the one followed by some car manufacturers (Honda-Accura, Toyota-Lexus, Nissan-Infinity).

[17]This practice is no longer applied to all ARCO stations.

[18]On September 27, 2006, 7-Eleven announced it would not renew the 20-year contract with Citgo (http://www.cbsnews.com/stories/2006/09/27/business/main2046157.shtml).

Brand	Total obs(in %)	Total Stations	Parent Company/Owner	Upstream Presence
CHEVRON	30.54	1,454	Chevron Corporation	Yes
76	22.56	1,225	Conoco Phillips	Yes
SHELL	15.16	1,069	Royal Dutch Shell	Yes
VALERO	8.95	643	Valero Energy Corporation	Yes
UNBRANDED	5.61	611	Unbranded	No
MOBIL	3.23	490	Exxon Mobil Corporation	Yes
7-ELEVEN	3.22	224	Seven & I Holdings Co. Ltd. (Japan)	No
CIRCLE K	1.98	140	Conoco Phillips	Yes
CITGO	1.45	227	Petróleos de Venezuela, S.A.	Yes
TEXACO	1.3	170	Chevron Corporation	Yes
EXXON	1.22	170	Exxon Mobil Corporation	Yes
QUICK STOP	0.9	71	The Kroger Co.	No
ARCO	0.77	238	BP	Yes
DIAMOND SHAMROCK	0.67	404	Valero Energy Corporation	Yes
ROTTEN ROBBIE	0.59	30	Independent	No
PILOT	0.38	9	Pilot/Marathon Oil Company	Yes
TESORO	0.32	30	Tesoro Corporation	Yes
FLYING J	0.32	12	Flying J	Yes
UNITED	0.15	14	Independent	No
USA PETROLEUM	0.11	22	Independent	No
UNOCAL	0.09	36	Chevron Corporation	Yes
LOVES	0.08	3	Independent	No
MIRASTAR	0.08	6	Tesoro Corporation	Yes
CONOCO	0.07	36	Conoco Phillips	Yes
ROBINSON OIL	0.05	2	Independent	No
FOOD 4 LESS	0.04	5	The Kroger Co.	No
SUMMIT	0.02	4	Independent	No
TRAVELCENTERS OF AMERICA	0.02	1	TravelCenters of America	No
SINCLAIR	0.02	3	Sinclair Oil	Yes
REGENT	0.02	2	Independent	No
COSTCO	0.02	22	Costco Wholesale Corporation	No
ULTRAMAR	0.01	9	Valero Energy Corporation	Yes
FLYERS	0.01	4	Independent	No
BEACON	0.01	11	Valero Energy Corporation	Yes
JIFFY LUBE	0.01	2	Pennzoil	Yes
ALL-STAR	0.01	1	Independent	No
TOTAL	100	7,409		

Table 3.2: Brands, Parent Company and Upstream Presence

Brand	Price	SD	Min	Max
CHEVRON	306	32.31	215	425
76	301	33.90	212	405
SHELL	301	33.83	207	410
VALERO	304	30.95	208	390
UNBRANDED	305	32.92	212	407
MOBIL	302	33.16	220	410
7-ELEVEN	311	27.17	230	369
CIRCLE K	301	32.25	220	368
CITGO	266	22.91	224	356
TEXACO	300	34.51	226	401
EXXON	297	34.60	214	399
QUICK STOP	290	31.83	218	344
ARCO	293	33.27	215	378

Table 3.3: Market Statistics - Price

charges on average higher prices than even the -a priori- high quality brands, such as Shell (10 cents less on average) or Chevron (4 cents less).

However, these numbers do not tell the whole story. In order to draw valid conclusions, one must extend the analysis and include other variables that might influence this spread in prices. For example, instead of reflecting differences in qualities, the 10 cent difference between 7-Eleven and Shell might be consistent with a situation in which consumers value the brands the same but it just happens that 7-Eleven stores are located in isolated (facing no competitors), high-income places while Shell stations are distributed uniformly across California.

Aggregate comparisons only provide a general idea of how prices behave on average, in this case for the whole state of California. However, stations operate in

different markets, they sell to different types of consumers and face varying degrees of competition, hence their ability to set prices is also constrained by these effects. For the regression analysis, the station-specific OPIS price data are complemented with location and geographic information, spot and average state prices from the Energy Information Administration (EIA), and own calculations of station level location variables.

In this analysis, competition is introduced through the number of competitors that are within a one mile radius of a circular market around each station. This is the traditional approach in the literature.[19] Table 3.4 summarizes the average number of competitors by brand. On average, all brands have between 4 and 5 competitors within one mile. All brands have at least one station with no competitors within a mile and the maximum number of rivals ranges from 13 to 18 stations in a one mile radius. Following up on the above speculation, it appears that 7-Eleven faces the same or even more competition than Shell.

To control for production costs, a variable approximating wholesale cost is included in the regression. The cost variable is intended to control for shifts in the wholesale cost faced by each of the stations, and two different measures are used in the analysis. As explained in Chapter 2, a gas station may buy their gas from the

[19]This is not an ideal measure of competition. Due to the presence of geographical features, one way roads, etc, this method is likely to introduce some error. A measure based on driving distance would more accurately reflect proximity to competitors. However, due to this method's intense computational requirements most academic and industry studies use Euclidean distance instead. See references listed in footnote [4]. An exception is Houde (2008), who defines markets according to traffic patterns of consumers. The presence of these market anomalies is assumed to be minimal in the present sample.

Brand	Mean	SD	Min	Max
CHEVRON	4.22	3.13	0	18
76	4.68	3.14	0	17
SHELL	4.39	3.03	0	16
VALERO	5.18	3.11	0	17
UNBRANDED	4.25	3.29	0	18
MOBIL	4.21	2.80	0	15
7-ELEVEN	5.02	3.11	0	17
CIRCLE K	3.76	2.77	0	13
CITGO	5.02	3.26	0	17
TEXACO	4.24	2.91	0	13
EXXON	5.09	3.35	0	15
QUICK STOP	4.91	3.69	0	16
ARCO	5.61	3.26	0	16

Table 3.4: Market Statistics- Competitors Within a Mile

wholesale market at the rack price or directly from the refinery at the Dealer Tank Wagon (DTW) price (which is usually higher than the rack price because it includes transportation costs). This information is only observable to the station, so it needs to be approximated. The daily spot price of gasoline in the Los Angeles Harbor is available from the Energy Information Administration, and is used in the analysis as one specification. Figure A.4 in the Appendix plots monthly rack, DTW (collected through surveys), spot and average prices for California. As expected, the four cost variables are very closely correlated. Another alternative variable for cost shifts is included and presented in the main results of this paper: the average price of gas for the whole state of California (also from EIA).

3.3 Estimation Strategy

In order to parse out the effects of brand and competition on the prices observed at the pump, a multivariate regression analysis is performed. The framework is based on an empirical application of a hedonic price function.[20] This function describes the *equilibrium* relationship between the price of a product and its characteristics. In this context, consumers maximize utility with respect to the current attributes of a differentiated good. The estimated function is determined by the nature of the interaction of buyers and sellers in the marketplace. The model specifies the price of gasoline in a particular station as a function of its brand, location, and other idiosyncratic characteristics of the station and its market:

$$\begin{aligned} PRICE_{ijkt} = \alpha_i + \beta BRAND_i + \gamma_1 COMPETITION_i + \gamma_2 COST_t + \\ \gamma_3 FUELTYPE_k + \gamma_4 ZIP_j + \gamma_5 OTHER_{it} + e_{ijkt} \end{aligned} \tag{3.1}$$

where $PRICE_{ijkt}$ is the price of type of gasoline k at station i in zipcode j at day t; $BRAND_i$ is the brand under which the gasoline is marketed in station i, the omitted category is an "unbranded" station; $COMPETITION_i$ includes a measure of competition for station i (distance to competitors, number of competitors in a certain radius); $COST_t$ is a proxy for the wholesale cost of gasoline at date t; $FUELTYPE_k$ denotes whether the gasoline is Regular Unleaded, Midgrade Unleaded, Premium Unleaded, or Diesel; ZIP_j are zipcode-level fixed effects; and $OTHER_{it}$ includes

[20]For a more detailed explanation of hedonic pricing models and its assumptions, refer to the extensive literature on the topic. See Rosen (1974) and Bajari and Benkard (2005), for example.

other covariates: day of the week and month. Four different versions of equation 3.1 are estimated clustering standard errors at the station level, and the main results are discussed and presented in Section 3.4. The expected effects are discussed in detail below.

The coefficient of interest is the brand effect, and its level and sign are expected to be different according to the perceived quality of the brand. The effect will be different for high and low quality brands as well as convenience stores. A higher price is expected to be associated with high-end brands of gasoline when compared to their unbranded counterparts. Similarly, the effect on price of selling a no frills brand of gasoline such as ARCO is expected to be lower or similar to selling unbranded gasoline.

The price effect of convenience store brands (7-Eleven, Circle K, and Quick Stop) is not clear a priori. As discussed in the previous section, two different effects in opposite directions may occur. Prices in convenience stores might be higher than regular stations if firms consider that the consumers might pay a premium for not having to make an additional stop on their trips (like a one-stop-shop). On the other hand, since gas prices are so easy to spot for a driver, a station might use a low price strategy for their gasoline to attract customers to buy complementary goods (loss leader strategy).

Price at a station is also affected by the degree of competition in the market. Two competition variables are included, the first one is the number of rivals that a firm has in a one mile radius. Conditional on the number of firms, the more competition that

a station has, the lower the expected price. To account for possible non linearities in this effect, a squared term is also included. Additionally, the number of competitors variable is complemented with the proximity of competitors. A variable measuring the distance to the closest station is included in the regressions.[21] This analysis is admittedly limited, since the entry and exit decisions of firms are not incorporated, mainly due to restrictions in the data. Note that the objective of this chapter is *not* to test the causal effect of the number of firms on the price, but rather its relationship in equilibrium.

The cost variable is expected to explain a significant portion of the price. Its inclusion is used to control for shifts in the wholesale cost faced by each of the stations, and two different measures are used in the analysis: the daily spot price of gasoline and its lags and the average price of gas for California. Deriving the optimal lag structure of the spot variable is not straightforward, and any particular specification might seem too ad hoc for this analysis. Instead, the main results of this paper are obtained using the state average price (from EIA) as a proxy for cost shifts. Assuming that prices at any given point in time reflect all the information necessary about past prices, there is no need to worry about the correct lag structure.

In the regressions, stations have different intercepts according to their zipcodes (zipcode level fixed effects model). Standard errors are clustered at the station level. Other control variables are also included in the regression. It is expected that pricing strategies change between regular weekdays and the weekends, as the consumers might be different not only in composition, but in behavioral characteristics (Eckert

[21] See Manuszak (2001) for a similar approach.

et al., 2005),[22] so an indicator variable for day of the week is included. Last, one specification includes dummies for the months of the year to test for possible time effects not captured by the cost variable. It would also correct for any temporal bias in the reporting of prices (for example, 7-Eleven may only have reported prices for the summer months, which are usually higher than winter months).

3.4 Regression Results

Table 3.6 shows the five different specifications and the brand coefficients are reported in Table 3.5. In all regressions, zip code level fixed effects are included. Unbranded stations and Regular Unleaded are the omitted categories for brand and fuel type respectively. A little less than 1.5 million observations were included in the estimations, and the overall explanatory power of the variables is 90%. The standard error of the estimations are clustered by errors and presented in brackets. The first Model includes brand variables, fuel type and day of the week dummies. Model 2 integrates distance, and Model 3 the number of competitors and its squared term. The last Model includes month dummies.

Table 3.5 shows that brand is indeed a significant determinant of the price of gasoline. The estimates suggest that controlling for idiosyncratic and market characteristics, Shell, 76, Chevron, Mobil, and Texaco stations can charge on average

[22]For example, the National Household Travel Survey (from the U.S. Department of Transportation) found that the most daily trips are made on Friday and the fewest daily trips are made on Sunday.

between 5 and 6 cents more than an unbranded station. Consistent with the general perception, one could refer to these brands as high quality.

	Model 1	Model 2	Model 3	Model 4
CHEVRON	6.37	6.259	6.269	6.158
	[0.360]**	[0.361]**	[0.361]**	[0.364]**
76	5.28	5.205	5.216	4.858
	[0.378]**	[0.378]**	[0.378]**	[0.381]**
SHELL	5.189	5.117	5.125	4.714
	[0.393]**	[0.393]**	[0.393]**	[0.397]**
VALERO	-2.298	-2.187	-2.169	-2.252
	[0.408]**	[0.408]**	[0.408]**	[0.412]**
MOBIL	5.424	5.362	5.365	4.956
	[0.474]**	[0.475]**	[0.475]**	[0.477]**
7-ELEVEN	1.617	1.734	1.725	2.146
	[0.433]**	[0.434]**	[0.433]**	[0.436]**
CIRCLE K	-0.181	-0.199	-0.188	-0.136
	[0.550]	[0.554]	[0.553]	[0.568]
CITGO	3.573	3.672	3.662	1.299
	[0.456]**	[0.457]**	[0.457]**	[0.457]**
TEXACO	4.484	4.498	4.5	3.801
	[0.778]**	[0.775]**	[0.777]**	[0.773]**
EXXON	-0.632	-0.613	-0.604	-0.718
	[0.633]	[0.630]	[0.628]	[0.611]
QUICK STOP	-4.99	-5.057	-5.069	-5.23
	[0.577]**	[0.584]**	[0.588]**	[0.593]**
ARCO	-4.326	-4.369	-4.33	-4.629
	[0.678]**	[0.683]**	[0.679]**	[0.675]**
Observations	1,465,294	1,465,049	1,465,049	1,465,049
Number of zip	1,213	1,211	1,211	1,211
R-squared	0.90	0.90	0.90	0.91

Standard errors in brackets; * significant at 5%; ** significant at 1%

All regressions include zipcode FE; unbranded omitted category

Table 3.5: Regression Results

Being unbranded though does not mean having the lowest prices. In fact, ARCO and QuickStop stations charge on average almost 5 cents less than an unbranded station. Depending on how "brand mark-up" is defined, whether it is in relation to not being branded or in relation to a low quality brand, the results show that being a brand associated with good quality, or more services can allow a firm to charge up to 10.5 cents more (this number is based comparing Chevron with ARCO).

The evidence for convenience stores is varied. 7-Eleven charges on average 2 cents above an unbranded station. Note that after controlling for market characteristics, the raw statistics from Table 3.3 are reversed and now Shell has on average a higher price than 7-Eleven -more than double. There is a significant difference on the location and market environment between the average Shell and 7-Eleven station. On the other hand, the coefficient for Circle K, another convenience store, is not statistically significantly different from zero, meaning that it would charge approximately the same price as an unbranded station. On the other end of the spectrum of convenience stores, Quick Stop is the cheapest gasoline, 5 cents cheaper on average than an unbranded station.

The coefficients are robust throughout the four specifications. Table B.1 in the Appendix shows that the rankings of the coefficients (1 is the highest coefficient, 13 the lowest) do not change at all between specifications (even the difference in values between the coefficients is not much higher than a tenth of a cent). The last column lists the rankings associated with the raw price statistics presented in Table 3.3. These rankings are indeed completely different, and provide evidence that each brand may have different location strategies (7-Eleven may choose to set up their

shops in more expensive areas), which are taken into account into the regressions. Additionally, the hypothesis that all the brand coefficients are simultaneously equal to zero was rejected at the 99% confidence level.

Table 3.6 shows the remaining coefficients in the estimation results. The estimates suggest that premium gasoline can be sold up to 17 cents more than Regular gasoline, and Midgrade gasoline cost on average 10 cents more than Regular. The premium on Diesel is 20 cents for the first three models, and drops down to 6 cents when months are included in the regression.

The results for the competition variables are also consistent with intuition. Distance, the variable that measures how far the closest station is, is positively correlated with price, that is, the further the closest station is, the higher the price that a station charges. When the quantity of rivals in the vicinity are included (variables Competitors and CompetitorsSQ), the negative sign implies that the higher the competition (more rivals in a one mile radius), the lower the price set by a station, but this effect is not significantly different from zero.

In all the regressions presented so far, the cost variable was the average price of Regular (and Diesel) gasoline in the state of California. The results for all these regressions with an alternative cost specification (contemporary and lagged spot price) are presented in the Appendix (Tables B.2 and B.3). As the reader can confirm in the Appendix, the coefficients of interest are similar to those presented in the body of this dissertation.

	Model 1	Model 2	Model 3	Model 4
DI	20.267	20.268	20.251	6.076
	[0.888]**	[0.888]**	[0.888]**	[0.948]**
MU	10.251	10.252	10.248	10.28
	[0.062]**	[0.062]**	[0.062]**	[0.061]**
PU	17.109	17.118	17.115	17.156
	[0.143]**	[0.143]**	[0.143]**	[0.144]**
EIApriceCA	1	1	1	0.986
	[0.001]**	[0.001]**	[0.001]**	[0.002]**
EIApriceCA-DI	0.97	0.97	0.97	1.005
	[0.003]**	[0.003]**	[0.003]**	[0.004]**
Distance		0.341	0.239	0.242
		[0.085]**	[0.094]*	[0.095]*
Competitors			-0.169	-0.164
			[0.094]	[0.094]
CompetitorsSQ			0.008	0.007
			[0.007]	[0.007]
Constant	-0.007	-0.18	0.412	6.197
	[0.403]	[0.406]	[0.473]	[0.659]**
Day of the Week	Yes	Yes	Yes	Yes
Month	No	No	No	Yes
Observations	1,465,294	1,465,049	1,465,049	1,465,049
Number of zip	1,213	1,211	1,211	1,211
R-squared	0.90	0.90	0.90	0.91

Standard errors in brackets; * significant at 5%; ** significant at 1%

All regressions include zipcode FE; unbranded omitted category

Table 3.6: Regression Results Continued

One may assume that the models underlying the determination of prices significantly vary according to the fuel type in question. That is, conditional on the fuel type a station is selling, the price strategies may vary within brands. The dataset allows further exploration of this particular hypothesis, so separate regressions are run for the three unleaded fuel types (Regular, Midgrade, and Premium) and Diesel.

The results for the specification including competition variables (Model 3 in Tables 3.5 and 3.6) are presented in Table 3.7.

Results show that pricing strategies might indeed be different according to fuel type. Depending on whether the type of fuel is Regular, Midgrade, Premium, or Diesel, branded stations charge different mark-ups over their unbranded counterparts. Stations do not necessarily set their mark-ups x cents above the average price, or even $x\%$ over their cost. For example, Chevron charges 3 cents more than an unbranded station for Regular gasoline (1% of the average price), while it would charge almost 15 cents above the price that an unbranded station would charge for Premium (which represents approximately 5% of the average price). Valero is the only brand that consistently charges lower prices than unbranded, for the three fuel types. It is also interesting to note that 7-Eleven charges *less* than an unbranded station for Regular gasoline, but almost 10 cents more for Premium gasoline.

There is an interesting change in the competition variables. The distance to the closest station is still positive and significant (station with further competitors charge higher prices), except for the case of Diesel. And the effect of the number of competitors is still negative, for all fuel types, but becomes significant for the case of Regular unleaded gasoline, and slightly less so for the case of Midgrade. The evidence also suggests that the effect of competition is nonlinear in the case of Regular unleaded gasoline, that is, adding a second competitor increases competition more than a third competitor, and so on.

But are these brand-price relationships stable depending on the level of the wholesale cost? In other words, are consumers willing to pay the same x cents more for brand y when gasoline is around 2 dollars a gallon and when it peaks near 4 dollars a gallon? In order to further explore the hypothesis that mark-ups (related to both brand and geographic differentiation) are different when prices are higher than when prices are lower, two separate regressions are run, one for a low price period (May, 2007) and one for a low price period (November, 2006). The results of these regressions are presented in Table 3.8. The first column presents regression results for a 1 week period (first 2 columns), and 1 month period (columns 3 and 4).[23]

The data show that there are significant pricing differences when wholesale prices are high and when prices are low. Branded stations like Chevron, Shell or 76 not only charge a higher absolute mark-up when wholesale costs are high, but also a higher percentage over the wholesale price than unbranded stations. This evidence suggests that stations have more market power when prices are high than when prices are low. However, distance and number of competitors are more relevant when wholesale prices are higher than when prices are lower. This means that as the market gets more competitive, having one less competitor or being further apart does not make stations increase their prices as much as when prices are lower. A reason for this could be that the behavior of consumers changes, that they compare prices more intensely when prices are high. But this discrepancy between the brand coefficients and the competition coefficients leaves the door open for further research about the dynamics and interactions between brand and location.

[23]Results for a 2 month period show similar results.

3.5 Discussion

The empirical estimations show that brand is an important dimension to differentiate a product, and that it can provide some retailers with enough market power to charge about 11 cents higher than a low quality station would (Chevron and ARCO for example). Also, the data show that convenience stores have differing strategies, some may be using gasoline as a loss leader, and others can be exploiting the complementary nature of the other products offered at the station. The evidence also suggests that some unbranded independent stations have some local market power over the low price focus stations.

Depending on whether the type of fuel is Regular, Midgrade, or Premium, branded stations charge different mark-ups over their unbranded counterparts, and the strategy is also heterogeneous even among different brands. Last, the data show that there is significant difference in terms of pricing when prices are high and when prices are low, but the strategies for brand and competition differ.

Also, the results for the competition variables show that the distance of the closest competitor matters when stations choose their pricing strategies, and that the number of competitors matters for Unleaded Regular and Midgrade gasoline, but not so much for the cases of Premium and Diesel.

The analysis in this chapter suggests that there is at least one differentiating dimension that the FTC should include into their definition of a market. Consumers indeed value brand and are willing to pay a premium for certain brands of gasoline. Additionally, there appears to be no evidence that this characteristic becomes less

important as prices increase, at least in absolute terms. It is clear that the Commission should be taking this dimension into consideration when they define the market and assess market power. Back to the example in the introduction, one might predict that a hypothetical merger between Chevron and ARCO will indeed increase prices in the marketplace. However, this might just be revealing a higher willingness to pay by consumers rather than higher market power.

	RU	MU	PU	DI
CHEVRON	3.337	6.309	14.673	4.88
	[0.326]**	[0.772]**	[0.685]**	[0.647]**
76	2.343	5.441	13.636	3.221
	[0.335]**	[0.783]**	[0.707]**	[0.715]**
SHELL	2.541	6.016	10.128	4.601
	[0.357]**	[0.780]**	[0.914]**	[0.683]**
VALERO	-1.431	-1.563	-3.3	1.077
	[0.375]**	[0.851]	[0.747]**	[0.706]
MOBIL	1.774	4.35	10.105	8.613
	[0.370]**	[0.892]**	[1.245]**	[1.117]**
7-ELEVEN	-1.365	1.338	9.111	-1.843
	[0.402]**	[0.810]	[0.762]**	[2.320]
CIRCLE K	-3.407	0.274	7.749	-0.476
	[0.499]**	[0.902]	[0.895]**	[1.391]
CITGO	0.538	3.241	11.532	-0.726
	[0.417]	[0.819]**	[0.773]**	[1.433]
TEXACO	1.892	5.956	8.188	5.975
	[0.712]**	[1.268]**	[1.452]**	[1.232]**
EXXON	-1.79	-1.09	4.525	-0.765
	[0.591]**	[1.197]	[1.325]**	[0.856]
QUICK STOP	-6.605	-5.595	4.544	-13.246
	[0.531]**	[0.922]**	[1.141]**	[2.483]**
ARCO	-6.914	-4.812	2.755	-5.275
	[0.561]**	[1.097]**	[1.057]**	[2.175]*
EIApriceCA	0.997	1	1.011	0.967
	[0.001]**	[0.001]**	[0.001]**	[0.003]**
Distance	0.186	0.268	0.711	0.152
	[0.091]*	[0.101]**	[0.165]**	[0.179]
Competitors	-0.217	-0.244	-0.09	-0.179
	[0.081]**	[0.113]*	[0.137]	[0.213]
CompetitorsSQ	0.012	0.013	-0.008	0.023
	[0.006]*	[0.009]	[0.010]	[0.015]
Constant	3.954	10.931	8.042	21.81
	[0.450]**	[0.837]**	[0.854]**	[1.112]**
Observations	657,488	296,750	244,470	266,341
Number of zip	1,211	1,168	1,157	1,021
R-squared	0.93	0.93	0.92	0.74

Standard errors in brackets; * significant at 5%; ** significant at 1%

All regressions include zipcode FE; unbranded omitted category

Table 3.7: Regression Results By Fuel Type

	1 WEEK		1 MONTH	
	LOW	HIGH	LOW	HIGH
CHEVRON	3.412	9.866	3.231	9.374
	[0.617]**	[0.554]**	[0.563]**	[0.505]**
76	2.339	8.716	2.592	7.906
	[0.629]**	[0.568]**	[0.576]**	[0.521]**
SHELL	3.568	8.07	3.555	7.706
	[0.664]**	[0.611]**	[0.602]**	[0.554]**
VALERO	-4.227	-0.761	-4.189	-1.085
	[0.679]**	[0.621]	[0.611]**	[0.564]
MOBIL	3.118	8.594	2.919	6.918
	[0.749]**	[0.736]**	[0.665]**	[0.659]**
7-ELEVEN	0.908	4.094	0.753	2.597
	[0.726]	[0.686]**	[0.675]	[0.628]**
CIRCLE K	-4.847	2.013	-4.775	0.857
	[0.930]**	[0.806]*	[0.864]**	[0.745]
CITGO	1.026	5.761	0.179	4.505
	[1.514]	[1.118]**	[1.522]	[1.084]**
TEXACO	3.305	5.677	2.848	5.465
	[1.382]*	[1.390]**	[1.216]*	[1.345]**
EXXON	-2.875	0.813	-2.531	0.105
	[0.915]**	[0.960]	[0.903]**	[0.850]
QUICK STOP	-5.209	-4.382	-5.167	-5.325
	[0.849]**	[0.960]**	[0.794]**	[0.894]**
ARCO	-4.057	-1.894	-4.615	-3.3
	[2.228]	[0.814]*	[1.781]**	[0.781]**
MU	10.39	10.208	10.459	10.18
	[0.135]**	[0.173]**	[0.116]**	[0.137]**
PU	17.319	16.796	17.857	17.404
	[0.207]**	[0.260]**	[0.180]**	[0.203]**
Distance	0.187	0.051	0.281	0.058
	[0.130]	[0.126]	[0.122]*	[0.117]
Competitors	-0.25	-0.375	-0.211	-0.345
	[0.119]*	[0.128]**	[0.113]	[0.118]**
CompetitorsSQ	0.012	0.019	0.009	0.018
	[0.009]	[0.010]	[0.009]	[0.009]*
Constant	248.224	357.569	132.541	197.505
	[0.684]**	[14.413]**	[10.747]**	[2.017]**
Observations	25,407	32,162	36,702	101,694
Number of zip	1,183	1,195	1,196	1,210
R-squared	0.74	0.78	0.72	0.76

Standard errors in brackets; * significant at 5%; ** significant at 1%

All regressions include zipcode FE; unbranded omitted category

Table 3.8: Regression Results- High and Low Cost Periods

Chapter 4

Measuring Market Power. A Case Study

This chapter investigates the effect of the presence of captured consumers with different information sets on local market power. A simple and original test is performed to quantify the mark-ups that firms with a specific type of local market power can charge over their competitors. The test compares prices by firms that exhibit almost identical cost structures but sell to different types of consumers. The market in question is retail gasoline located near selected rental car locations. With a panel dataset with prices for over 20,000 stations in 30 different markets across the US for the 26 month period between January 2006 and February 2008, it is found that prices are 4 cents higher at stations that serve more uninformed or inelastic consumers (i.e. are located near rental car companies). The size of this coefficient provides a proxy for the *effect size* of market power in the retail market for gasoline.

4.1 Introduction

How competitive are retail gasoline markets? The previous chapter tried to answer this question by analyzing the extent to which location and brand matter to explain gasoline retail prices. This chapter presents a complementary approach and studies an extreme case of local market power in which some stations sell to consumers with lower price-elasticity of demand. Thus, the quantitative results provide a lower bound on the level of competition in gasoline markets.

The test in this chapter exploits the fact that firms with similar cost structures and located in the same market might still sell to two different types of customers, with differing information sets and search costs. In particular, this chapter compares the price charged at a station that is near a rental car location with the price charged at stations that are further away from rental car companies. It is argued that differences in price observed in these two types of firms are evidence of the existence of market power.

Rental car companies provide their cars to consumers with a full tank of fuel. In turn, they require the renters to either return the car with a full tank, or pay the company a fee to fill it for them.[1] The price per gallon charged by the rental car is usually significantly higher than the market price, and extra fuel surcharges are often levied.[2] It seems that the norm for consumers would be to choose the former

[1]Examples of fuel policies on rental car contracts can be found in Appendix D.

[2]In the case of Alamo (Figure D.1), for example, it is explicitly stated that: "Price per gallon/litre will be higher than local fuel prices"

option, i.e. to return the car with a full tank of gasoline.[3] Renters who decide to refill their tanks before returning the car face more constraints than local gasoline buyers. First, they can only purchase gasoline in stations near the final destination.[4] Second, these consumers are most likely visitors to the city and at least a portion of them may not know the locations (let alone the prices) of other stations besides the ones they saw after driving their cars off the rental car lot. Some visitors may also be business travelers, who are either passing the cost to their employers, or in the case of the self-employed, may be able to write off the cost on their income tax. Last, not only are their incentives to invest in learning the market prices very low, but their cost of search might be very high (opportunity cost of time).

To summarize, gasoline markets near rental car locations can be characterized as having two types of consumers, locals and visitors. These two types of consumers differ in the price elasticity of demand for each station. Since a gas station facing both types (such as a station close to a rental car location) cannot discriminate with two different prices, it is expected that its price increases with the number of uninformed consumers, or visitors in a market. The higher mark-up compensates for the sales to lost local consumers. The number of local buyers lost by this station as prices increase depends on factors concerning mainly search costs for locals and characteristics of

[3]For example, in a 2008 survey exploring recent travel trends in business, it was reported that as part of the measures taken by firms to cut down on travel costs, travelers were asked to return vehicles with a full tank of gas to avoid costly surcharges. (Orbitz for Business and Business Traveler Magazine Survey, www.orbitzforbusiness.com)

[4]Some rental car companies have an explicit clause stating that the fuel has to come from a station "no more than x miles away" and require a receipt of the gas purchase. (See Dollar's contract in Figure D.3 for example: "The renter must refill the gas tank of the vehicle within a 10-mile radius of the rental return facility".)

alternative stations (proximity, brands, etc). Additionally, since visitors have no restrictions on the fuel type they put in the rented cars, it is expected that they will only demand Regular Unleaded gasoline, and that the more expensive Midgrade and Premium unleaded fuels will be sold to locals. Thus, the predictions imply a higher price for Regular Unleaded in stations with a higher proportion of visitors to locals consumers.

This study looks at gasoline prices near major airports across the United States for a 2 year period between 2006 and 2008. The results show that an unbranded station that is closest to a rental car location can charge approximately 4 cents more for Regular Unleaded gasoline than a similar station situated farther away. And, consistent with the main hypothesis, the effect is not significantly different from zero for the other fuel types (Midgrade and Premium). On average, being close to a rental car company (but not being the closest) usually yields a premium of only 1 cent per gallon.

The analysis and results on this Chapter are complementary to those in Chapter 3. In Chapter 3, brand and location were explored as determinants of price differences across 7,400 stations in the state of California, concentrating on quantitative measures of price differentials by brand. Building from the results and the model used in that Chapter, this Chapter focuses on one extreme source of market power derived from strategic location and the existence of different types of consumers, incorporating along the way and testing with a different dataset the robustness of those results found for the state of California.

The findings in this paper complement the existing literature on local market power in gasoline retailing (Shepard (1991), Borenstein (1991), and Barron et al. (2001) for example). In her largely cited paper, Shepard (1991) concentrates on the case of local market power evidenced by pricing strategies *within* the firm, rather than *across* firms. She compares the difference between the margins charged for full-service and self-service gasoline in two different kinds of firms: those that offer both types (multiproduct firm) and those that only offer either full-service or self-service (single-product stations). She conducts the empirical analysis using a cross-section dataset of retail prices and characteristics of 1,527 stations in eastern Massachusetts in 1987. She finds that differences in the differential between full service and self service gasoline can be more than double in a multifirm setting than in single product firms, strengthening the hypothesis that the price differences are not cost driven but rather reflecting the fact that the multiproduct firm can exploit their local market power by discriminating prices within the firm. Barron et al. (2001) replicate Shepard's empirical model with station level information for 600 stations for the Los Angeles Basin area from 1992-1995 and find similar results. Borenstein (1991) concentrates on the margin differences between leaded and unleaded gasoline using aggregate average retail prices for 63 Metropolitan Areas for January of the years 1981 to 1989. He concludes that differences in margins between leaded and unleaded gasoline are best explained by the existence of buyers with a low cross-elasticity among sellers.

The rest of this chapter is organized as follows: the next section describes the dataset in detail and includes a description of the main variables used in the multivariate analysis. Section 4.3 discusses the theoretical predictions using a simple

framework and outlines the econometric strategy to be used in Section 4.4. Section 4.5 concludes the chapter with a summary of the findings from this analysis.

4.2 Description of the Data

The objective of this section is to describe the summary statistics of the dataset used in the empirical analysis of Section 4.4, and explain how it was systematically constructed from the original data sources. The study focuses on gasoline prices in markets with a significant proportion of car renters, or visitors. Focusing on gas stations located in markets surrounding major airports, the dataset includes prices for three different fuel types.[5] In addition, the dataset includes information on location and distances between stations and rental car companies for each market.

The 30 largest airports in terms of passenger boardings in 2005 were selected.[6,7] The rankings on the figures are based on the Air Carrier Activity Information System (ACAIS) from the Federal Aviation Administration (FAA). Note that passenger boardings are only a crude approximation of the size of the rental car market since a passenger is not necessarily a visitor (especially for those airports that are hubs for a given airline)[8] and the city characteristics influence the rent/no rent decision by visitors. It is more likely that the rental car market is larger in San Diego than in

[5]Airports are the primary location chosen by rental car companies to conduct business.

[6]These airports are defined in ACAIS as "large primary commercial service airport hubs", publicly owned airports receiving scheduled passenger service, they have at least 10,000 passengers annually and have 1% of all passenger boardings in each calendar year.

[7]For a similar approach to defining the markets, see the FTC methodology to study antitrust issues for gasoline marketing (FTC, 2004)

[8]Delta, for example has different sized hubs in Atlanta, Salt Lake City, Cincinnati/Northern Kentucky, and JFK in New York City.

New York's JFK airport even though the boardings in JFK more than double those in San Diego International. [9] Figure 4.1 shows the location of all the continental airports in the study.

Rental car information was collected from the direct links of each airport's website ("Rental Car Companies" under "Ground Transportation"). These companies have counters inside the terminals and shuttle services to and from the airport. Table B.4 in the Appendix summarizes the participation of each of the major rental car companies in the sample.[10] The "Airport 7" plus Enterprise are present in almost every market while a second group of brands only cater to a few airports.[11]

Figure 4.2 presents a snapshot of a typical market: all gasoline stations (denoted by pump icons) and all rental car locations (flags) located nearby the Atlanta International Airport (ATL). Figures C.1 to C.29 in Appendix C include maps for the remaining 29 markets. The location of ATL's rental car lots and gas stations is similar to most of the markets. Most rental car companies are located within the boundaries of the airport, and a few are located off-site. Stations are spread out along the main roads surrounding the airport. Denver International (Figure C.6) is an exception, where there are no gas stations for a few miles around the airport.

[9]Revenue data that later became available reveal that 28 of the 30 selected airports in this study are in the top 50 car rental markets for July 2002 June 2003 (http://www.autorentalnews.com/stats/2003/Top50airport.pdf)

[10]This participation is consistent with revenue figures in the United States rental market (Auto Rental News, 2005)

[11]The term Airport 7 was coined by Andrew Taylor, the current CEO of Enterprise, to describe the airport-based rental car firms. (Besanko et al., 2007)

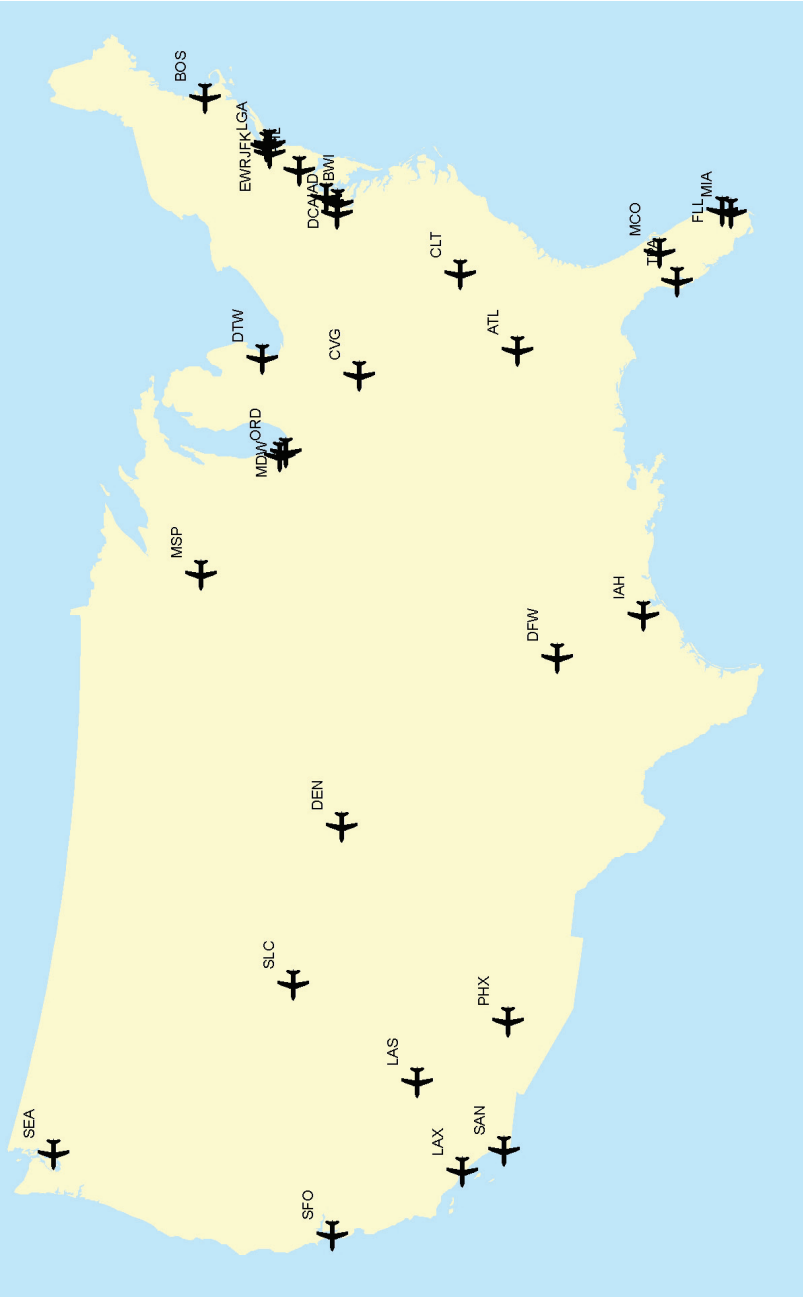

Figure 4.1: Map of Continental US Airports

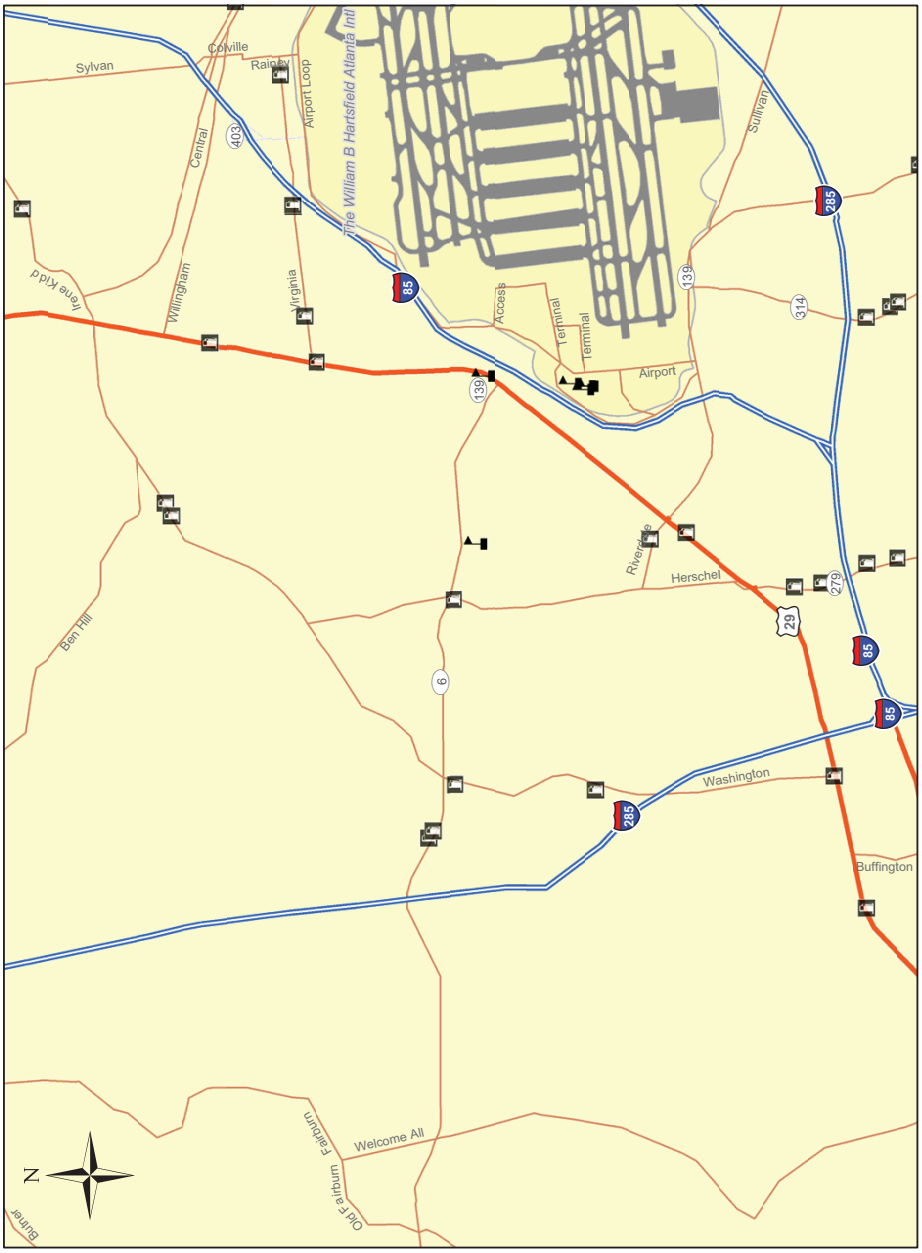

Figure 4.2: Market Example: Hartsfield-Jackson Atlanta International (ATL)

Gas stations' characteristics and retail prices were obtained from OPIS (Oil Price Information System), the same source used in the analysis in Chapter 3. OPIS provides daily service station-level data for up to 120,000 stations across the United States. Prices are collected from credit card transactions, direct feeds and other survey methods, and are provided for three different types of Unleaded gasoline: Regular, Midgrade and Premium. The resulting dataset contains an unbalanced panel of daily retail prices between January 2006 and February 2008 for the three fuel types sold by all gas stations in the 30 markets described above (more than 20,000 stations are covered).[12]

[12]The panel is unbalanced because not all the stations report prices for every day in the period, and some days do not have prices at all.

	Airport Name	ST	Boardings 2005*	Population MA 2006**	Number of Rental Cars	Gasoline Stations 2 mi.	5 mi.	7 mi.	10 mi.
ATL	Hartsfield-Jackson Atlanta Intl	GA	42,402,653	5,138,223	7	18	65	103	200
BOS	General Edward Lawrence Logan Intl/Boston	MA	13,214,923	4,455,217	8	12	56	91	142
BWI	Baltimore/Washington Intl Thurgood Marshal	MD	9,829,432	5,290,400	8	6	56	97	182
CLT	Charlotte/Douglas Intl	NC	14,009,608	1,583,016	8	9	55	96	159
CVG	Cincinnati/Northern Kentucky Intl	KY	11,277,068	2,104,218	8	0	36	47	63
DCA	Ronald Reagan Washington National	VA	8,623,907	5,290,400	8	3	47	93	201
DEN	Denver Intl	CO	20,799,886	2,408,750	10	0	2	2	14
DFW	Dallas/Fort Worth Intl	TX	28,079,147	6,003,967	10	2	48	105	227
DTW	Detroit Metropolitan Wayne County	MI	17,580,363	4,468,966	8	3	27	68	137
EWR	Newark Liberty Intl	NJ	16,444,959	18,818,536	6	8	57	93	158
FLL	Fort Lauderdale/Hollywood Intl	FL	10,729,468	5,463,857	12	17	82	151	230
HNL	Honolulu Intl	HI	9,784,404	909,863	8	5	21	26	33
IAD	Washington Dulles Intl	VA	13,032,502	5,290,400	8	2	27	44	64
IAH	George Bush Intercontinental/Houston	TX	19,032,196	5,539,949	9	0	50	90	138
JFK	John F Kennedy Intl/NYC	NY	20,260,359	18,818,536	6	5	36	61	110
LAS	McCarran Intl/Las Vegas	NV	21,402,676	1,777,539	11	11	96	165	253
LAX	Los Angeles Intl	CA	29,372,272	12,950,129	11	15	74	129	249
LGA	La Guardia/NYC	NY	13,014,314	18,818,536	6	9	90	133	200
MCO	Orlando Intl	FL	16,592,133	1,984,855	11	7	42	76	168
MDW	Chicago Midway Intl	IL	8,383,698	9,505,748	8	10	78	184	331
MIA	Miami Intl	FL	15,092,763	5,463,857	19	18	127	208	288
MSP	Minneapolis-St Paul Intl/Wold-Chamberlain	MN	17,971,771	3,175,041	9	0	26	77	138
ORD	Chicago O'Hare Intl	IL	36,720,005	9,505,748	8	0	67	152	303
PHL	Philadelphia Intl	PA	15,376,569	5,826,742	7	0	20	44	88
PHX	Phoenix Sky Harbor Intl	AZ	20,315,544	4,039,182	13	0	60	111	201
SAN	San Diego Intl	CA	8,628,648	2,941,454	9	15	52	90	136
SEA	Seattle-Tacoma Intl	WA	14,359,530	3,263,497	9	14	67	108	177
SFO	San Francisco Intl	CA	16,070,133	4,180,027	12	14	30	49	87
SLC	Salt Lake City Intl	UT	10,601,918	1,067,722	9	2	17	41	91
TPA	Tampa Intl	FL	9,297,643	2,697,731	10	11	71	111	192

*Source: Federal Aviation Administration; ** US Census Bureau

Table 4.1: Market Characteristics

Table 4.1 presents the main characteristics of the 30 markets. The first 3 columns list the airport denominator (by which the markets will be referred to in the analysis), the name of the airport, and the state in which it is located. The airports are located in 21 states. Three metropolitan areas: Chicago, New York City, and Washington, DC have more than one associated airport.[13]

Columns 4 and 5 of Table 4.1 tabulate the total number of passenger boardings and population in the Metropolitan Area associated with each market. Passenger boardings were obtained from the FAA, and population numbers come from the Department of Labor and Statistics at the US Census Bureau. The markets vary widely in population size: from a low of about 900,000 people in Honolulu, and around 18M in the Metropolitan Area around New York City (served by 3 airports).

The volume of passengers also varies widely across airports, from a low of around 8M in Chicago Midway International (MDW) to over 42M passengers in Hartsfield - Jackson International Airport in Atlanta (ATL). These numbers are not entirely descriptive of the passengers that actually visit the city (and are potential car renters) because some of the airports serve as the hub of a major airline and because the demand for rentals varies across cities. Additionally, one may speculate that the type of consumers served is quite heterogeneous across airports. For example, some places are strictly tourism-oriented like Las Vegas and Honolulu, while others, such

[13]Chicago O'Hare and Midway in Chicago, JFK, Newark, and La Guardia in the NYC area, and Washington/Dulles, Ronald Reagan and Baltimore/Washington in the DC area).

as Washington DC, or New York City, have a different mix of tourists and business passengers flying into their airports.[14]

Table 4.1 also records the location of the main rental car companies around the airports. Column 6 shows the number of rental cars in each of the markets. A total of two hundred and seventy six rental car locations were mapped in all markets. There are an average of 9 rental car companies around each airport, with a minimum of 6 for all three of the airports in the New York area and a maximum of 19 in Miami.

The last four columns of Table 4.1 display the number of gasoline stations that are located in 4 different radii (2, 5, 7, and 10 miles) around each airport. In some airports, there are no gasoline stations for 2 miles from the geographical center of the airport, such as CVG, IAH, and PHL. With the exception of Denver, there are a minimum of 17 stations in a 5 mile radius (SLC) and a maximum of 127 (MIA). The Denver airport has the lowest number of stations, 14, in a 10 mile radius, with only 2 stations for at least 7 miles (a fact that is also evident from map C.6).

Table 4.2 shows prices in cents per gallon (cpg) by airport, for Regular Unleaded gasoline. In the period under study (Jan 2006-Feb 2008), average prices differ about 50 cpg. The lowest average prices are recorded in the state of Texas, in Houston (IAH) at 268 cpg, followed by Dallas-Fort Worth (DFW) and Minneapolis/St Paul, Minnesota (MSP) at 270 cpg. The highest average prices can be found in the state of California, in the San Francisco airport (SFO) at 314 cpg, closely followed by San

[14]The existence of two different types of travelers (business and tourism passengers) with different demand elasticities could have direct implications in terms the pricing strategies of the firms with market power in the different markets.

Diego International (SAN) (311 cpg), and the Los Angeles airport (LAX) (308 cpg). Honolulu International airport (HNL) is also one of the highest priced airports with 310 cpg on average over the recorded period. The richness of the dataset can be more accurately appreciated by closely inspecting columns 4 and 5: the minimum price observed in the whole period is 113 cents around Las Vegas (LAS), while a maximum of 419 was recorded in a station in Honolulu (HNL); that is a 306 cent variation in prices across the whole period. Column 3 shows that along with inter-airport variation, a standard deviation of around 30 cents per airport can also be observed. This is due to the high variability of oil prices during the analyzed period. Similar patterns can be observed for Midgrade and Premium Unleaded gasoline (Table B.5 in the Appendix).

The basic test performed in this Chapter is to compare the price charged at the stations that are located very close to the rental car locations versus the average in the larger surrounding market. Table 4.3 summarizes the average price by airport according to the distance to the airport (1, 2, and 3 miles) and the average price observed in those stations that are closest to a rental car location ("CLOSEST"). There is no clear pattern from the table that stations very close to rental car outlets indeed charge higher prices. In almost half of the airports, a pattern of decreasing prices as distance to the airport increases is observed. However, in the remaining airports average prices go up and down, or up continuously as distance increases. The multivariate analysis in the next section further explores the difference and parses out the effect of confounding variables to determine whether a price difference is indeed observed and consistent with the hypothesis.

	Regular Unleaded				
	Mean	SD	Min	Max	N
ATL	270	33.30	180	371	161,292
BOS	276	30.54	196	361	113,977
BWI	277	30.58	196	366	105,122
CLT	274	29.82	175	366	74,544
CVG	277	32.88	195	362	41,236
DCA	282	30.70	198	370	117,888
DEN	276	31.60	192	370	66,556
DFW	270	29.58	167	363	220,208
DTW	278	36.06	180	413	124,952
EWR	271	31.73	188	380	119,028
FLL	283	27.57	208	380	105,104
HNL	310	23.34	250	419	17,862
IAD	279	30.41	187	360	43,209
IAH	268	30.69	187	360	154,323
JFK	297	30.99	216	391	60,039
LAS	288	25.38	113	359	64,362
LAX	308	29.85	208	405	150,300
LGA	291	34.79	194	390	98,177
MCO	275	27.04	201	370	99,507
MDW	297	39.10	195	410	142,342
MIA	284	28.58	207	376	88,423
MSP	270	32.14	166	360	110,795
ORD	294	38.69	202	410	127,795
PHL	277	31.87	187	369	130,813
PHX	276	28.50	200	351	131,264
SAN	311	29.48	207	406	59,364
SEA	295	31.07	204	401	109,073
SFO	314	33.14	225	412	75,081
SLC	273	33.16	183	350	70,236
TPA	273	28.27	196	380	134,762

Table 4.2: Market Statistics -Price in Cents per Gallon

	CLOSEST	1 mile	2 miles	5 miles
ATL	278	272	273	270
BOS	305	275	275	275
BWI	291	-	277	275
CLT	301	274	278	274
CVG	293	-	-	276
DCA	276	-	285	286
DEN	297	-	-	273
DFW	298	272	279	271
DTW	298	279	277	275
EWR	267	-	269	269
FLL	290	296	285	283
HNL	322	311	308	311
IAD	283	279	282	281
IAH	270	-	271	268
JFK	297	298	295	297
LAS	287	288	289	288
LAX	289	308	311	308
LGA	297	297	300	299
MCO	289	276	275	274
MDW	305	305	302	297
MIA	281	287	283	284
MSP	270	269	269	270
ORD	299	301	293	295
PHL	292	288	287	286
PHX	283	-	277	275
SAN	332	317	316	313
SEA	294	297	295	292
SFO	319	327	323	314
SLC	273	271	273	274
TPA	284	277	276	274

Table 4.3: Market Statistics -Price in Cents per Gallon

4.3 Estimation Strategy

Before describing the specification to be estimated, it is useful to delineate and discuss some of the intuition behind the pricing strategies of firms in markets where two different types of consumers, locals and visitors, are present.

To capture the idea that firms sell differentiated products, assume a monopolistically competitive market where each firm in the market faces a demand

$$Q^D = \lambda q_F + (1 - \lambda)\, q_L \tag{4.1}$$

where

$$\begin{aligned} q_F &= kp^{-\beta} \\ q_L &= kp^{-\alpha} \end{aligned} \tag{4.2}$$

represent the demand for each fuel type by visitors and locals respectively ($\alpha > \beta > 1$). The differences in the elasticities of demand incorporate (in a reduced form) the differences between these two types of consumers, or in other words, their absolute utility or willingness to pay and the opportunity cost of finding other prices (search cost and benefits). The constant k is a station-specific amplifier and captures stations' characteristics (location, brand, accessibility, etc). Aside from the values of the firm-demand elasticities, the market-demand for gasoline might still be very inelastic in the short run.

If the stations were able to discriminate among consumers and set different prices, then two different prices per station would be implemented. From the first order conditions of a single-product monopolist, the mark-up for each type of consumer would be inversely related to the price-elasticity of demand in each market:[15]

$$\frac{p^* - mc}{p^*} = \frac{-1}{\varepsilon} \tag{4.3}$$

[15]For more details on the Inverse Elasticity Rule, see Tirole (1988), page 66.

where ε is either α or β. But stations post a unique price for gasoline, thus the optimal price implicitly defined in equation 4.3 is actually a function of the elasticity of the *average* demand Q^D, defined in equation 4.1:

$$\varepsilon = -\left[\omega\beta + (1-\omega)\,\alpha\right] \tag{4.4}$$

where $\omega(\lambda) = \frac{\lambda p^{-\beta}}{\lambda p^{-\beta}+(1-\lambda)p^{-\alpha}}$, a weighted average of α and β that depends on the importance of each consumer type (ω grows from 0 to 1 as λ goes from 0 to 1). A prediction from this model is that prices across stations will differ as long as λ is different for each station. Naturally, it is sensible to think that the proportion of visitors a station serves depends on the distance to the car rentals. Using the Implicit Function Theorem and equation 4.3, a prediction from this model is:

$$\frac{\partial p}{\partial \lambda} = -\frac{-\frac{p}{\varepsilon}\frac{\partial \varepsilon}{\partial \omega}\frac{\partial \omega}{\partial \lambda}}{1-\frac{1}{\varepsilon}} > 0 \tag{4.5}$$

That is, stations closer to the rental cars will have higher prices than those located in the same market but serving fewer visitors (lower λ). In addition, stations in markets with more visitors would have, ceteris paribus, higher prices than stations in markets populated with price sensitive consumers.

Since rental car users have no restriction as to the type of fuel they should use, they can be thought of as buying the cheapest fuel type (Regular Unleaded) and therefore $\lambda = 0$ for all stations selling Midgrade and Premium in all markets regardless of the number of people visiting their stations.[16]

[16]This is true as long as the prices for Midgrade and Premium are still above the price for Regular Unleaded. Also, this argument is weak in the sense that a station can post prices for the three fuel types and still sell mainly to visitors (i.e. quantities would be needed to test the prediction).

To measure the ability of stations with market power to charge higher prices than their nearby competitors, a multivariate regression analysis is performed, adopting a hedonic framework similar to that used in Chapter 3. The basic estimation strategy relies on the relationship between the average price in a market and the average price charged by the station that is closest to the rental cars in the market, and the price charged by those that are within a certain radius around the airport (which controls for local characteristics, such as transportation and real estate costs). The model specifies the price of gasoline in a particular station as follows:

$$\begin{aligned} PRICE_{ijt} = \alpha_i + \beta CLOSEST_i + \gamma_1 CLOSE_i + \gamma_2 COMPETITION_i + \\ + \gamma_3 BRAND_i + \gamma_4 COST_t + \gamma_5 DIESEL_i + \gamma_6 ZIP_j + \gamma_7 OTHER_{it} + e_{ijt} \end{aligned} \tag{4.6}$$

where $PRICE_{ijt}$ is the price of gasoline at station i in zipcode j at date t; $CLOSEST_i$ denotes that station i is the closest station to a rental car location; $CLOSE_i$ equals 1 if the station i is within a mile of a rental car location; $COMPETITION_i$ include measures of competition (distance and number of competitors); $BRAND_i$ identifies the brand under which the gasoline is marketed in station i; $COST_t$ approximates the wholesale cost of gasoline at date t using average prices from the Energy Information Administration according to the Petroleum Administration for Defense District (PADD) that a market belongs to; $DIESEL_t$ denotes whether station i sells Diesel fuel; ZIP_j are zipcode level fixed effects; and $OTHER_{it}$ includes other covariates such as the day of the week and month, as discussed in Chapter 3. Standard errors are clustered at the station level. Separate regressions are run for 3 different fuel types.

Under the hypothesis that firms located next to a rental car location have market power, the coefficient of interest, β, is expected to be positive and significant. That is, if the station is the first station that a consumer faces when he/she gets out of a rental car company, its gas prices are significantly higher than those further away. The competition variables take similar forms to the ones specified in the previous Chapter. Distance to the closest competitor and the number of competitors in a 1 mile radius are included. Separate dummies are included for the main brands in the sample. The coefficients for the 12 brands that coincide with those included in Chapter 3 are expected to yield similar results. Eleven additional brands that were not present in the California sample are shown in the tables. As with last Chapter, the ommited category for brand is "Unbranded". The cost variable controls for shifts in the wholesale cost of gasoline and is specified.

4.4 Regression Results

Table 4.4 presents the regression results for Regular Unleaded. Four different specifications are presented: the first column includes the coefficient of interest, a dummy for whether the station sells Diesel, wholesale cost, brand, and day of the week variables. Column 2 incorporates distance to the closest station, and column 3 the number of competitors. Column 4 adds month dummies. All regressions include zip code level fixed effects, and standard errors are clustered at the station level. Over 3M observations are included in the estimation of the coefficients for Regular Unleaded. The overall explanatory power of the variables is 88%.

The results on the table are consistent with the hypothesis that being the station that is closest to a rental car location effectively provides market power: a station charges on average 4 cents more than a similar station located further away. The size of this coefficient provides a proxy for the *effect size* of market power in the retail market for gasoline. If this is indeed an extreme case of imperfect information, then the coefficient should be an upper bound for other markets with imperfect information.

It is important to note at this point that the test is measuring price changes as a result of market power, not how much profit a station owner is making. So, even if the station is renting the place at higher real estate prices, those prices only reflect the intrinsic market power associated with the location. So, whether the owner gets to keep the above normal profits or the landowner does is unimportant for the conclusions of the analysis.

To parse out the effects of "being close to a rental car" and "being *the* closest to a rental car", the coefficient γ_1 is included, since the stations that are located near the area are expected to have very similar cost structures. From the table, being close, but not being the closest to a rental car location, also provides some market power. However, even though the coefficient is statistically different from zero, its actual size is very small, less than 1 cent.

The results of the estimation are also consistent with the analysis in Chapter 3. Competition variables show that the further away a competitor is, the higher the price that is charged on average by a station. Also, as the number of competitors increase,

prices go down. The estimated coefficients for the different brands are presented in the Appendix (Table B.6) and are qualitatively similar to those estimated in the previous Chapter.

	Model 1	Model 2	Model 3	Model 4
Closest	4.305	4.007	3.893	3.898
	[1.577]**	[1.547]**	[1.555]*	[1.554]*
Close	0.69	0.743	0.739	0.737
	[0.311]*	[0.308]*	[0.308]*	[0.308]*
Wholesale	0.989	0.989	0.989	0.988
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Distance		0.568	0.448	0.448
		[0.049]**	[0.052]**	[0.052]**
Competitors			-0.1	-0.101
			[0.016]**	[0.016]**
Constant	8.796	8.427	8.939	8.775
	[0.237]**	[0.238]**	[0.253]**	[0.254]**
Brand	Yes	Yes	Yes	Yes
Month	No	No	No	Yes
Day of Week	Yes	Yes	Yes	Yes
Observations	3,117,634	3,117,634	3,117,634	3,117,634
Number of zip	2,982	2,982	2,982	2,982
R-squared	0.88	0.88	0.88	0.88

Standard errors in brackets; * significant at 5%; ** significant at 1%

Table 4.4: Regression Results - Regular Unleaded

If market power is indeed derived from the presence of uninformed renters of cars, then it would be expected that the results are only significant for Regular Unleaded gasoline, since renters would probably not buy Midgrade or Premium gasoline. As the intrinsic models generating prices are assumed to be different, based on the

analysis in Chapter 3 between all the different fuel types, the regressions are run separately.

Tables 4.5 and 4.6 present the estimates for Midgrade and Premium gasoline. While the estimated coefficients are similar, the premium for being located close to a rental car location vanishes (is not statistically different from zero). This is consistent with the hypothesis that the market power obtained by the station is very likely derived from the captivity of the uninformed consumers from out of town, since these individuals are only likely to fill the tank of their rentals with the cheapest gasoline available. If this mark-up were reflecting other cost-based differences for those stations and not market power derived from captured consumers, then the mark-up would be persistent across fuel types.

4.5 Discussion

This chapter provides a quantitative measure of local market power stemming from the presence of imperfectly informed consumers. According to the evidence found in the analysis, a firm with local market power can charge up to 4 more cents for every gallon of Regular Unleaded gasoline sold. Consistent with the hypothesis that the mark-up is driven by the presence of uninformed renters, the same coefficient for Midgrade and Premium is not significantly different from zero. This test can be interpreted as a useful upper bound for similar cases in which market power is observed but not easy to quantify. The results are also consistent with those found

	Model 1	Model 2	Model 3	Model 4
Closest	4.204	3.831	3.787	3.793
	[2.188]	[2.112]	[2.124]	[2.125]
Close	0.42	0.468	0.471	0.473
	[0.452]	[0.447]	[0.449]	[0.450]
Wholesale	0.993	0.993	0.993	0.992
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Distance		0.563	0.44	0.439
		[0.079]**	[0.086]**	[0.086]**
Competitors			-0.101	-0.101
			[0.026]**	[0.026]**
Constant	17.738	17.374	17.885	17.771
	[0.346]**	[0.349]**	[0.373]**	[0.375]**
Brand	Yes	Yes	Yes	Yes
Month	No	No	No	Yes
Day of Week	Yes	Yes	Yes	Yes
Observations	1,176,303	1,176,303	1,176,303	1,176,303
Number of zip	2,929	2,929	2,929	2,929
R-squared	0.87	0.87	0.87	0.87

Standard errors in brackets; * significant at 5%; ** significant at 1%

Table 4.5: Regression Results - Midgrade Unleaded

in the previous chapter, competition and brand variables matter to differentiate the product.

Antitrust authorities and other policy makers will find these estimations useful when running simulations and carrying out cost-benefit analyses to contemplate possible interventions in this or other markets where there is a significant proportion of imperfectly informed consumers.

	Model 1	Model 2	Model 3	Model 4
Closest	2.137	1.777	1.715	1.727
	[1.663]	[1.631]	[1.643]	[1.643]
Close	-0.213	-0.162	-0.156	-0.154
	[0.510]	[0.507]	[0.510]	[0.509]
Wholesale	1	1	1	0.999
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Distance		0.551	0.415	0.415
		[0.097]**	[0.105]**	[0.105]**
Competitors			-0.113	-0.114
			[0.032]**	[0.032]**
Constant	22.719	22.362	22.923	22.788
	[0.384]**	[0.389]**	[0.422]**	[0.424]**
Brand	Yes	Yes	Yes	Yes
Month	No	No	No	Yes
Day of Week	Yes	Yes	Yes	Yes
Observations	1,013,725	1,013,725	1,013,725	1,013,725
Number of zip	2,925	2,925	2,925	2,925
R-squared	0.86	0.86	0.86	0.86

Standard errors in brackets; * significant at 5%; ** significant at 1%

Table 4.6: Regression Results - Premium Unleaded

Chapter 5

Implications for Antitrust Regulation

The work conducted in the previous two chapters has direct implications for antitrust regulation in the retail gasoline industry. This section addresses the applications of the results in the context of antitrust regulation.[1] In particular, this chapter looks at the regulations enforced by the FTC highlighting possible ways in which the results of previous chapters can improve the decision-making process.

5.1 The Regulatory Process

Gasoline retailing is less than perfectly competitive. As such, market power may be abused, lowering consumer surplus and potentially creating situations where Pareto

[1] Please refer to Appendix 2.1 for a discussion about non-FTC related government interventions affecting the market.

improvements can be achieved. Government intervention can help to improve efficiency. The main objective of antitrust authorities is to minimize or altogether prevent these suboptimal situations. To this effect, in the United States, the Federal Trade Commission oversees mergers and acquisition, and evaluates potential cases of undesirable use of market power (price gouging).

As noted in the introduction, not only does the FTC currently spend substantial resources investigating mergers in the petroleum industry, but it also allocates a large portion of its funds to investigating alleged anticompetitive conduct, gasoline price differentials, and rapid price increases, and to even monitor gasoline prices. In its own words:

> For more than 20 years, the FTC has been the federal antitrust agency primarily responsible for reviewing conduct in the petroleum industry to assess whether it is likely to reduce competition and harm consumer welfare. In this role, the FTC has devoted substantial resources to investigating and studying the industry. For example, during the period of large oil industry mergers in the late 1990s, the Bureau of Competition spent almost one-fourth of its enforcement budget on investigations in energy industries. The FTC has taken a strict approach when reviewing petroleum-related mergers and has obtained relief in markets at lower concentration levels than it has in other industries. Although the FTC has expended most of its petroleum-related resources to investigate mergers, the agency also has devoted significant resources to non-merger matters, including investigations of gasoline prices in two regions of the United States, the Unocal case [...], an ongoing program to monitor and investigate gasoline price anomalies, public conferences on factors that affect the price of refined petroleum products, and industry studies [...]. (FTC, 2004)

The first concerns over the competitiveness of the market occurred as early as the late 19th century and resulted in the breakup of Standard Oil through antitrust rulings. More recently, antitrust authorities, in particular the FTC and DOJ and Department of Energy, have devoted a large portion of their resources to deal with issues that range from investigating the factors that influence price variations in general to more specific reports about possible price manipulations in particular markets (such as the congressionally mandated study on price spikes after Hurricane Katrina) and the issuance of numerous opinions and orders related to merger-related cases since 1981. For example, in the late 1990s, the Bureau of Competition of the FTC spent almost one fourth of its enforcement budget on investigations of energy industries (FTC, 2004). These resources were used to investigate mergers (see Table E.1 for a list of selected mergers reviewed by the FTC) and potential anticompetitive behavior in the sector, to implement programs destined to monitor and investigate gasoline price anomalies, to organize public conferences, and to publish industry studies. From 1973 to May 2007, the FTC conducted approximately 190 oil industry investigations that resulted in at least 44 enforcement actions, including final orders, complaints issued or filed in court, and matters in which a transaction was abandoned after initiation of a Commission investigation.[2]

[2]From FTC website: http://www.ftc.gov/ftc/oilgas/enf_invst.htm, last accessed on August 3, 2008

5.1.1 Assessing Mergers

To assess mergers, the FTC uses the DOJ/FTC Horizontal Merger Guidelines[3] to determine whether competition is lessened. The merger review process developed in the guidelines is as follows. First, the relevant market in which the merging firms compete needs to be defined; after that, market shares and concentration ratios are calculated, and determines whether competition is threatened. This step determines which cases the Bureau will look into more closely, complementing the approach with more in-depth industry studies.

The first step, defining of the market, is one of the most difficult and challenging tasks for antitrust authorities and getting it right (or wrong) has very clear welfare implications. Consider the case in which the FTC approves a merger between two "branded" refineries A and B on the condition that the new merged firm sells (divests) a certain number of gas stations. Implicit in that decision is the definition of the product and its market: is it a commodity? Is it a differentiated good? What is the relevant geographic market? The analysis provided in the previous chapters can inform the decision making process. In order to understand why, one needs to review how the FTC defines the market.

For a market to be "a relevant antitrust market," it should pass the hypothetical monopolist test as defined by the Merger Guidelines: "all the competitors in a market have been identified if a merger among them would lead to a small but significant non-

[3]United States Department of Justice and Federal Trade Commission, *1992 Horizontal Merger Guidelines (with April 8, 1997, Revisions to Section 4 on Efficiencies) reprinted in* 4 Trade Reg. Rep. (CCH)

transitory increase in price (the SSNIP criterion)". For most markets, small usually means 5 percent. However, in the case of gasoline related cases, the FTC staff uses a one-cent-per-gallon price increase for petroleum mergers in many instances (FTC, 2004). According to the hypothetical monopolist test, a merger between a subset of stations that leads to a price increase larger than the SSNIP implies that consumers do not have substitutes available outside that subset and therefore the subset *is* the "relevant market".

Even though the SSNIP criterion is a sensible approach to defining the relevant market, the implications and results are highly sensitive to the assumptions that the FTC is making about the nature of price movements, and many economists believe it is too rigid and formulaic (Farrell, 2008).[4] The estimates provided in Chapters 3 and 4 can inform the application of the SSNIP criterion. To calculate the market and the price effect of a potential merger, the authorities need to know how retailers will adjust their prices when market conditions change. This becomes a harder task the larger the differences among products. In this case, a measure of "closeness" between stations needs to be defined from the elasticity of substitution among products. In the case of gasoline stations, geographic distance and brand, and other services define the "product" in theory.[5] That is why it is important to determine if and how brand and location affect consumers' substitution patterns.

[4]In late 2009, the FTC and DOJ jointly called for public comments regarding the revision of the Merger Guidelines. Even though the FTC explicitly stated in the call that it will probably keep the hypothetical monopolist test, it is currently looking at ways to improve the decision making process by complementing it with alternative approaches. *Horizontal Merger Guidelines: Questions for Public Comment*: http://www.ftc.gov/bc/workshops/hmg/hmg-questions.pdf

[5]Given the nature of commuters, even euclidean or driving distance might not be a good measure of location closeness (Houde, 2008)

Going back to the Merger Guidelines, after defining the relevant market, the FTC looks at market shares and concentration ratios[6] to "find the relevant markets in which competition might be lessened, to assess the likelihood and significance of possible competitive harm, and to fashion remedies to ensure that competition is not reduced in those relevant markets and consumers are not thereby harmed." If competition is threatened, the FTC carries out further investigations to better understand the issues ("whether and how the merger might create or facilitate the exercise of market power in those markets") and take action. The measure used by the FTC to measure market concentration is the Herfindahl-Hirschman Index (HHI). The HHI equals the sum of the squared market shares of all market participants. The more unequal the market shares, the higher the HHI (keeping the number of firms constant). After a merger, if the number of competing firms is reduced, the HHI increases. This change in the index is greater when the market shares of the merging firms are larger.

Post-merger markets are categorized into three concentration zones, and the Commission evaluates the change in the concentration ratio according to these zones. If the HHI is below 1,000, [7] the market falls into the "unconcentrated" category, and the FTC is unlikely to challenge it. If the HHI ranges between 1,000 and 1,800 ("moderately concentrated" category), and the index changes by 100 after the merger, then the FTC considers that this "potentially raises significant competitive concerns".

[6]Concentration ratios indicate the relative size of firms with respect to the industry at large.

[7]The HHI in a market with n equal-sized sellers is equal to 10,000/(n). A market with ten equal-sized sellers has an HHI of 1,000, and a market with six equal-sized sellers has an HHI of 1,667.

Last, if the HHI is over 1,800 ("highly concentrated") and it increases by 50 after the merger, there is a "rebutable presumption that it creates or enhances market power, or facilitates it exercise".[8]

After concentration ratios are assessed, the FTC investigates those cases that raise red flags. Specialists look at entry conditions and general competition effects, and determine whether the merger might raise valid anticompetitive concerns. If they conclude that the merger is bound to have competitive effects, the FTC can challenge the merger (through preliminary injunctions). Or, if only parts of the merger raise concern, they might just require divestitures in the selected markets that would be negatively affected by the merger, and allow the merger to proceed.

The Merger Guidelines provide a hypothetical construct for defining an antitrust market, but they do not delineate a specific model to implement the SSNIP theory. In practice, the actual evaluations performed by authorities remain distant from the ideal application of a sophisticated and formal one-fits-all model or technique. Officials operate on a case by case basis; both the method and the evidence used to define antitrust markets vary widely. Coate and Fischer (2008) study and describe the methods used in more than 100 merger cases analyzed by the FTC in the last twenty years. In their words: "A literal application of the formal Guidelines market definition algorithm would be unworkable; because such an analysis could not be completed in the time constraints facing staff in a merger investigation." In the majority of cases, no complex analysis is carried out and market facts are used,

[8]These thresholds sometimes vary in practice when the merger parties want to expedite the merging process, so the FTC agrees to take stringent concentration ratios into account to evaluate the merger.

which are based on partial evidence (internal documents, customer interviews, and summary statistics). For retailing gasoline, this also appears to be the case.

According to the Oil Merger Report (FTC, 2004), most of the merger activity and analysis occurs in the upstream segments of the vertical chain. The characteristics of this segment make it a likely candidate for abuse of market power. In many cases, however, mergers upstream affect downstream activity, and as a result, the FTC also analyzes it. The "gasoline marketing" segment is included in the wholesale and retail distribution activities. As mentioned above, the SSNIP is 1 cent per gallon and the usual antitrust market definition involves all branded and unbranded gasoline in a metropolitan (or similar size) area (FTC, 2004 p. 226). This definition seems reasonable when the focus is placed on the wholesaling activity, but loses appeal when the retail activity is analyzed. It sounds obvious that a consumer will not react to an anticompetitive price increase by switching purchases to stations 50 miles away. In addition, as shown in Chapter 3, brand differences can account for up to 15 times the SSNIP.

It is expected that the authorities would refine and narrow the market definition when retailing is at the core of the anticompetitive analysis. Assumptions on the cross-elasticities for different gas stations are needed. It is here where the contribution of this dissertation becomes clear. The main message is that brand is an important dimension that should not be ignored. One should expect an increase in prices after a horizontal merger between high value brand and low value brand retailers. But, given the results found in Chapter 3, this does not necessarily mean abuse of market power,

since the merged firm can be expected to carry the high value brand. Additionally, a given HHI might mean the same depending on the brands of the merged stations.

The FTC is worried about identifying cases in which market power can be abused, and the estimates in Chapter 4 inform the regulators about how serious that problem can be, that is, what is the price increase that would be associated with having a large proportion of uninformed consumers. If a regulator desires to quantify the actual price effects of firms with market power derived from informational issues, it would not be easy to find an experiment that is cleaner than the one performed in Chapter 4, one in which the source of the information asymmetry is as intuitively clear. In the public call for comments mentioned in footnote [4], the FTC acknowledges that these experiments provide useful information to the decision making progress, and considers incorporating the information conveyed by their results in the merger revision process.

Another contribution of this dissertation is related to a "price policing" function exercised by the FTC. Since 2002, the FTC has used the Oil Price Information System (OPIS) data (similar to the one used in this dissertation) and a public gasoline price hotline maintained by the US Department of Energy to monitor gasoline prices and to identify anomalies in the behavior of 360 retail areas in 20 wholesale regions. The FTC uses econometric models to determine whether retail and wholesale prices adjust according to historic trends and relationships. If prices are outside of the normal range, the Commission's staff looks at possible causes of these disruptions, such as movements in crude oil prices, refinery fires or pipeline outages, changes in taxes or fuel requirements, unusual changes in demand due to weather conditions,

and possible anticompetitive activity. Additionally, they look at complaints received by the FTC's own Consumer Response Center and information provided by state and local officials to identify possible price manipulations. Historically, the FTC has concluded that most disruptions in prices are due to normal "business-related" causes, as opposed to anticompetitive practices (FTC, 2004). The robust estimates found in the previous chapters provide measures for the effects of brand and information frictions on price.

5.2 Concluding Remarks

The mission of the FTC is inherently difficult, and the analysis in this dissertation provides tools to complement their decision making in a way that will lead to more effective decisions. There are costs associated with allowing anticompetitive behavior to persist but there are also costs to society of preventing acceptable competitive behavior to develop naturally. This dissertation informs the regulators in both directions: it gives information to help understand price change that occur as a result of firms making use of their market power (uninformed consumers) and it also advances the understanding of consumer choice and price variations associated with product differentiation.

The coefficients from the estimations in Chapter 3 can be incorporated in many decisions by the FTC: in their price estimations, in their simulations that aim at defining the antitrust market (i.e. applying the SSNIP criterion), and in the re-

gressions that are used to spot anomalies in the behavior of prices in a variety of markets.

Also, the measure of market power provided in Chapter 4 will give policy makers a clear idea of the extent of market power that can be gained as a result of price manipulation in markets with a large proportion of consumers who are not informed and have high search costs. This benchmark could also be extrapolated to other markets outside the realm of gasoline that experience similar demand conditions.

Last, it might be useful to point out that what is evident from this analysis is also explicitly stated in an economic analysis by of the Merger Guidelines used by the FTC (Scheffman et al., 2002), in which the authors find that the study of price discrimination issues by the FTC, which is currently based on quantitative evidence typically focusing on prices and margin data, "deserves much more economic attention, both as to theory and empirical evidence".

Chapter 6

Conclusions

Retail gasoline markets are less than perfectly competitive. The potential price effects associated with imperfectly competitive markets in the gasoline retail industry call for active government intervention, mostly in the form of antitrust policy. The Federal Trade Commission and the Department of Justice are the two main agencies in the US in charge of looking for and preventing anticompetitive practices, and a sizable portion of their budgets is allocated to overseeing the gasoline industry. Even after 40 years of active intervention, much is left to be learned about the main issues affecting the prices in this market, among the most important the underlying pricing strategies behind the retail gasoline market, which is the focus of this dissertation.

Chapter 3 provides an empirical analysis that focuses on product differentiation, with a central discussion around the brand dimension. The analysis in Chapter 3 strongly suggests that there is at least one differentiating dimension, brand, that the FTC should pay close attention to when defining a market, and this chapter provides

precise estimations to include this dimension in their analyses. Consumers are willing to pay a premium for consuming certain brands of gasoline. Additionally, there appears to be no evidence that this characteristic becomes less important as prices increase, at least in absolute terms. It is clear that the FTC should be taking this dimension into consideration when they define the market and assess market power. Back to the example in the introduction, one might predict that a hypothetical merger between Chevron and ARCO would indeed increase prices in the marketplace. However, this might just be revealing a higher willingness to pay for the Chevron brand by consumers rather than higher market power.

The empirical estimations in Chapter 3 show the extent to which brand and market density are differentiating dimensions in the retail gasoline market. It was estimated that branding can provide some retailers the ability to charge about 11 cents higher than a low quality station would (comparing the cases of Chevron and ARCO, for example). Also, the data show that convenience stores, like 7-Eleven, Circle K and QuickStop all have differing pricing strategies, some show evidence of using gasoline as a loss leader, and others are exploiting the complementary nature of the other products offered at the station to charge a higher price for gasoline. The evidence also suggests that some unbranded independent stations can charge higher prices than the low price focus stations, such as ARCO.

The competition variables show that the number of competitors and the distance of the closest competitor is also shown to matter when stations choose their pricing strategies. Prices decrease nonlinearly when competition becomes harsher: adding a second competitor increases competition more than a third competitor does.

Chapter 4 provides a quantitative measure of local market power associated with the presence of imperfectly informed consumers. According to the analysis, a retailer located nearest to an airport rental car location can charge up to 4 more cents for every gallon of Regular Unleaded gasoline sold. The coefficient for Midgrade and Premium is not significantly different from zero, suggesting that the mark-up is confined to gasoline goods purchased by car rental users. This test can be interpreted as a useful upper bound for similar cases in which market power is observed but not easy to quantify. The impact of competition and brand variables are also consistent with those found in the previous chapter.

Some future extensions of the research on this dissertation include incorporating longer panels to account for the effect of recent developments on the pricing strategies of the market. Incorporating data on sales would be useful to estimate demand equations for gasoline consumers, and these demand equations could be useful to carry out welfare analyses. It could also be explored how sensitive the results in Chapter 3 and 4 are to the definition of market based on euclidean versus driving distance.

An interesting expansion to the results in Chapter 4 would entail a more thorough exploration about the nature of the elasticities, i.e. separate the business travelers from those that are leisure tourists. Initial explorations based on day of the week suggest that these two groups operate differently and could potentially be motivating different pricing strategies by the firms. Also, the analysis of the effect of imperfect information on prices can be extended to similar contexts in the gasoline market that

are not necessarily around airports. For example, one could look at stations located on or near major highways in deserted areas.

Appendix A

Figures

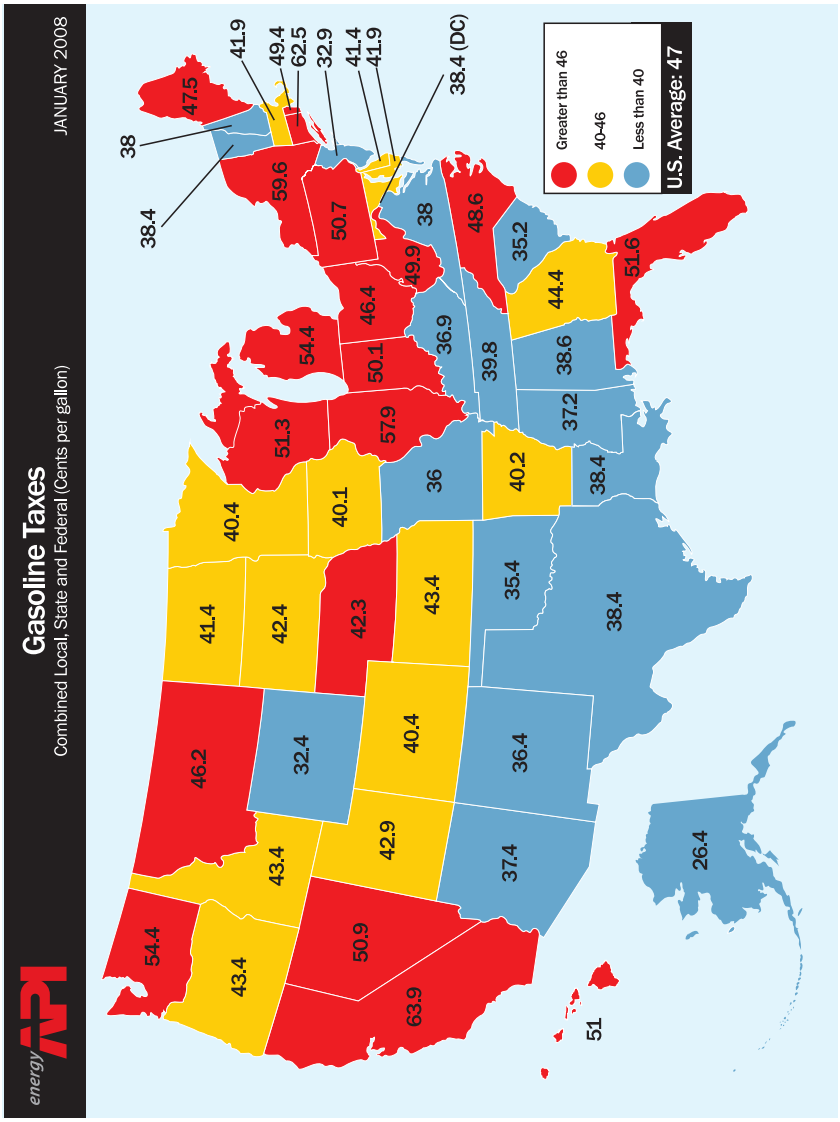

Figure A.1: Average Gasoline Taxes per State

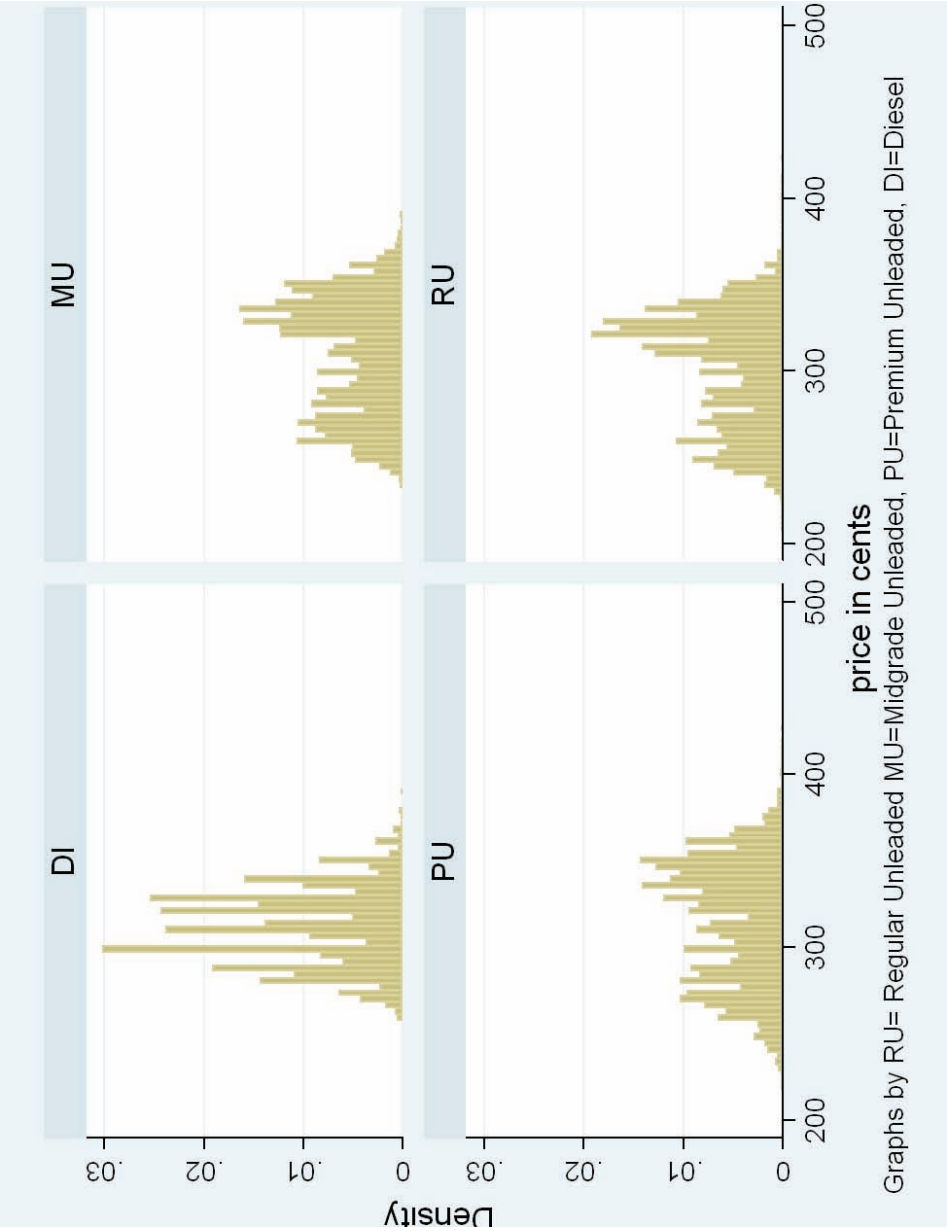

Figure A.2: Density Functions by Fuel Type

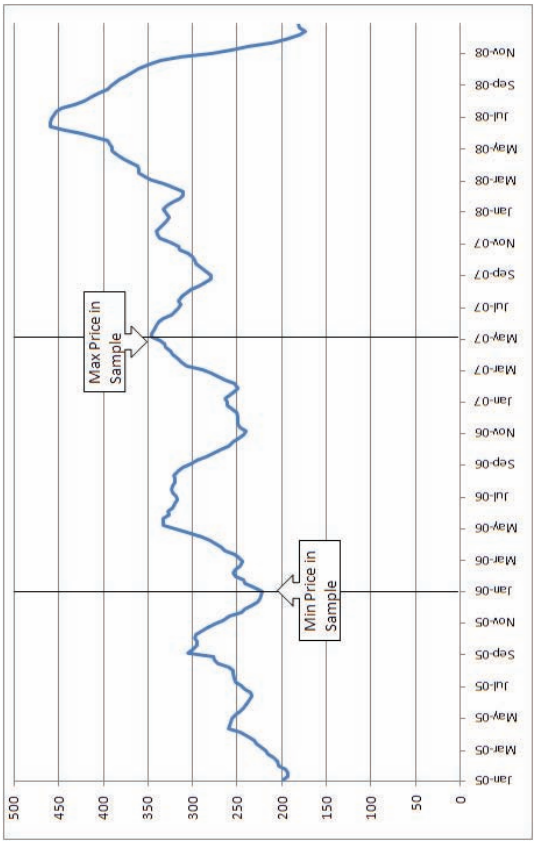

Figure A.3: Average Weekly Prices for California. Source: EIA

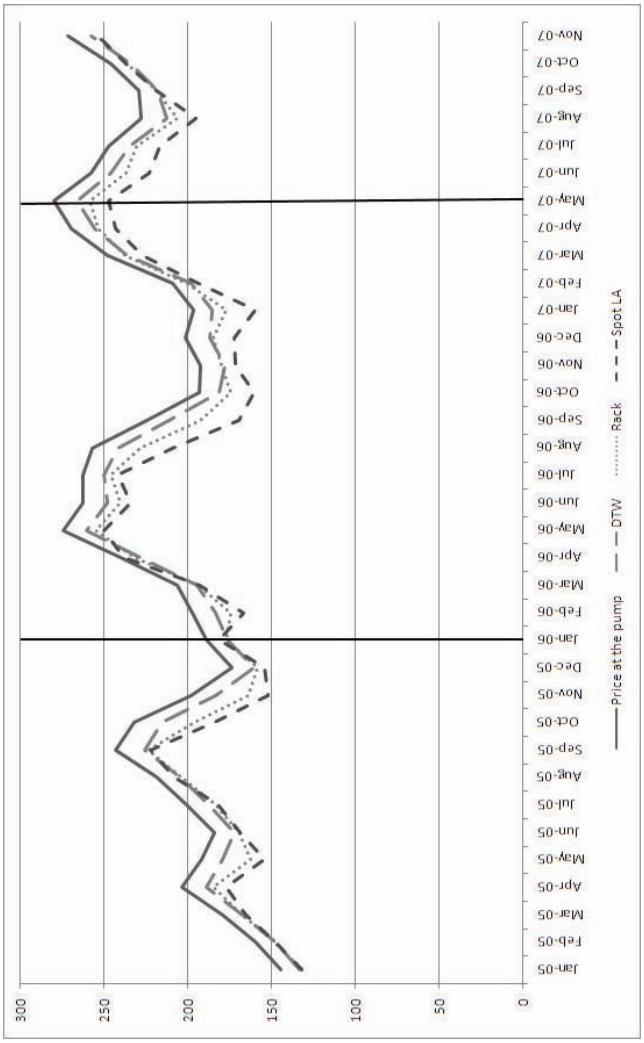

Figure A.4: Monthly Rack, DTW, Spot and Average Prices for Regular Unleaded Gasoline in California

Appendix B

Regression Results

The following table depicts in columns 2-5 the rankings of the coefficients in the regressions and the last column lists the rankings associated with the raw price statistics (1 is the highest coefficient, 13 the lowest). The first Model includes brand variables, fuel type and day of the week dummies. Model 2 integrates distance, and Model 3 the number of competitors and its squared term. The last Model includes month dummies. As noted in Chapter 3, the ordering does not change between regression specifications (even the difference in values between the coefficients is not much higher than a tenth of a cent), but the rankings are different for the raw statistics.

Brand	Model 1	Model 2	Model 3	Model 4	Raw Statistics
CHEVRON	1	1	1	1	2
76	3	3	3	3	6
SHELL	4	4	4	4	6
VALERO	11	11	11	11	4
UNBRANDED	8	8	8	8	3
MOBIL	2	2	2	2	5
7-ELEVEN	7	7	7	6	1
CIRCLE K	9	9	9	9	6
CITGO	6	6	6	7	13
TEXACO	5	5	5	5	9
EXXON	10	10	10	10	10
QUICK STOP	13	13	13	13	12
ARCO	12	12	12	12	11

1- Largest coefficient

Table B.1: Regression Results - Ranking of Coefficients

The following table show the results of the regressions using spot prices and a lag structure instead of average prices to control for shifts in costs. The first Model includes brand variables, fuel type and day of the week dummies. Model 2 integrates distance, and Model 3 the number of competitors and its squared term. The last Model includes month dummies.

	Model 1	Model 2	Model 3	Model 4
CHEVRON	5.226	5.081	5.091	5.367
	[0.367]**	[0.368]**	[0.368]**	[0.367]**
76	3.795	3.696	3.708	3.932
	[0.385]**	[0.386]**	[0.387]**	[0.385]**
SHELL	3.488	3.393	3.403	3.68
	[0.400]**	[0.401]**	[0.401]**	[0.399]**
VALERO	-2.345	-2.199	-2.178	-2.437
	[0.414]**	[0.416]**	[0.416]**	[0.415]**
MOBIL	3.789	3.708	3.71	4.033
	[0.485]**	[0.486]**	[0.486]**	[0.482]**
7-ELEVEN	1.582	1.736	1.724	1.691
	[0.445]**	[0.447]**	[0.445]**	[0.442]**
CIRCLE K	-0.297	-0.321	-0.309	-0.391
	[0.601]	[0.608]	[0.607]	[0.591]
CITGO	-4.369	-4.237	-4.249	-2.928
	[0.494]**	[0.494]**	[0.493]**	[0.479]**
TEXACO	2.79	2.808	2.811	3.247
	[0.790]**	[0.785]**	[0.787]**	[0.777]**
EXXON	-1.783	-1.759	-1.748	-1.222
	[0.627]**	[0.623]**	[0.621]**	[0.602]*
QUICK STOP	-6.288	-6.375	-6.387	-6.024
	[0.589]**	[0.597]**	[0.603]**	[0.599]**
ARCO	-6.319	-6.376	-6.33	-5.997
	[0.804]**	[0.810]**	[0.802]**	[0.760]**
Observations	1,465,294	1,465,049	1,465,049	1,465,049
Number of zip	1,213	1,211	1,211	1,211
R-squared	0.87	0.87	0.87	0.88

Standard errors in brackets; * significant at 5%; ** significant at 1%

All regressions include zipcode FE; unbranded omitted category

Table B.2: Regression Results - Spot Price and Lags

	Model 1	Model 2	Model 3	Model 4
MU	10.218	10.219	10.215	10.451
	[0.065]**	[0.065]**	[0.065]**	[0.064]**
PU	16.889	16.9	16.898	17.175
	[0.149]**	[0.149]**	[0.148]**	[0.150]**
Spot Price	0.206	0.206	0.206	0.208
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Spot Lag 1	0.214	0.214	0.214	0.263
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Spot Lag 2	0.239	0.239	0.239	0.208
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Spot Lag 3	0.084	0.084	0.084	0.12
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Spot Lag 4	0.102	0.102	0.102	0.115
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Spot Lag 5	0.197	0.197	0.197	0.23
	[0.001]**	[0.001]**	[0.001]**	[0.001]**
Constant	76.361	76.123	76.791	52.235
	[0.405]**	[0.409]**	[0.481]**	[0.647]**
Observations	1,465,294	1,465,049	1,465,049	1,465,049
Number of zip	1,213	1,211	1,211	1,211
R-squared	0.87	0.87	0.87	0.88

Standard errors in brackets; * significant at 5%; ** significant at 1%

All regressions include zipcode FE; unbranded omitted category

Table B.3: Regression Results Continued- Spot Price and lags

This table shows the participation of each of the major rental car companies in the sample.

Rental Car Company	Frequency	Weight
AVIS	30	11%
DOLLAR	30	11%
HERTZ	30	11%
NATIONAL	30	11%
BUDGET	29	11%
ALAMO	27	10%
ENTERPRISE	27	10%
THRIFTY	26	9%
ADVANTAGE	10	4%
PAYLESS	8	3%
EZ RENTACAR	5	2%
FOX	4	1%
Other	20	7%
Total	276	100%

Table B.4: Rental Cars Brands

	Midgrade Unleaded					Premium Unleaded				
	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N
ATL	279	34.27	191	380	57,690	290	35.13	194	391	42,978
BOS	284	31.62	202	371	32,478	291	31.97	206	386	30,757
BWI	289	31.25	201	376	33,999	295	31.67	200	375	29,520
CLT	283	29.83	204	370	29,069	290	30.72	205	365	24,154
CVG	283	33.03	200	362	18,763	293	33.25	206	375	13,204
DCA	294	31.35	206	381	42,543	300	32.59	201	381	31,928
DEN	286	32.66	201	376	38,664	295	33.91	200	390	23,791
DFW	281	30.11	199	370	73,025	288	31.69	190	391	59,872
DTW	285	36.27	190	401	40,579	295	36.39	196	390	31,397
EWR	280	33.35	190	381	27,297	284	34.90	192	386	38,560
FLL	294	27.95	210	380	48,215	303	29.23	216	391	42,051
HNL	320	23.77	257	427	6,087	328	23.80	252	439	3,371
IAD	290	30.89	190	370	18,625	299	31.23	194	373	14,188
IAH	277	31.89	182	360	44,451	282	33.56	189	361	38,091
JFK	304	32.50	224	397	16,786	313	34.12	220	420	19,318
LAS	296	26.51	213	368	29,332	306	26.64	226	380	31,404
LAX	317	30.88	226	410	71,306	325	31.31	226	416	56,380
LGA	301	35.34	200	400	27,346	308	36.44	196	401	34,452
MCO	285	27.33	196	380	49,227	293	27.89	205	381	45,041
MDW	305	39.83	201	413	56,034	315	40.34	210	451	44,925
MIA	294	29.79	210	389	35,593	302	31.02	201	401	31,895
MSP	278	33.33	178	375	36,244	288	33.83	185	371	31,845
ORD	302	39.05	209	420	52,688	313	39.40	203	430	40,255
PHL	288	32.12	193	380	36,238	296	32.68	192	400	43,634
PHX	284	29.02	194	352	64,791	295	29.64	212	379	54,495
SAN	320	30.82	240	412	31,422	330	30.10	238	420	23,736
SEA	304	32.03	210	401	37,171	315	32.12	216	400	29,094
SFO	325	34.81	230	429	31,821	328	35.73	230	431	30,775
SLC	283	33.88	192	360	31,077	290	34.36	198	369	24,666
TPA	283	28.81	206	370	57,742	291	29.20	201	401	47,948

Table B.5: Market Statistics -Price in Cents

	Model 1	Model 2	Model 3	Model 4
CHEVRON	4.068	4.097	4.084	4.079
	[0.146]**	[0.145]**	[0.145]**	[0.145]**
76	3.401	3.422	3.41	3.424
	[0.259]**	[0.258]**	[0.258]**	[0.258]**
SHELL	3.837	3.88	3.865	3.879
	[0.122]**	[0.121]**	[0.121]**	[0.121]**
VALERO	0.817	0.846	0.825	0.822
	[0.369]*	[0.369]*	[0.369]*	[0.369]*
MOBIL	2.497	2.519	2.48	2.472
	[0.156]**	[0.155]**	[0.156]**	[0.155]**
7-ELEVEN	1.357	1.385	1.35	1.331
	[0.139]**	[0.138]**	[0.138]**	[0.138]**
CIRCLE K	0.801	0.775	0.757	0.772
	[0.163]**	[0.163]**	[0.163]**	[0.163]**
CITGO	2.486	2.483	2.471	2.477
	[0.141]**	[0.140]**	[0.140]**	[0.140]**
TEXACO	2.569	2.602	2.582	2.588
	[0.238]**	[0.237]**	[0.237]**	[0.237]**
EXXON	3.031	3.077	3.047	3.039
	[0.177]**	[0.176]**	[0.176]**	[0.176]**
ARCO	-8.006	-7.946	-7.963	-7.972
	[0.717]**	[0.714]**	[0.717]**	[0.715]**
BP	3.112	3.14	3.112	3.123
	[0.136]**	[0.135]**	[0.135]**	[0.135]**
CONOCO	2.908	2.943	2.96	2.961
	[0.220]**	[0.217]**	[0.218]**	[0.218]**
DIAMOND SHAMROCK	0.444	0.458	0.444	0.429
	[0.209]*	[0.210]*	[0.211]*	[0.211]*
FINA	3.397	3.428	3.434	3.428
	[0.384]**	[0.381]**	[0.382]**	[0.382]**
GETTY	-0.11	-0.104	-0.128	-0.115
	[0.231]	[0.231]	[0.231]	[0.231]
HESS	-1.688	-1.629	-1.639	-1.65
	[0.181]**	[0.181]**	[0.181]**	[0.181]**
LUKOIL	3.545	3.613	3.61	3.607
	[0.426]**	[0.427]**	[0.425]**	[0.425]**
MARATHON ASHLAND	2.308	2.317	2.311	2.315
	[0.165]**	[0.163]**	[0.163]**	[0.163]**
PHILLIPS 66	2.221	2.193	2.205	2.208
	[0.208]**	[0.204]**	[0.203]**	[0.203]**
TESORO	0.865	0.963	0.989	0.995
	[0.349]*	[0.356]**	[0.352]**	[0.352]**

Standard errors in brackets; * significant at 5%; ** significant at 1%

Table B.6: Regression Results-Regular Unleaded Continued

	Model 1	Model 2	Model 3	Model 4
CHEVRON	5.824	5.854	5.835	5.834
	[0.234]**	[0.233]**	[0.233]**	[0.233]**
76	5.529	5.551	5.536	5.538
	[0.391]**	[0.389]**	[0.389]**	[0.389]**
SHELL	5.636	5.671	5.647	5.65
	[0.209]**	[0.208]**	[0.208]**	[0.208]**
VALERO	-1.593	-1.563	-1.581	-1.565
	[0.638]*	[0.637]*	[0.633]*	[0.633]*
MOBIL	3.998	4.008	3.962	3.954
	[0.298]**	[0.296]**	[0.297]**	[0.296]**
7-ELEVEN	2.886	2.908	2.87	2.836
	[0.214]**	[0.213]**	[0.213]**	[0.213]**
CIRCLE K	3.226	3.193	3.172	3.173
	[0.265]**	[0.265]**	[0.265]**	[0.265]**
CITGO	3.694	3.679	3.658	3.657
	[0.257]**	[0.257]**	[0.257]**	[0.257]**
TEXACO	5.714	5.739	5.715	5.715
	[0.358]**	[0.357]**	[0.359]**	[0.359]**
EXXON	4.466	4.509	4.476	4.464
	[0.376]**	[0.373]**	[0.372]**	[0.372]**
ARCO	-6.784	-6.73	-6.748	-6.739
	[1.154]**	[1.147]**	[1.158]**	[1.157]**
BP	4.897	4.911	4.875	4.874
	[0.233]**	[0.233]**	[0.233]**	[0.232]**
CONOCO	4.958	5.008	5.01	5.011
	[0.502]**	[0.497]**	[0.498]**	[0.498]**
DIAMOND SHAMROCK	0.633	0.653	0.625	0.618
	[0.314]*	[0.315]*	[0.316]*	[0.316]
FINA	5.282	5.317	5.335	5.332
	[0.653]**	[0.651]**	[0.653]**	[0.652]**
GETTY	1.271	1.268	1.233	1.207
	[0.421]**	[0.421]**	[0.421]**	[0.421]**
HESS	-1.443	-1.391	-1.405	-1.415
	[0.262]**	[0.262]**	[0.261]**	[0.261]**
LUKOIL	4.348	4.393	4.317	4.319
	[1.070]**	[1.073]**	[1.076]**	[1.078]**
MARATHON ASHLAND	3.387	3.387	3.385	3.381
	[0.363]**	[0.362]**	[0.363]**	[0.362]**
PHILLIPS 66	4.198	4.149	4.171	4.169
	[0.362]**	[0.351]**	[0.350]**	[0.350]**
TESORO	5.034	5.135	5.171	5.181
	[0.462]**	[0.468]**	[0.465]**	[0.465]**

Standard errors in brackets; * significant at 5%; ** significant at 1%

Table B.7: Regression Results-Midgrade Unleaded Continued

	Model 1	Model 2	Model 3	Model 4
CHEVRON	8.579	8.619	8.618	8.618
	[0.271]**	[0.270]**	[0.270]**	[0.270]**
76	9.037	9.063	9.069	9.073
	[0.433]**	[0.432]**	[0.431]**	[0.431]**
SHELL	8.648	8.679	8.67	8.671
	[0.248]**	[0.248]**	[0.248]**	[0.248]**
VALERO	-3.843	-3.801	-3.786	-3.783
	[0.624]**	[0.622]**	[0.621]**	[0.621]**
MOBIL	7.012	7.094	7.056	7.052
	[0.543]**	[0.543]**	[0.543]**	[0.542]**
7-ELEVEN	5.773	5.798	5.766	5.732
	[0.257]**	[0.257]**	[0.257]**	[0.257]**
CIRCLE K	7.126	7.09	7.084	7.083
	[0.294]**	[0.295]**	[0.295]**	[0.295]**
CITGO	5.733	5.725	5.723	5.722
	[0.278]**	[0.278]**	[0.278]**	[0.278]**
TEXACO	6.431	6.45	6.432	6.426
	[0.516]**	[0.517]**	[0.518]**	[0.517]**
EXXON	6.749	6.828	6.839	6.851
	[0.753]**	[0.749]**	[0.750]**	[0.751]**
ARCO	-2.449	-2.376	-2.367	-2.35
	[1.010]*	[1.000]*	[1.009]*	[1.008]*
BP	7.648	7.658	7.635	7.636
	[0.278]**	[0.277]**	[0.277]**	[0.277]**
CONOCO	8.305	8.351	8.384	8.384
	[0.515]**	[0.512]**	[0.513]**	[0.513]**
DIAMOND SHAMROCK	1.311	1.339	1.347	1.34
	[0.515]*	[0.512]**	[0.509]**	[0.509]**
FINA	6.291	6.336	6.345	6.34
	[1.060]**	[1.062]**	[1.052]**	[1.051]**
GETTY	5.598	5.61	5.593	5.59
	[0.542]**	[0.542]**	[0.539]**	[0.539]**
HESS	1.48	1.526	1.527	1.537
	[0.339]**	[0.340]**	[0.340]**	[0.340]**
LUKOIL	8.605	8.686	8.689	8.694
	[0.695]**	[0.696]**	[0.697]**	[0.697]**
MARATHON ASHLAND	5.26	5.245	5.26	5.254
	[0.502]**	[0.501]**	[0.499]**	[0.499]**
PHILLIPS 66	6.366	6.351	6.391	6.386
	[0.506]**	[0.498]**	[0.498]**	[0.498]**
TESORO	7.093	7.304	7.345	7.346
	[0.987]**	[0.990]**	[0.972]**	[0.971]**

Standard errors in brackets; * significant at 5%; ** significant at 1%

Table B.8: Regression Results-Premium Unleaded Continued

Appendix C

Maps

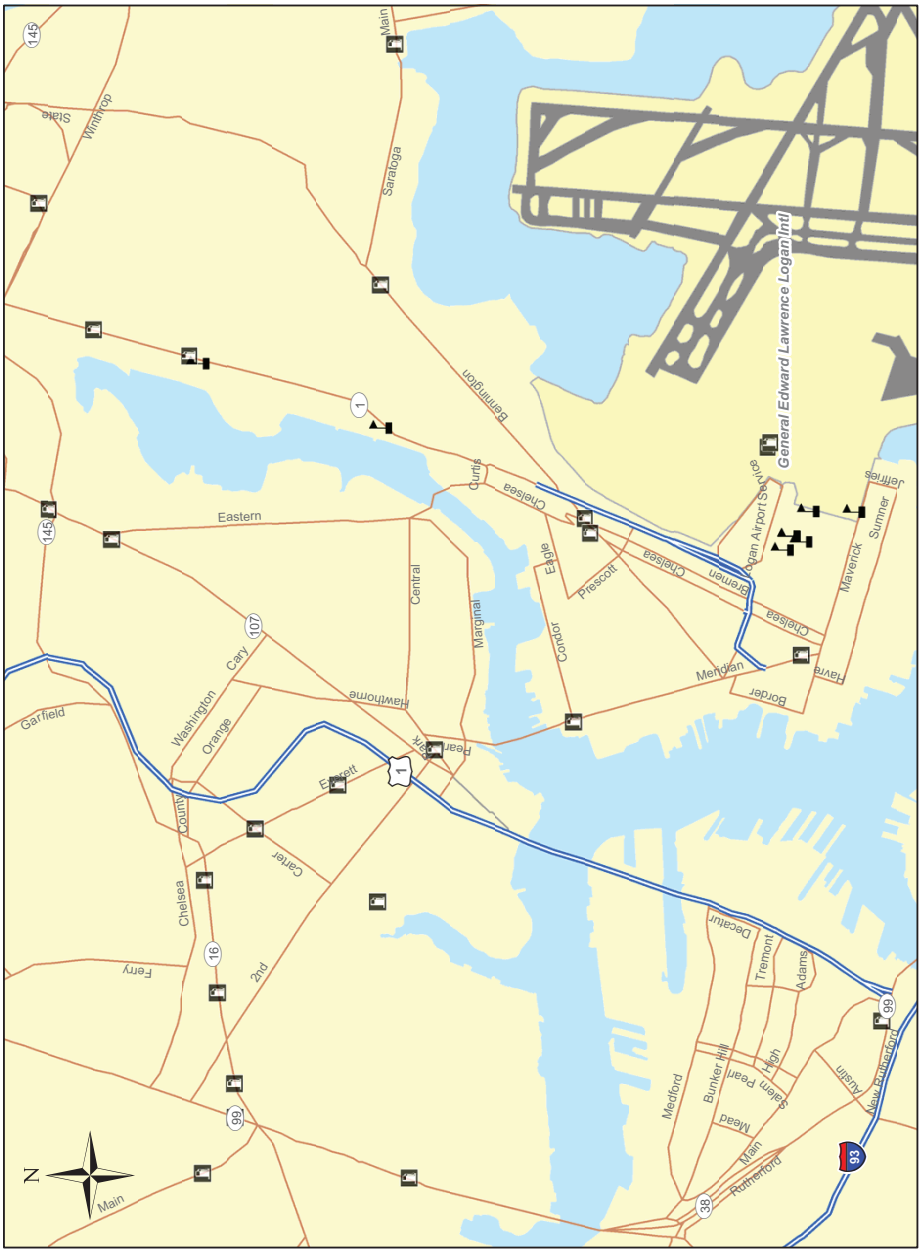

Figure C.1: General Edward Lawrence Logan International Airport (BOS)

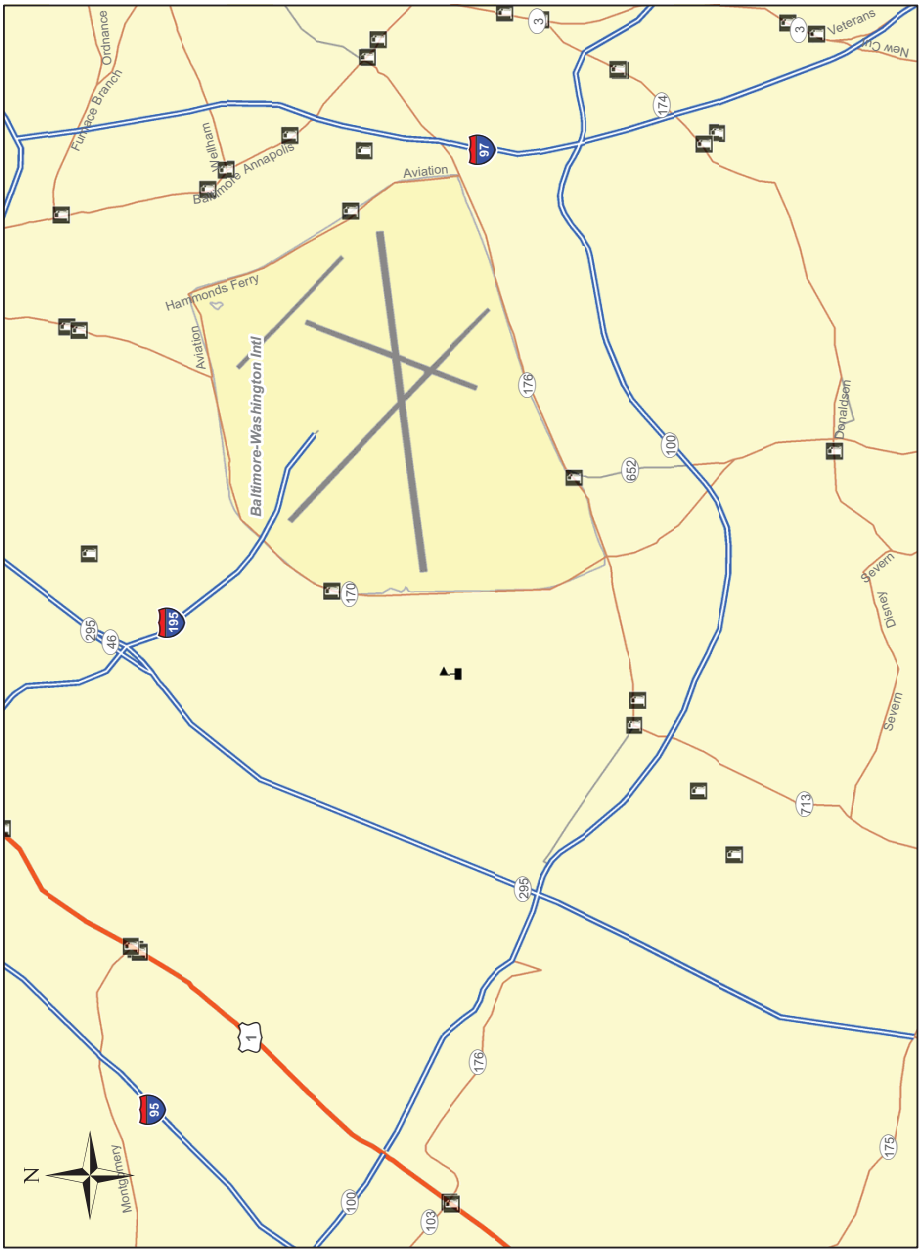

Figure C.2: Baltimore/Washington International Thurgood Marshal Airport (BWI)

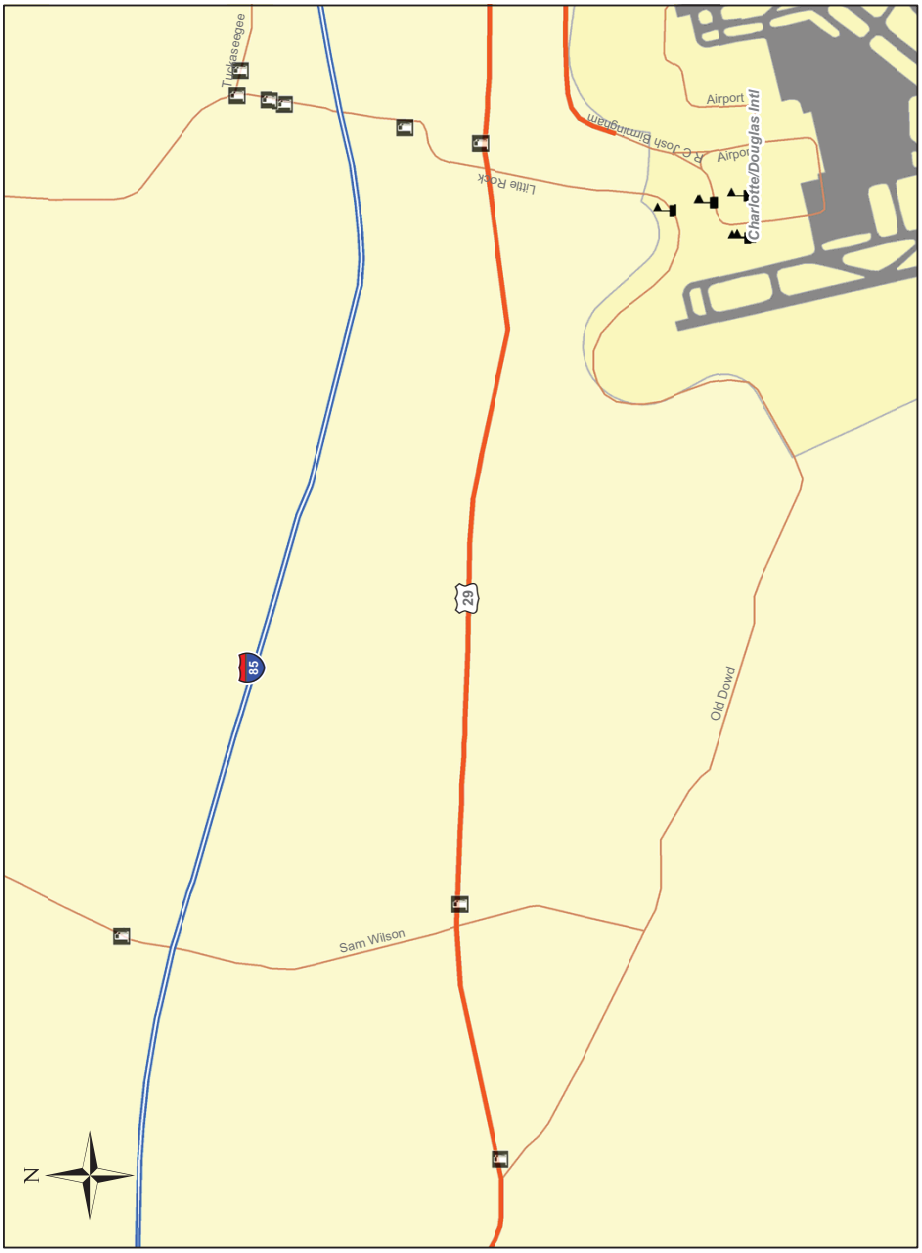

Figure C.3: Charlotte/Douglas International Airport (CLT)

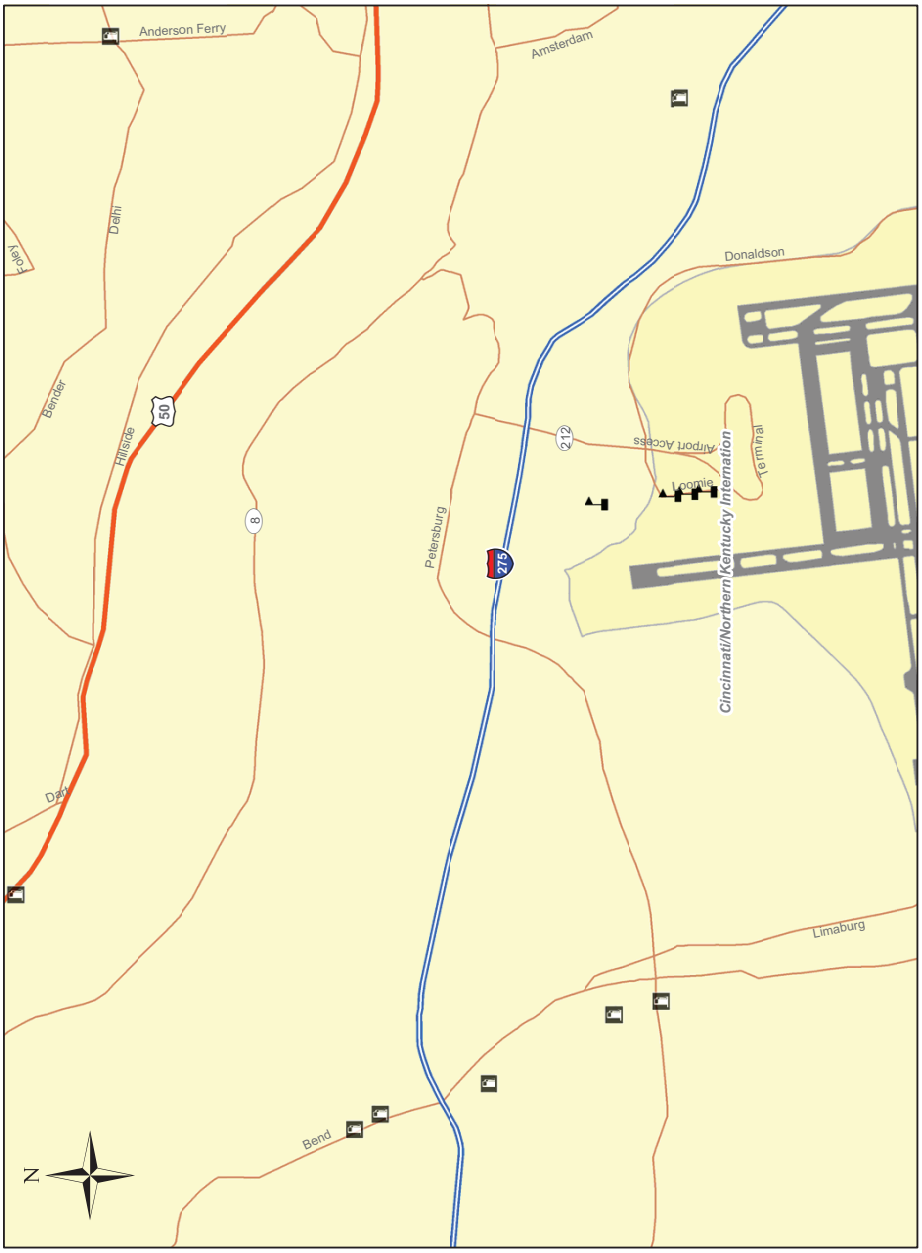

Figure C.4: Cincinnati/Northern Kentucky International Airport (CVG)

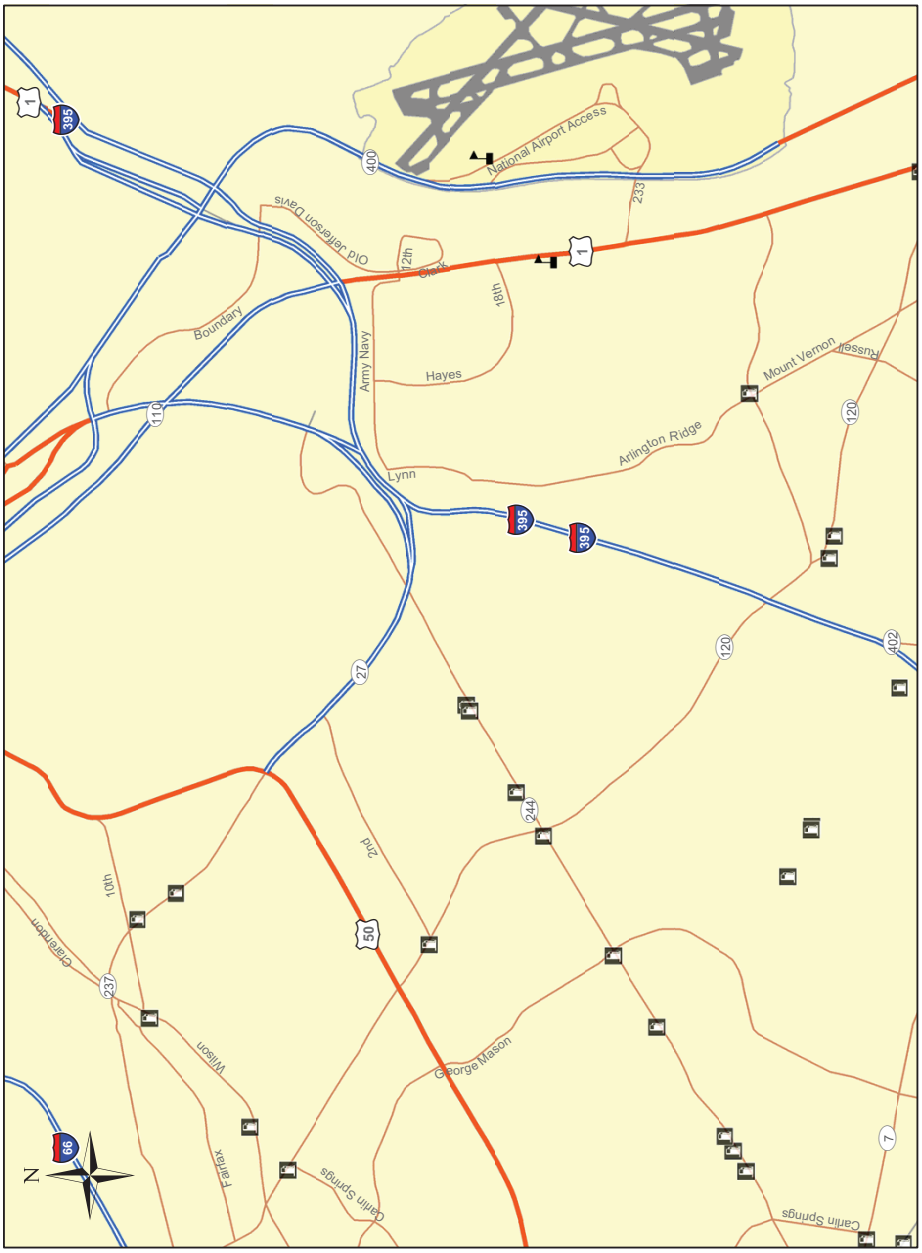

Figure C.5: Ronald Reagan Washington National Airport (DCA)

Figure C.6: Denver International Airport (DEN)

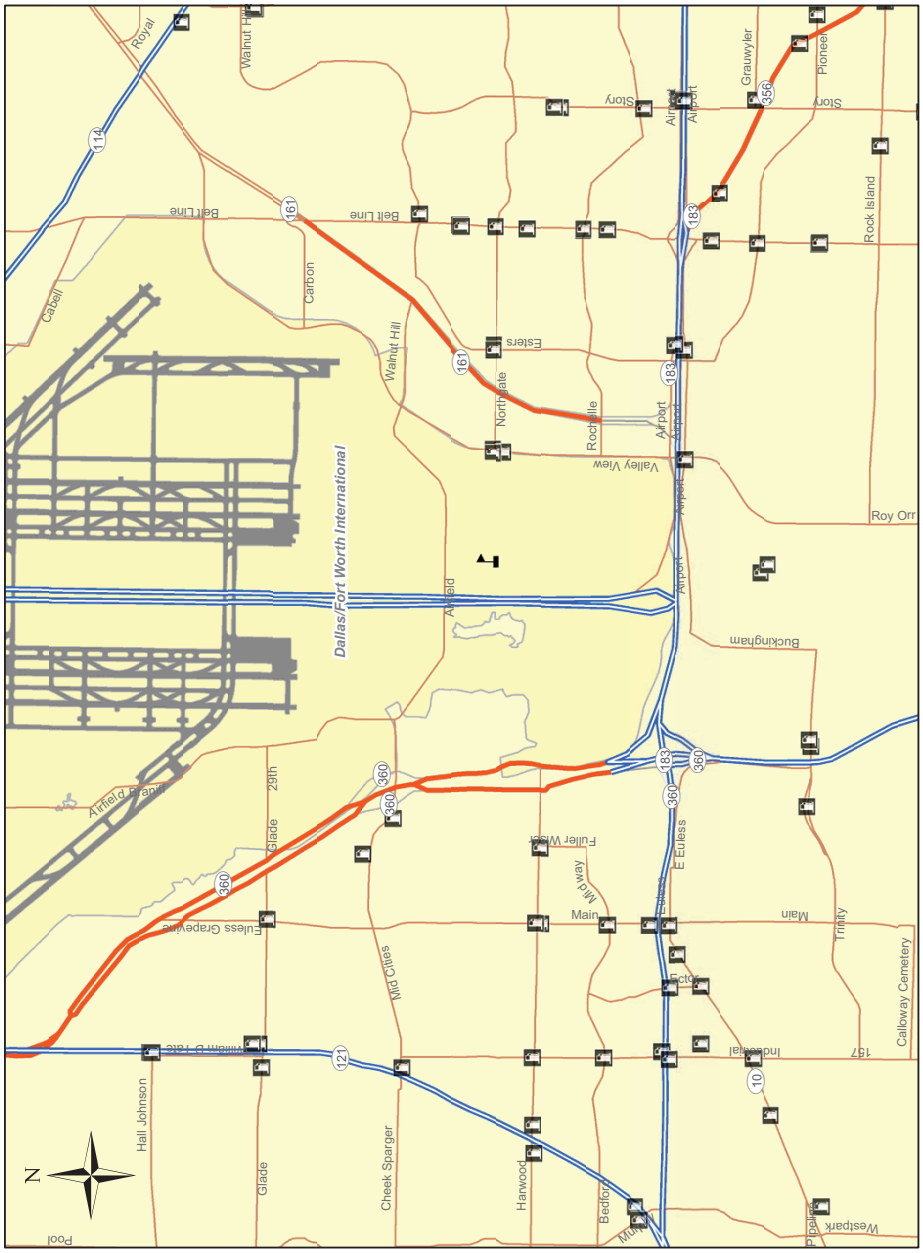

Figure C.7: Dallas/Fort Worth International Airport (DFW)

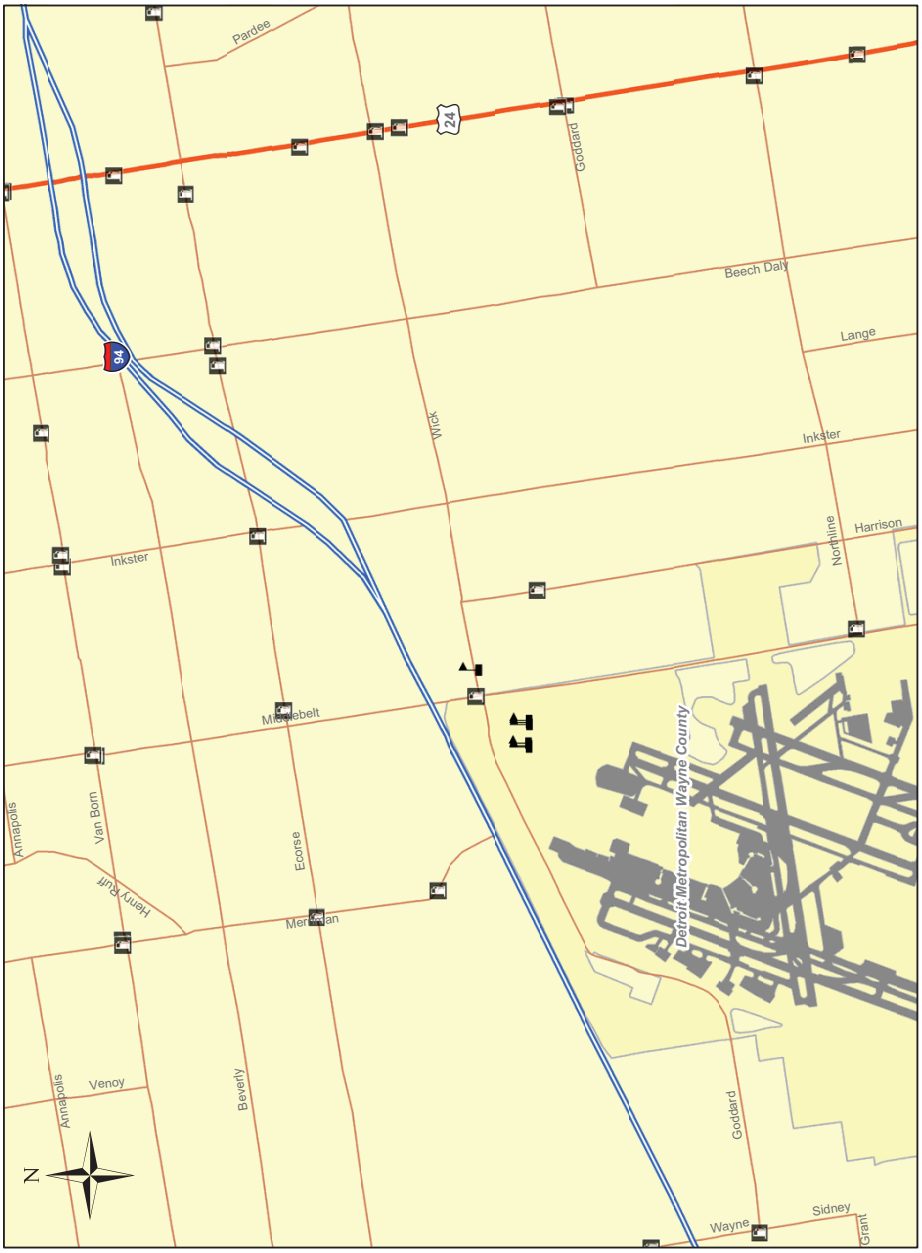

Figure C.8: Detroit Metropolitan Wayne County Airport (DTW)

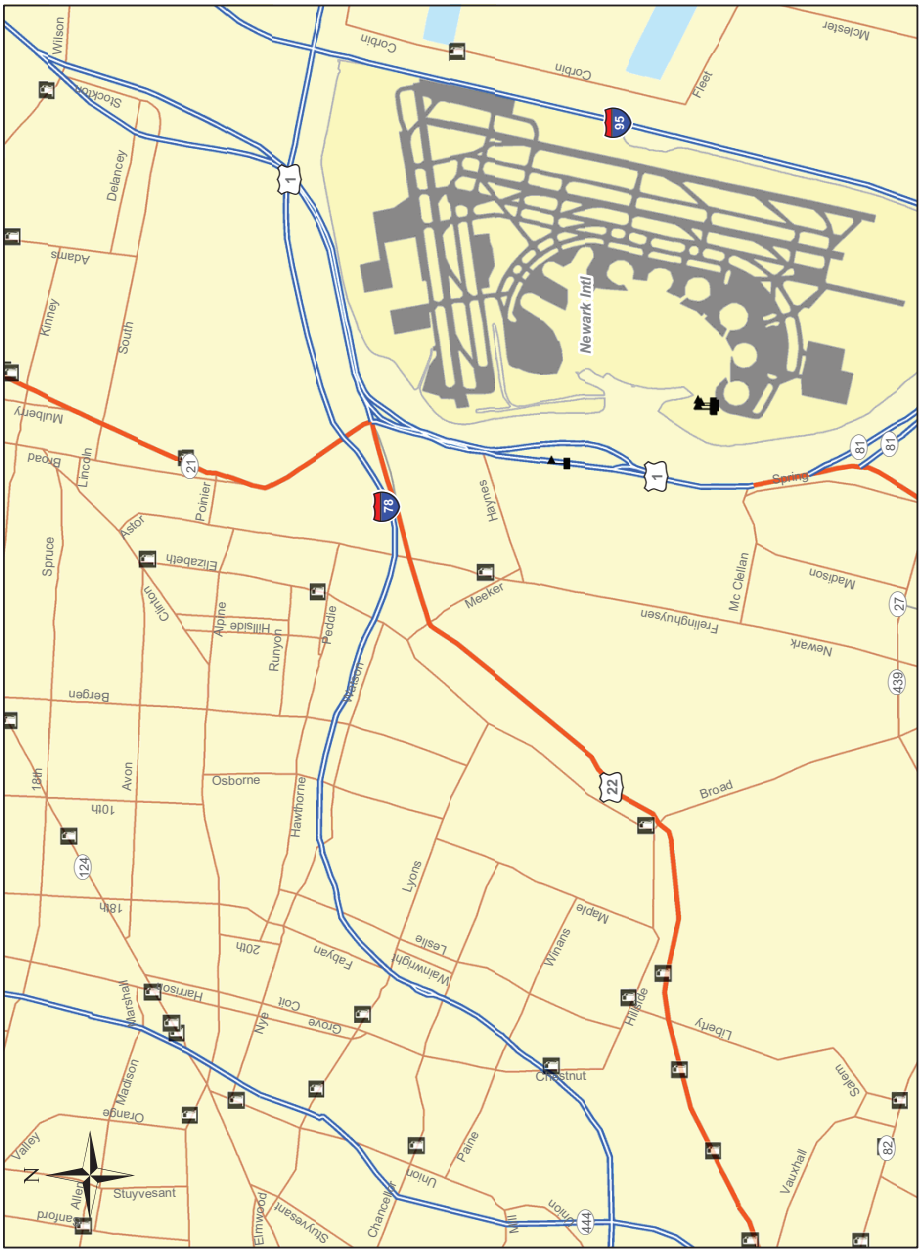

Figure C.9: Newark Liberty International Airport (EWR)

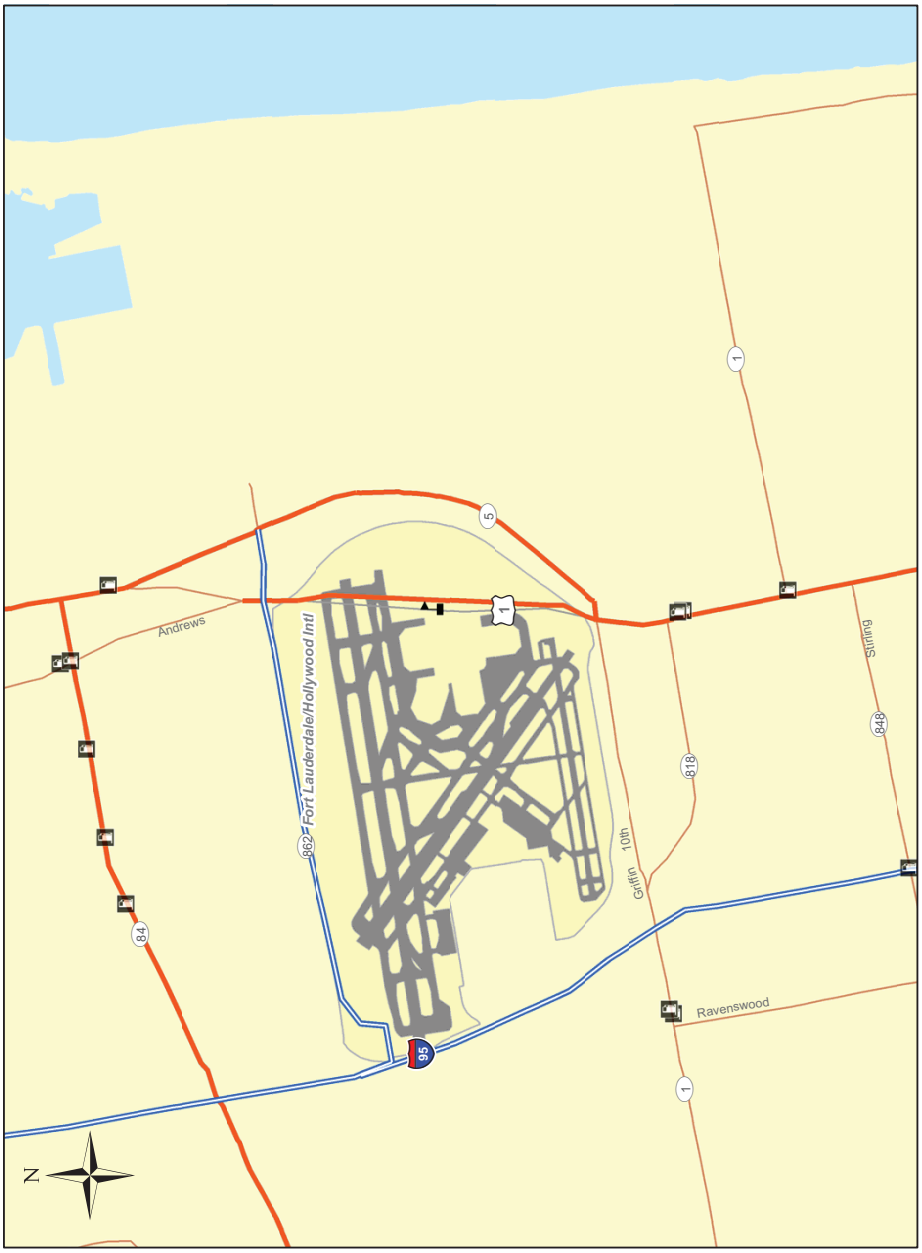

Figure C.10: Fort Lauderdale Hollywood International Airport (FLL)

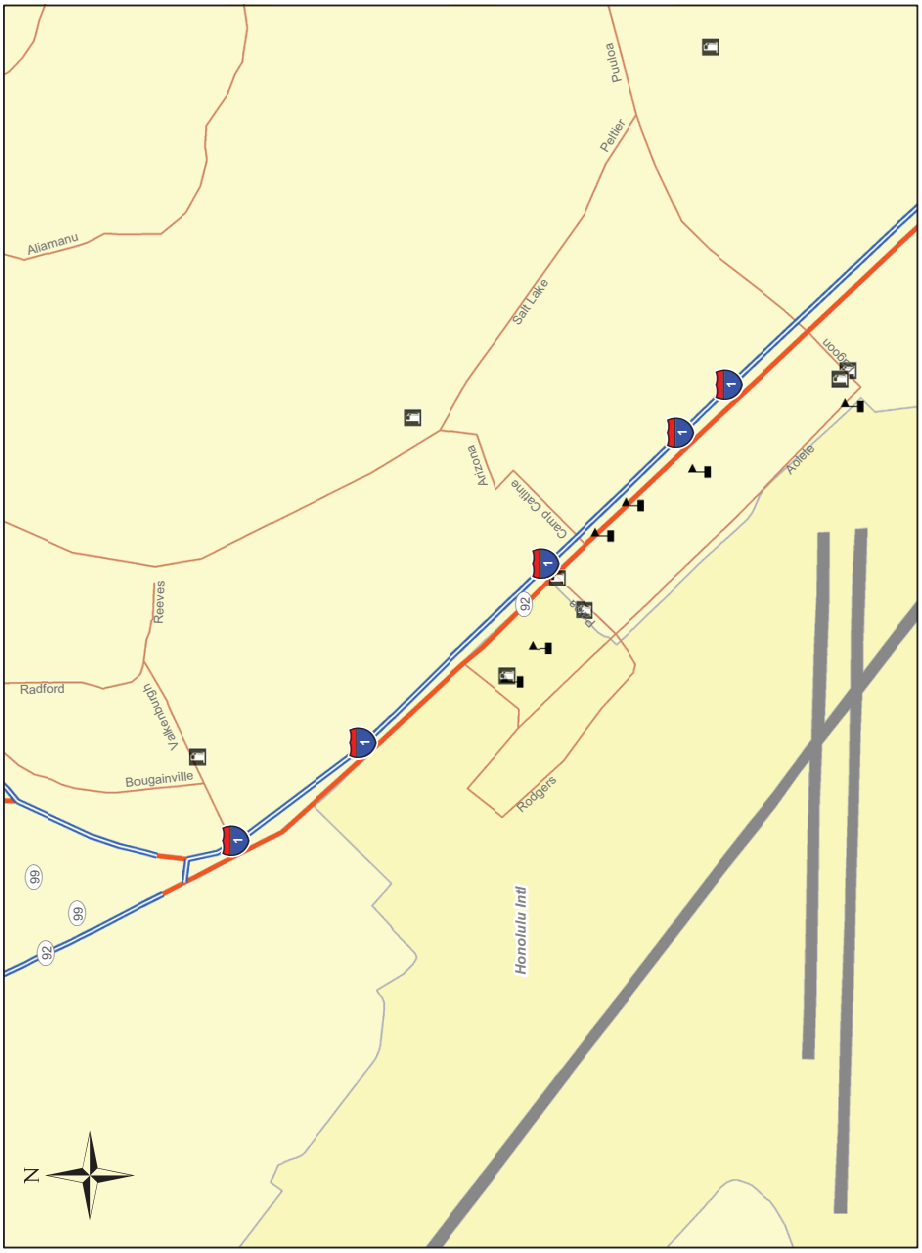

Figure C.11: Honolulu International Airport (HNL)

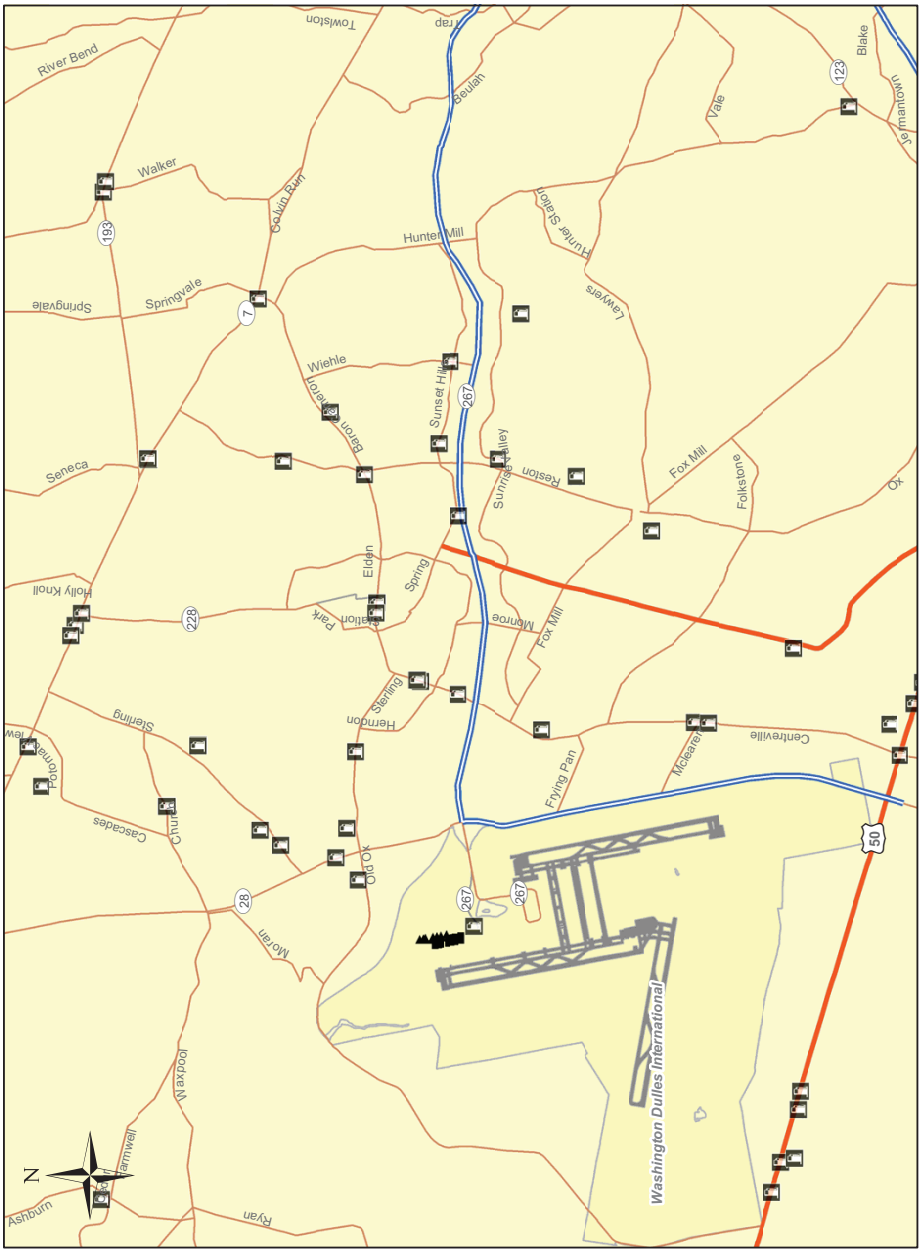

Figure C.12: Washington Dulles International Airport (IAD)

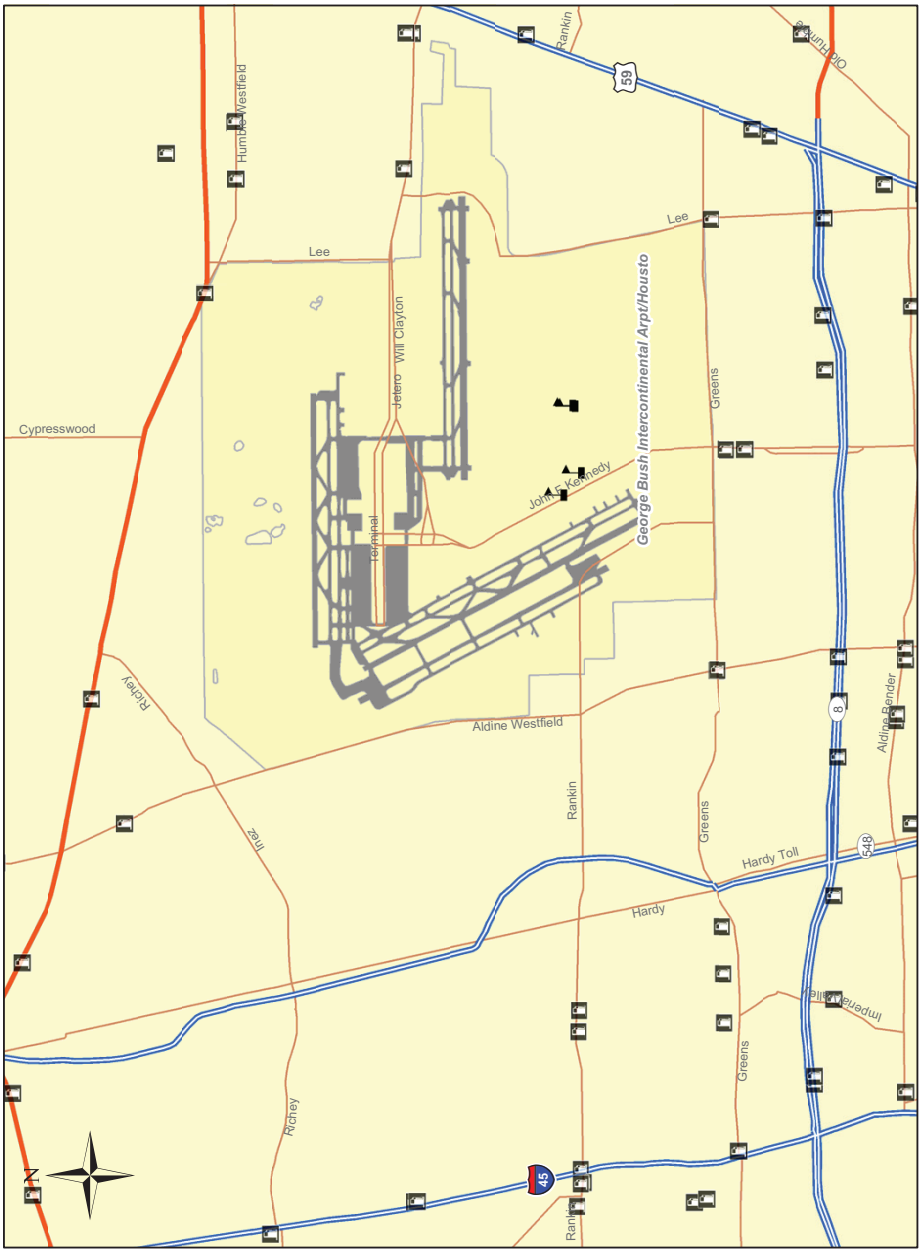

Figure C.13: George Bush Intercontinental Houston Airport (IAH)

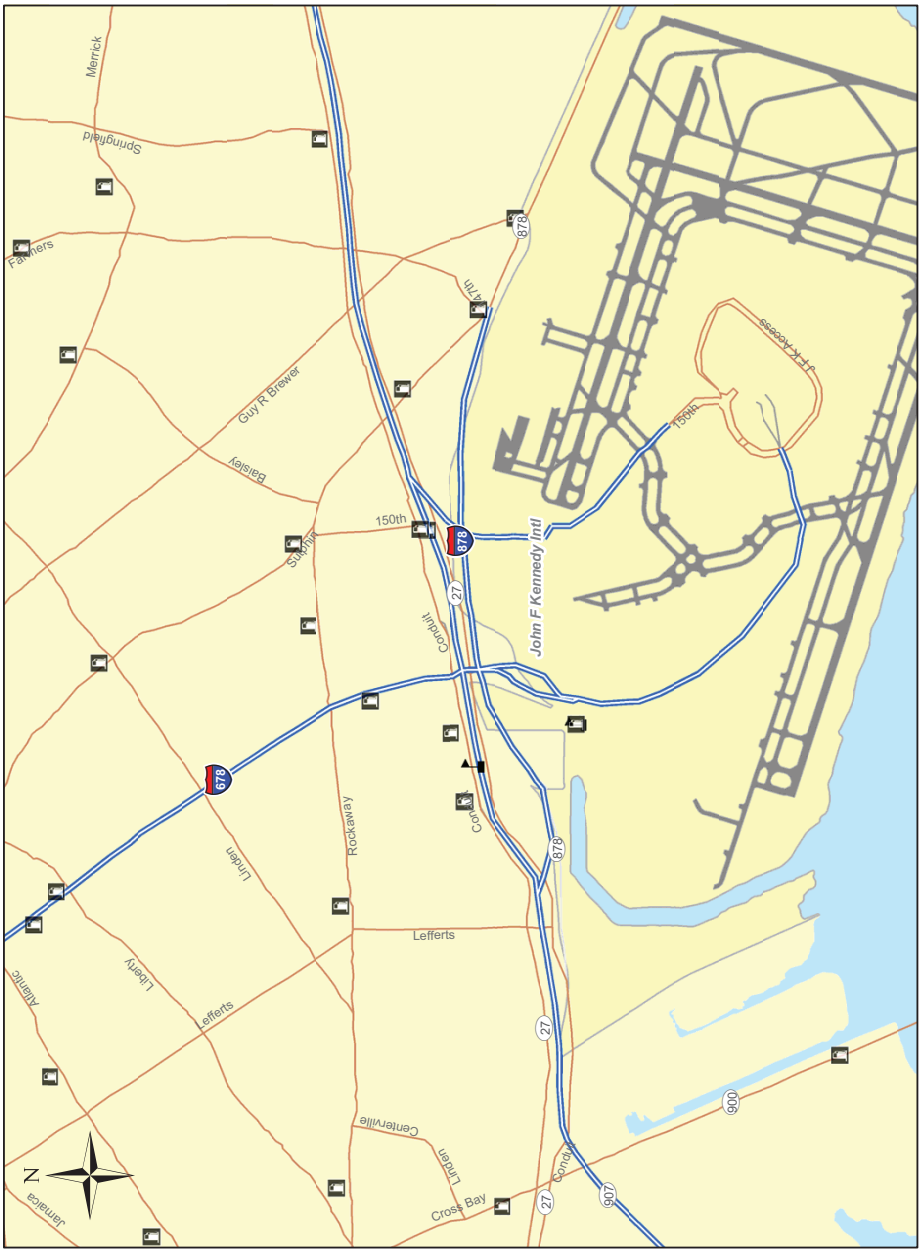

Figure C.14: John F Kennedy International Airport (JFK)

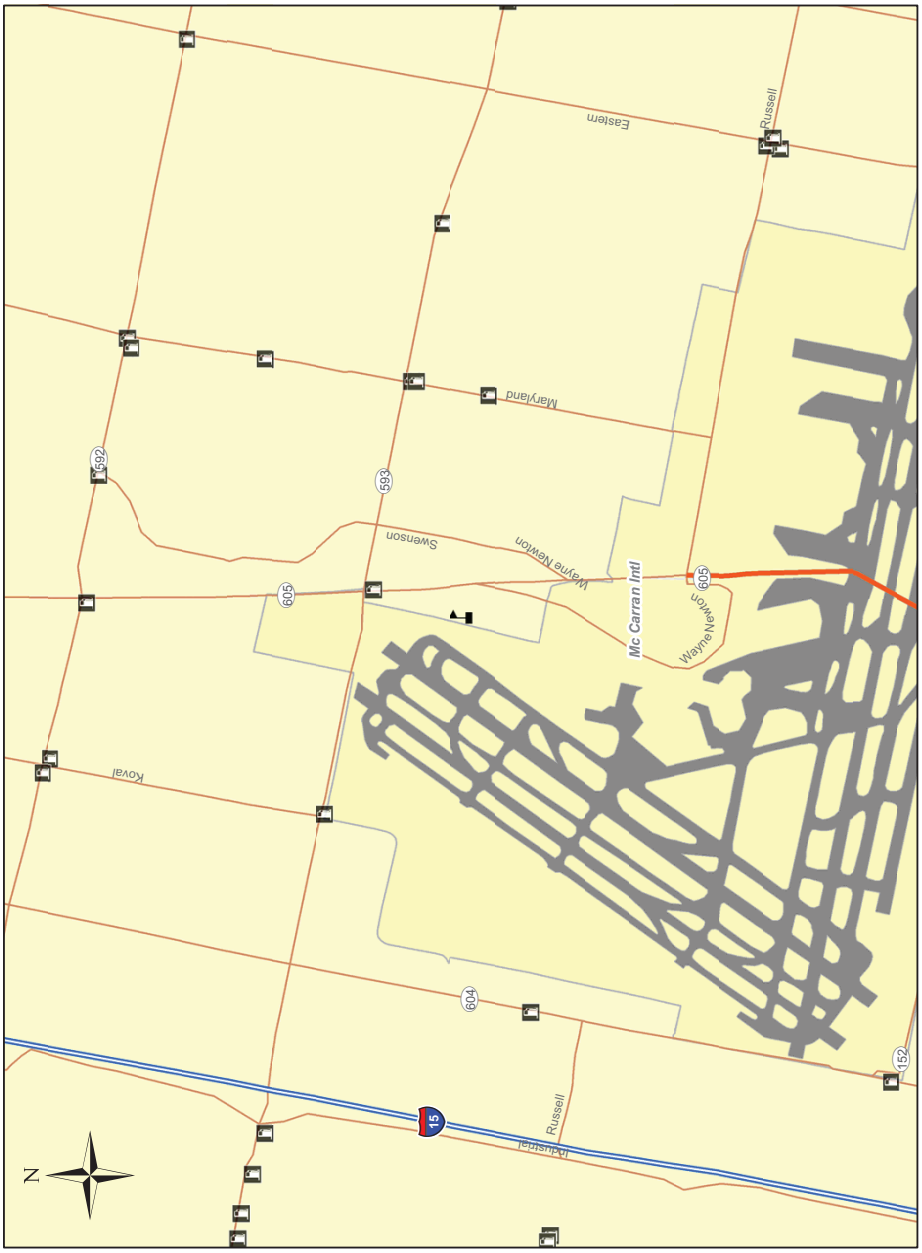

Figure C.15: Mc Carran International Airport (LAS)

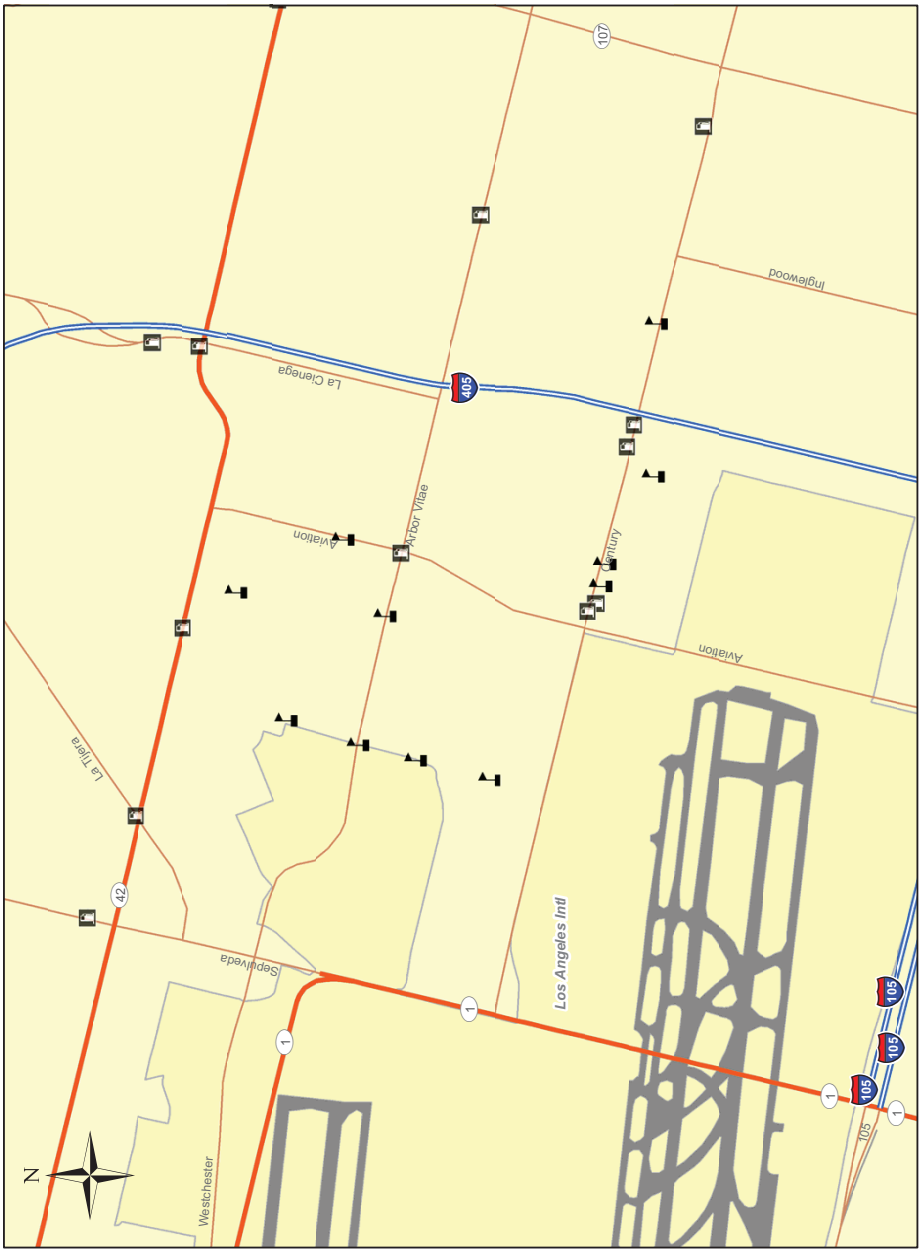

Figure C.16: Los Angeles International Airport (LAX)

Figure C.17: La Guardia Airport (LGA)

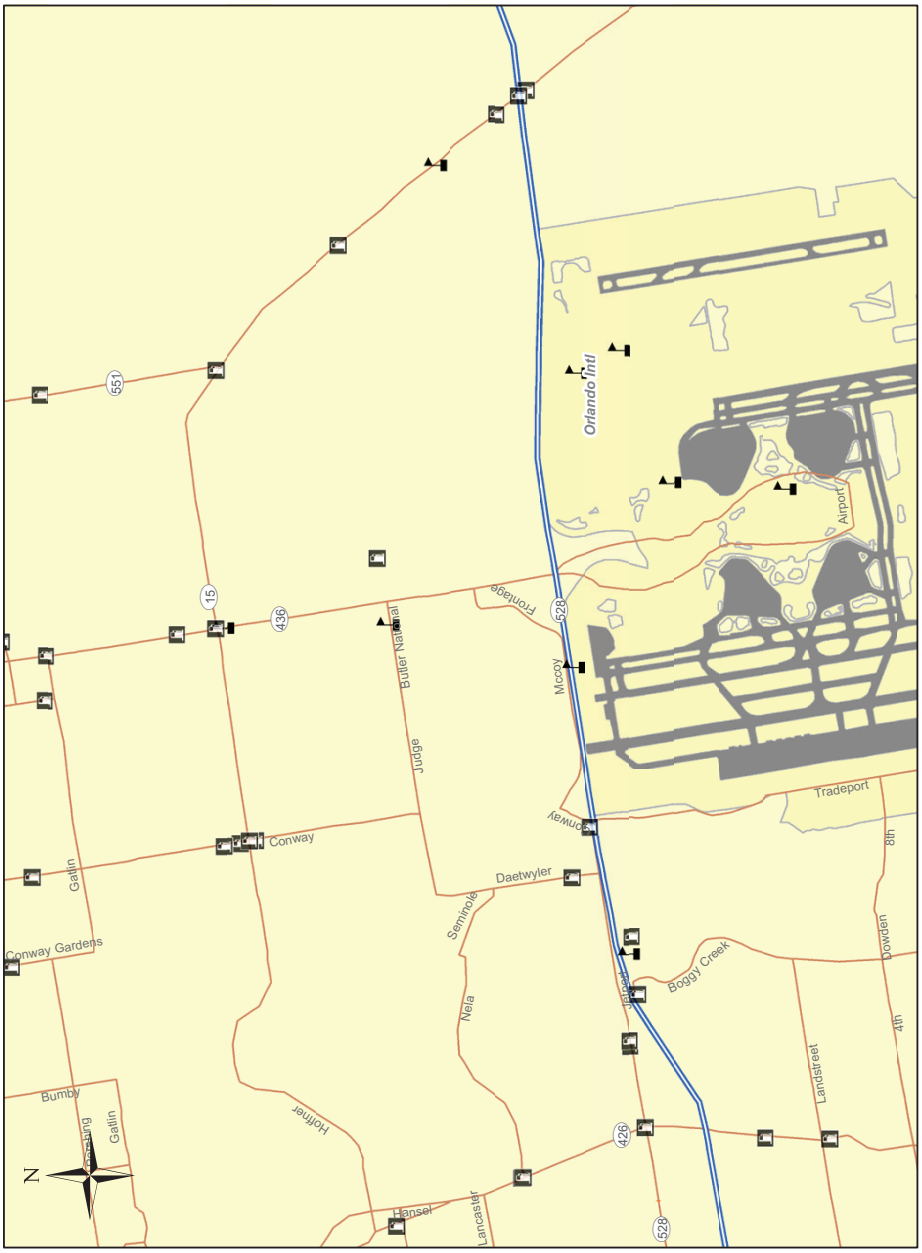

Figure C.18: Orlando International Airport (MCO)

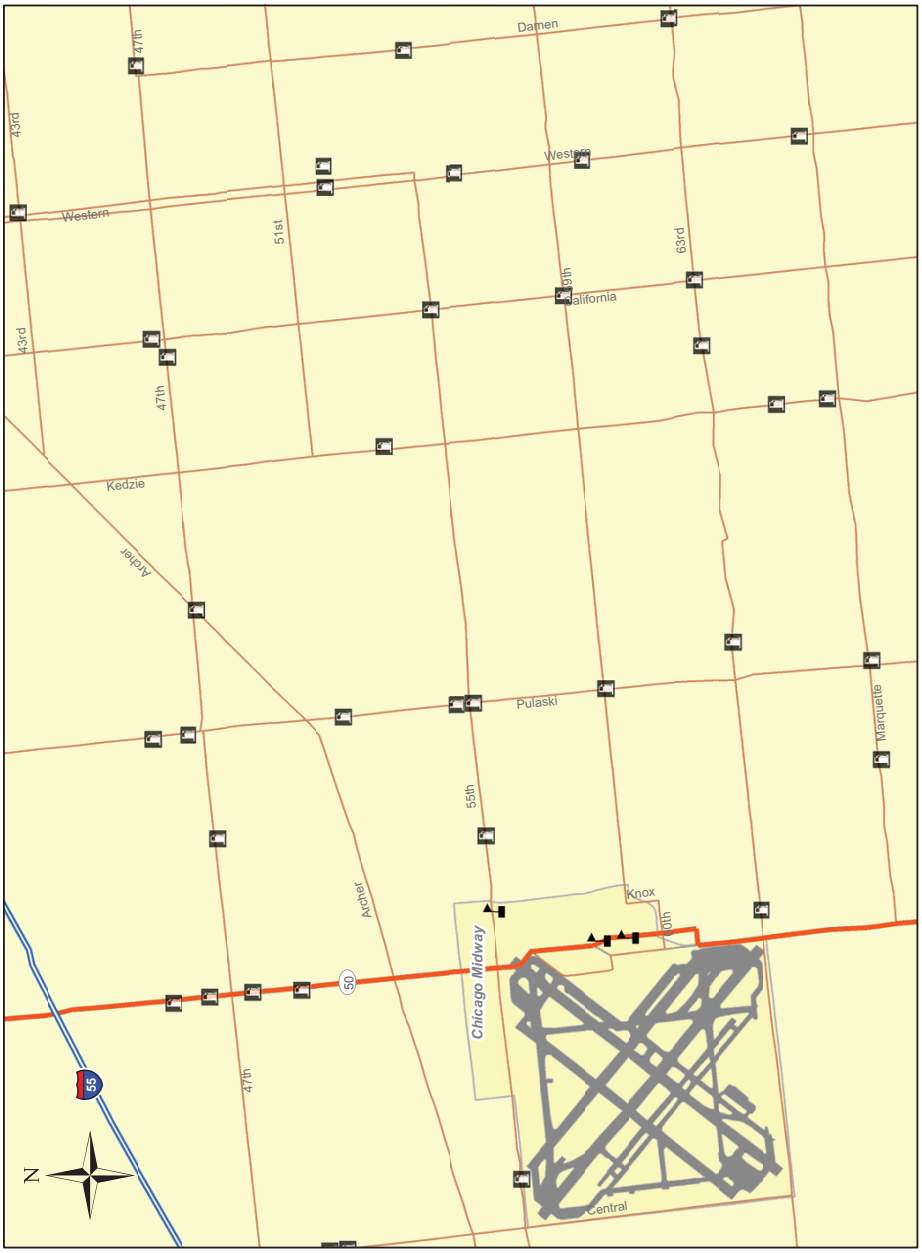

Figure C.19: Chicago Midway International Airport (MDW)

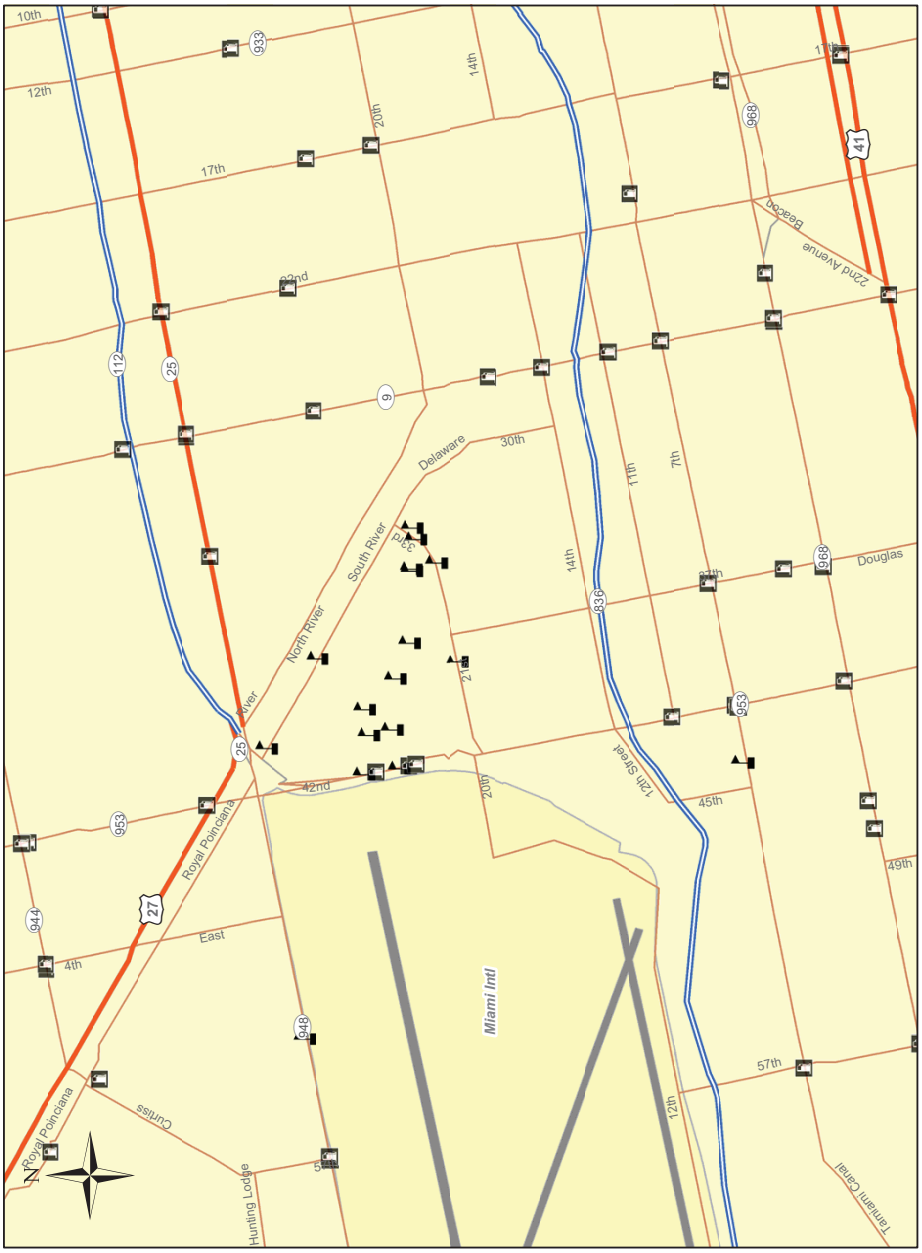

Figure C.20: Miami International Airport (MIA)

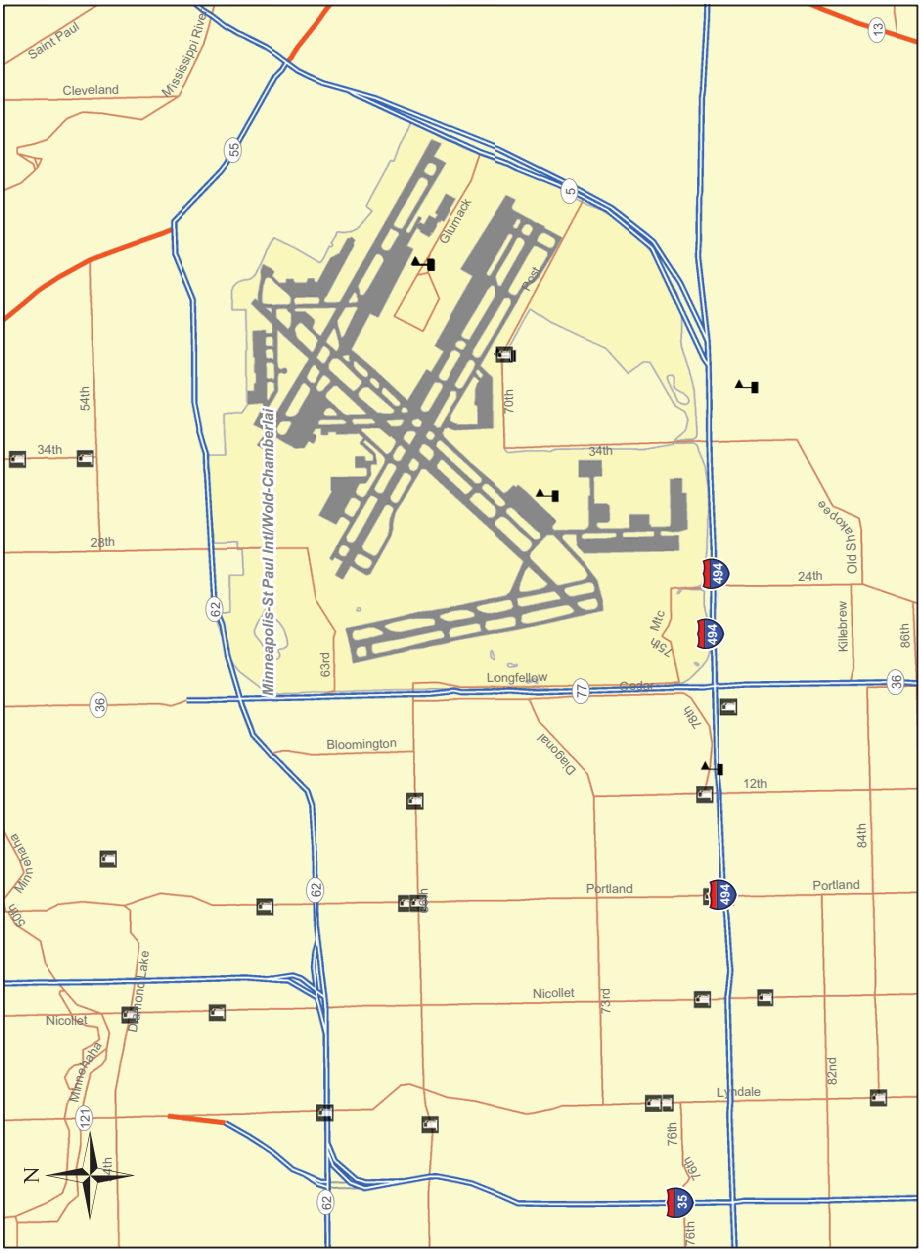

Figure C.21: Minneapolis/St Paul International Wold Chamberlain Airport (MSP)

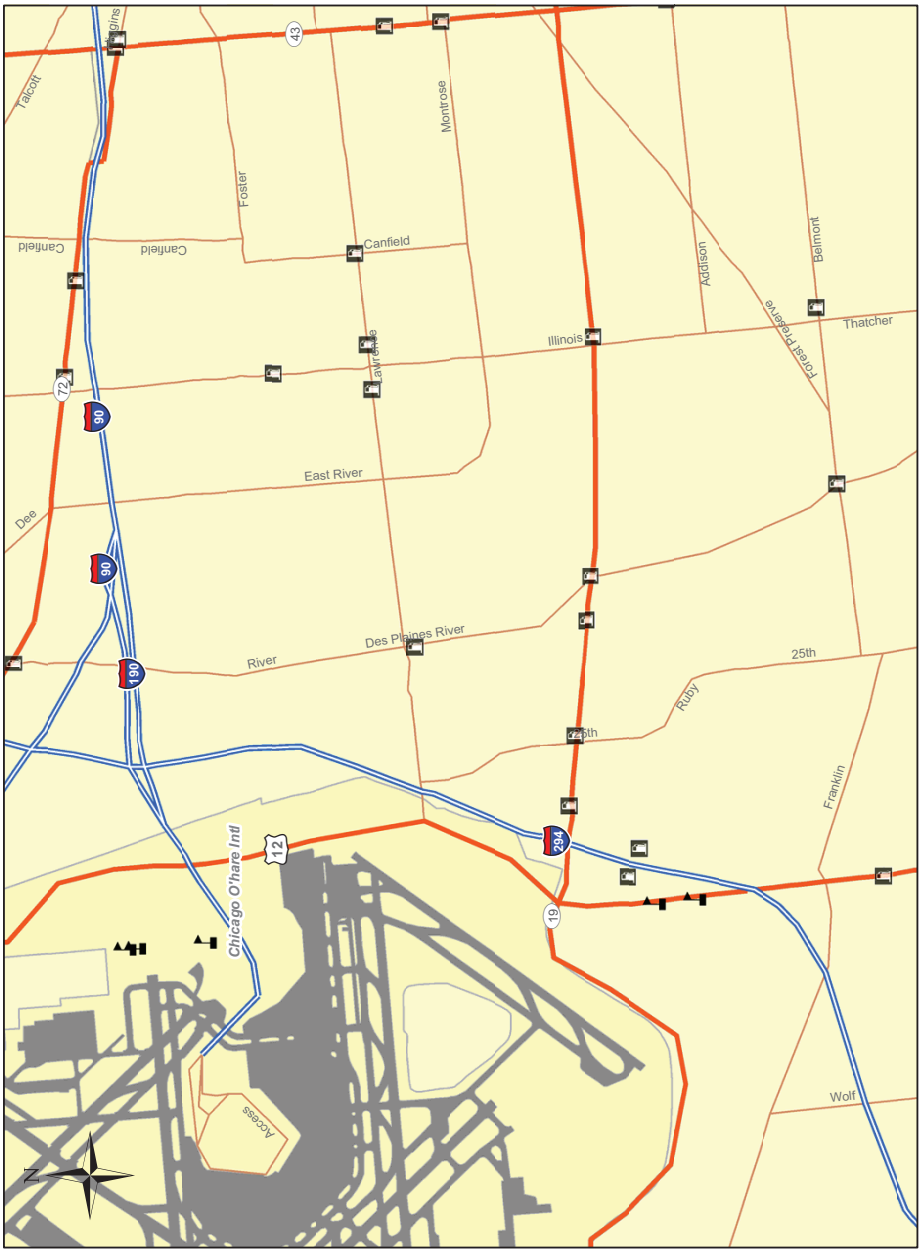

Figure C.22: Chicago O'Hare International Airport (ORD)

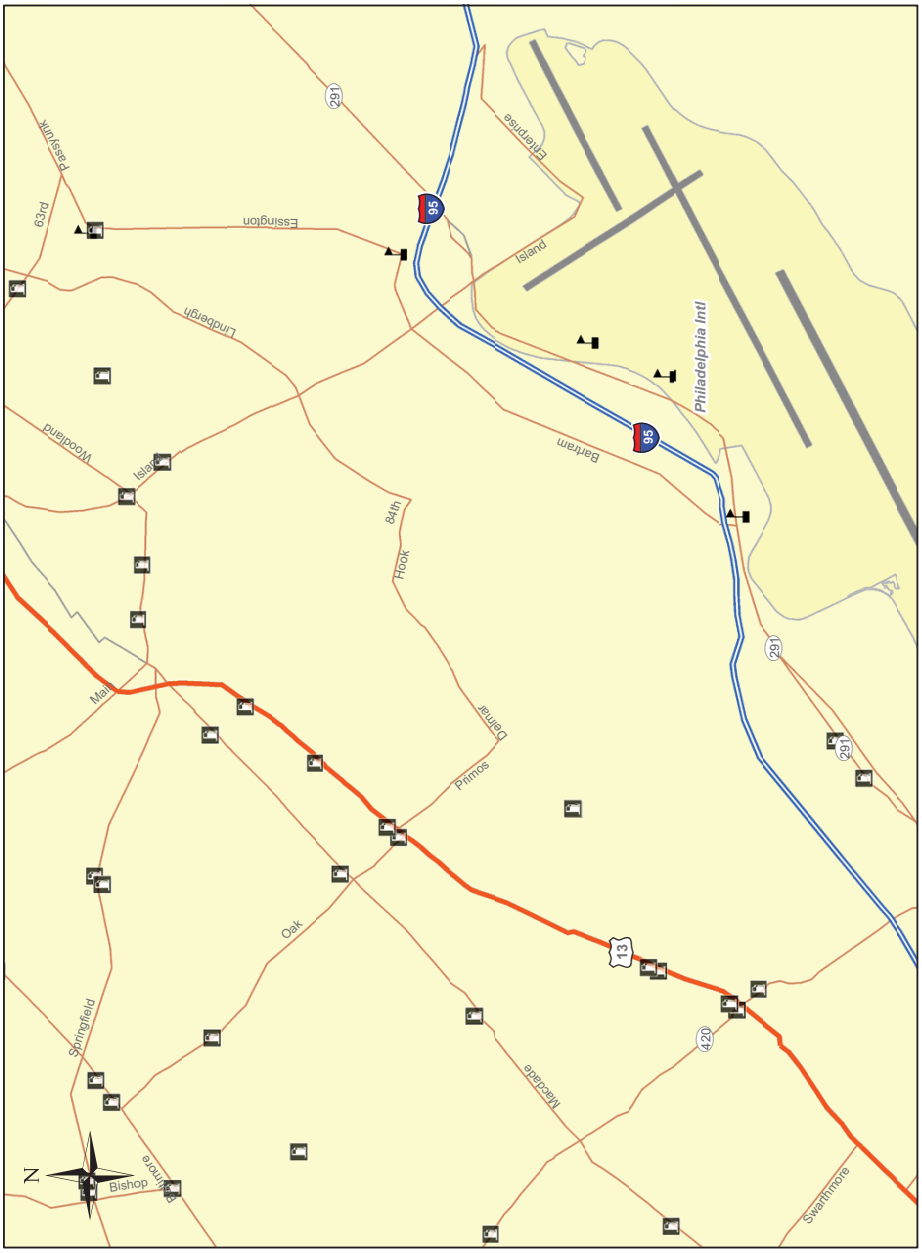

Figure C.23: Philadelphia International Airport (PHL)

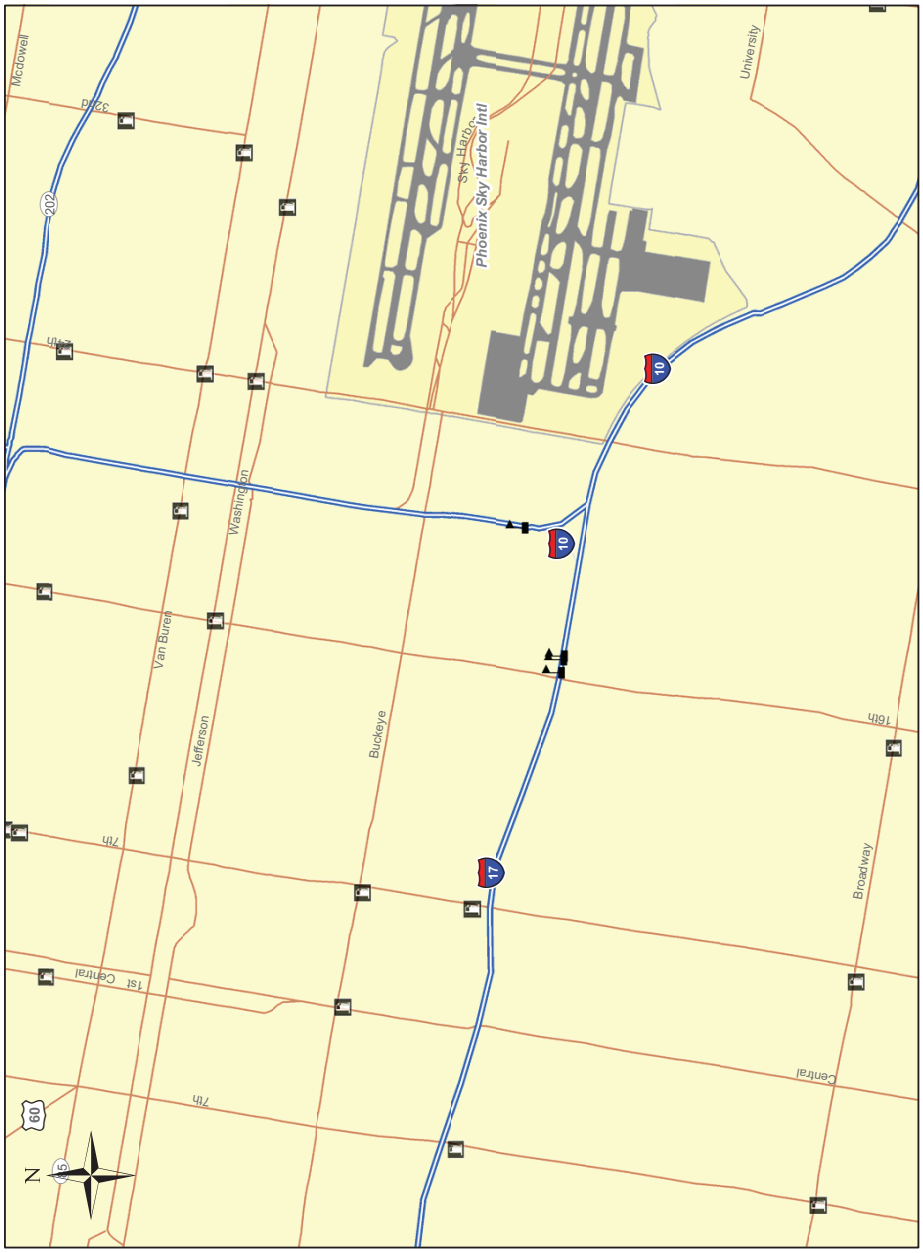

Figure C.24: Phoenix Sky Harbor International Airport (PHX)

Figure C.25: San Diego International Airport (SAN)

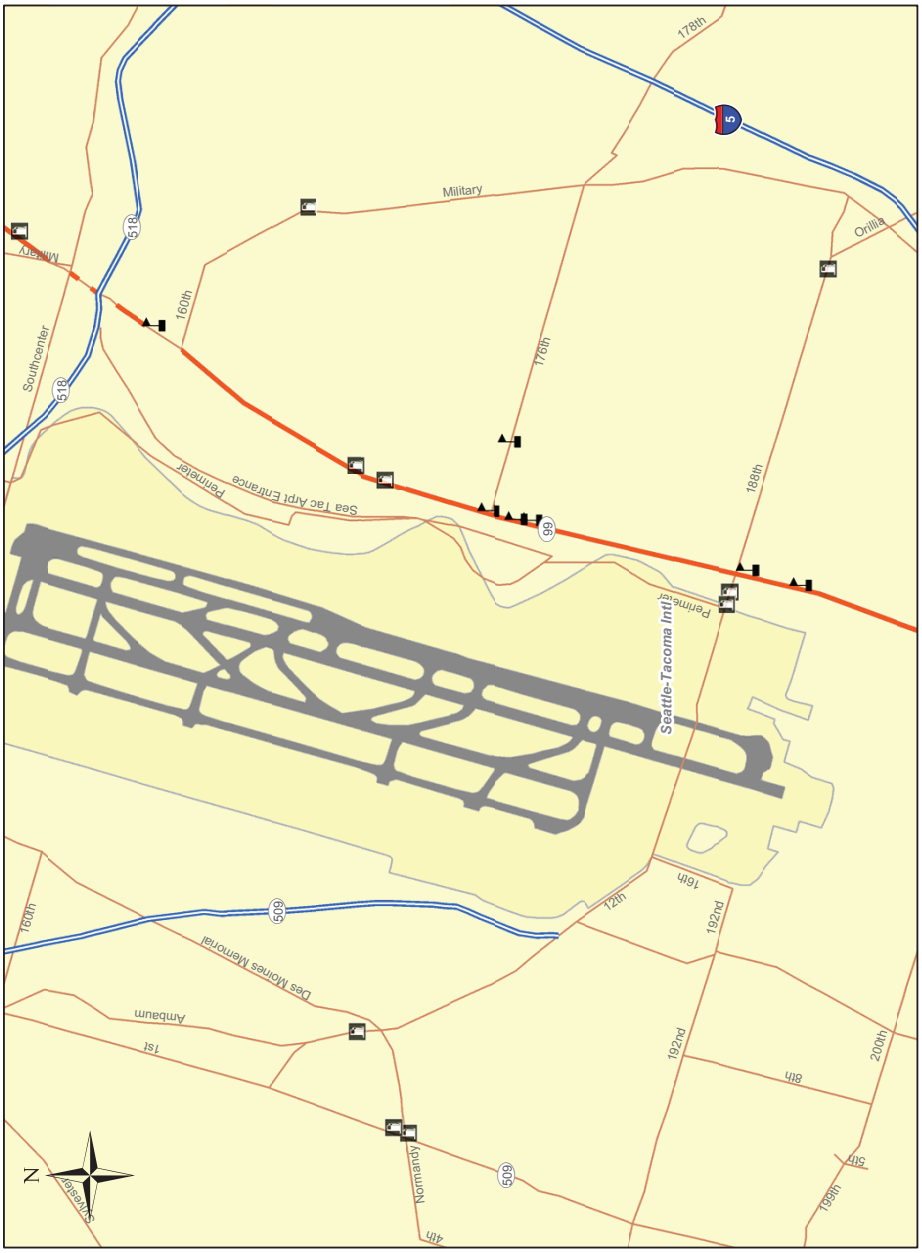

Figure C.26: Seattle/Tacoma International Airport (SEA)

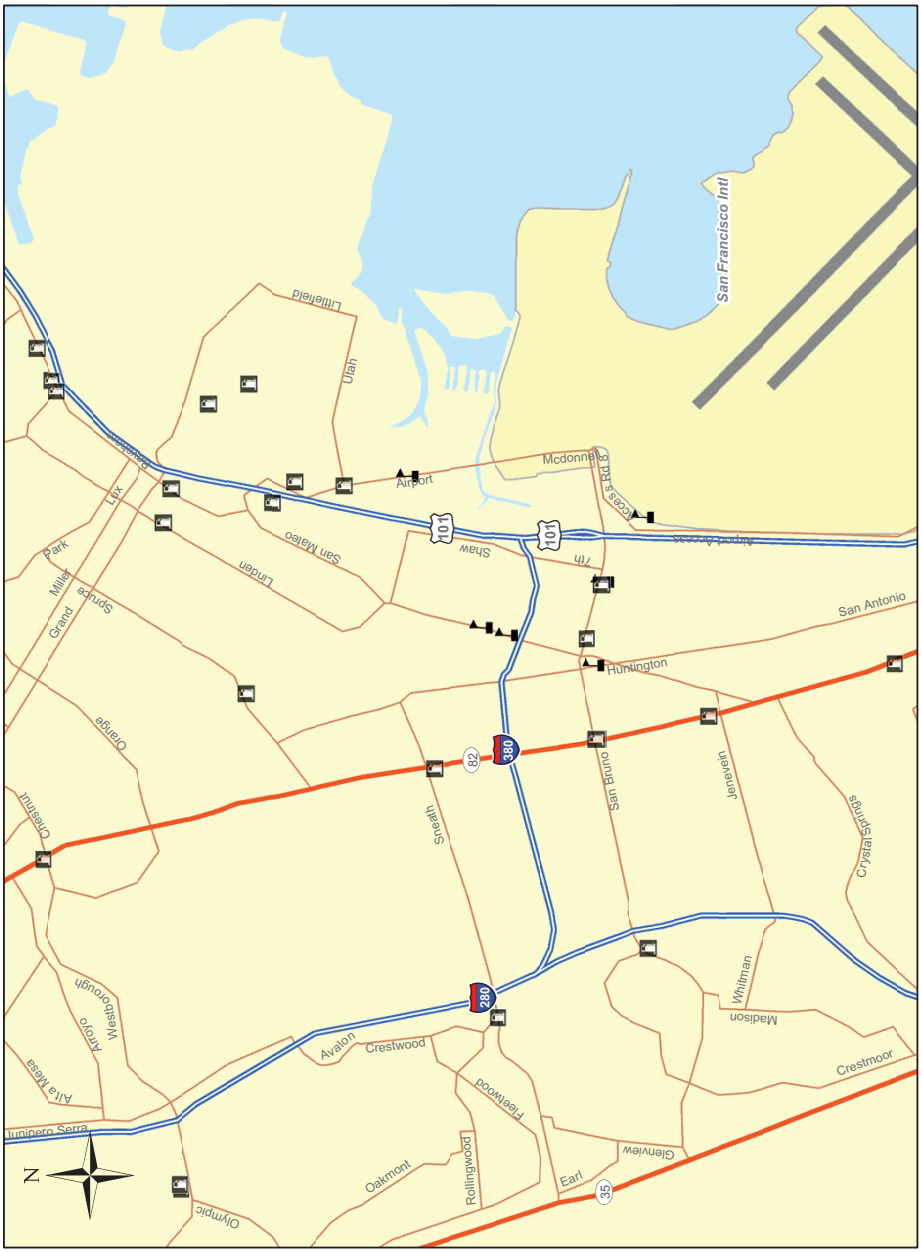

Figure C.27: San Francisco International Airport (SFO)

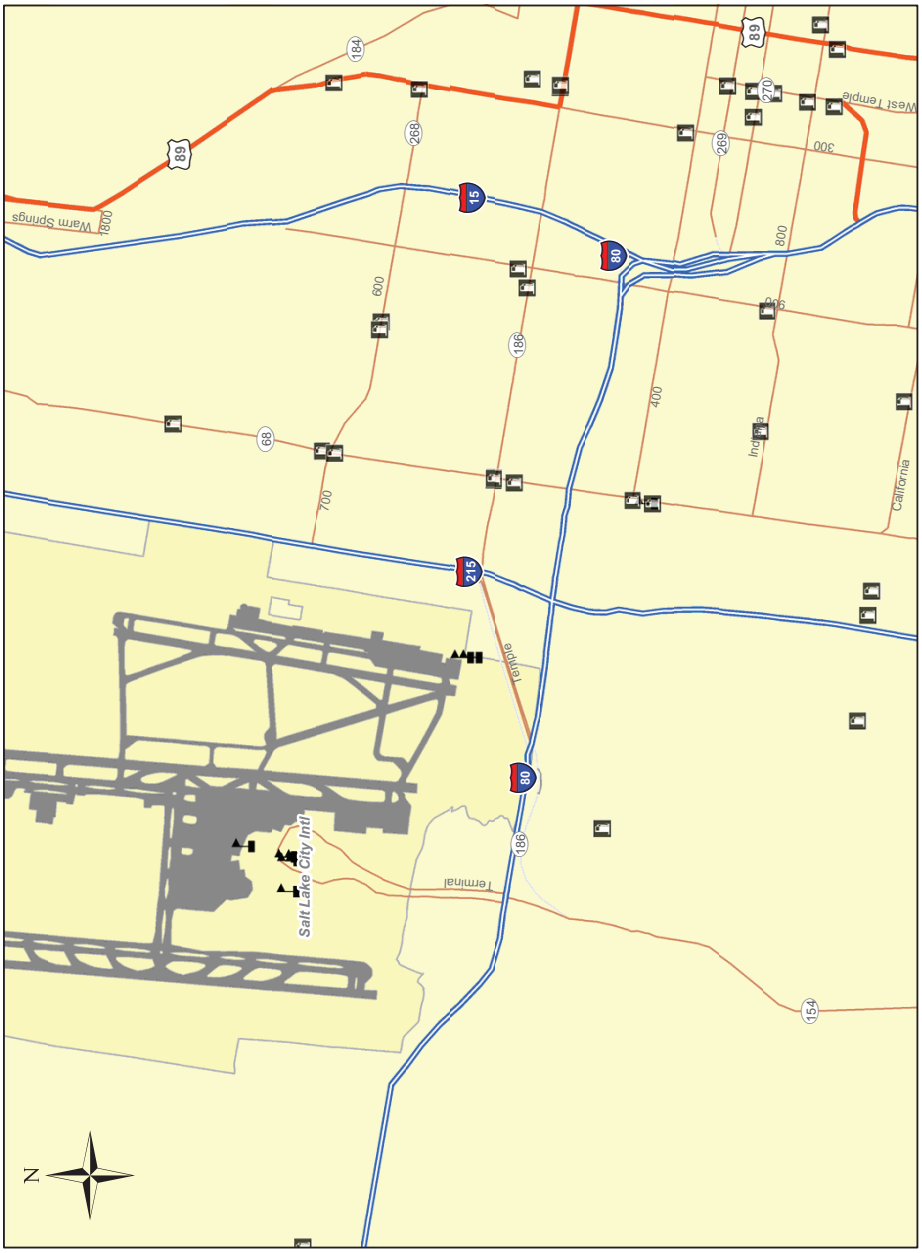

Figure C.28: Salt Lake City International Airport (SLC)

Figure C.29: Tampa International Airport (TPA)

Appendix D

Rental car market

Alamo Rental Policies

Return to Alamo Rental Policies Index

Rental Policies

Additional Driver
Age Requirement
Americans with Disabilities Act
Authorized Driving Areas
Auxiliary Equipment
CID
Cash Rentals
Check-In Days
Confirmation Number
Credit Card Guarantee
Credit Cards
Debit Cards
Driver's License Requirements
Driving Record Eligibility
Early Return Policy
Gas Policy
Gift/Prepaid Cards
Guaranteed Reservations
Handicap / Hand Control Equipped Vehicles
Luxury Car Policy
Master Rental Agreement
Maximum Rental Period
Minimum Rental Period
Mobility Impairments
No Show
One Way Rentals
Primary Renter
Refunds
Rental Agreement
Rental Extensions
Rental Qualifications
Reservation
Responsibility for Rental Vehicle
Saturday Night Stay
Travel Contingency Policy
Visually Impaired
Walkup / Walk-In

Gas Policy

As a customer, you have a choice as to how you would like to pay for fuel.

You will be provided with two options, both starting with a full tank of fuel in your vehicle at the time of rental.

Option 1: Upfront Fuel
This option allows a renter to pay for the full tank of gas at the time of rental and return the tank empty. No refunds will be given for unused gas.

Option 2: Return Full or Pay Alamo for Gas
This option allows a renter to return the vehicle with a full tank of gas or pay Alamo at the end of the rental for gas used but not replaced. Price per gallon/litre will be higher than local fuel prices.

Important Note: For Europeans booking in the US and Canada, unless included in the rate package, payment for this tank will be required at time of rental. No refund will be given for fuel purchased but not used.

The total upfront fuel charge reflected is an estimate based on current prices and the average tank size for the car class reserved. This charge may change upon time of rental.

Exceptions

There are exceptions to this policy for the locations listed below:

Canada
Spain
United Kingdom
United States
South Africa

Exceptions

Canada

Europeans booking in Canada, the rental rate paid may not include the cost for fuel. The vehicle will be received with a full tank of fuel. Unless included in the rate package, payment for this tank will be required at time of rental. No refund will be given for fuel purchased but not used.

Spain

Car is supplied with a full tank, return full or cost will be Euros 12.00 plus tax plus the price of the fuel. There is a Euro 48.08 deposit held against credit card to ensure petrol tank is returned full. For the Balearic Islands only (service provided by Hiper Rent a Car), the policy is as follows: A charge of between 43 and 92 Euros will be held on the customer's credit card depending on the car group. Different petrol deposits are requested depending on where the client is returning the vehicle. No petrol refunds are made at the airport, where clients are kindly asked to return the tank as empty as possible. For Hotel/Office drop-offs, clients are kindly asked to return the tank full in order to get the whole deposit back.

United Kingdom

All rentals will be provided with a full tank of fuel. On rentals of 5 days or longer you will be required to prepay for your fuel at the time of rental. This method eliminates the need for you to refuel the tank prior to returning. The fuel amount charged at time of rental will be based on a market competitive price and the car model rented. We are unable to issue a refund for unused fuel. A fuel deposit will not be required for rentals of 5 days or longer. For rentals of 1 to 4 days a fuel purchase option is available. Ask for further details when picking up your vehicle.

United States

For Europeans booking in the US, the rental rate paid may not include the cost for fuel. The vehicle will be received with a full tank of fuel. Unless included in the rate package, payment for this tank will be required at time of rental. No refund will be given for fuel purchased but not used.

South Africa

A fuel deposit will be required at time of rental. This will be refunded upon return of the vehicle with a full tank of fuel.

© Vanguard Car Rental USA Inc.

Figure D.1: Alamo Rental Car

Fuel

Refueling Options

- Gas Service
- Fuel Service
- Self-Service
- Driving less than 75 miles?

Gas Service: Save yourself time and frustration by adding our Gas Service Option to your next online reservation. By selecting the Gas Service Option, you can purchase a tank of gas directly from Avis at the time of rental, and avoid the hassle of searching for a gas station to fill the tank before returning the car.

If the Gas Service Option isn't exactly what you're looking for, you can choose one of the following refueling options at the time of rental:

> **Fuel Service**: If you decline the Gas Service Option and return the car less than full, you can choose our Fuel Service Option. If you choose the Fuel Service Option and did not purchase gas, you will be charged for the gas used per mile driven at a predetermined rate. If you choose the Fuel Service Option and purchased gas but the tank is less than full, you will be charged a predetermined rate per gallon for the fuel needed to fill the tank.
>
> **Self-Service**: You will purchase fuel just prior to returning and will return the car to Avis with a full tank of gas. If you choose this option, Avis will not charge you for fuel.
>
> **Driving less than 75 miles?** Our newest refueling service for customers who drive less than 75 miles pay a low flat fee for fuel. Now, if you drive less than 75 miles, you can return the car without refueling and we'll automatically charge you a flat fee of $10.50. If you present a receipt for the purchase of fuel, the charge will be removed at the time of return.

Please Note: only the Gas Service Option can be reserved online. If you do not select the Gas Service Option during your online reservation, you can choose a refueling option at the time of rental.

Gas Service Option Terms & Conditions

- Fees for the Gas Service Option are not included in the Estimated Total.
- Fees are assessed and applied at the time of rental.
- Fees vary by location and are determined by current market value of gasoline in surrounding area of rental location and the fuel tank size of rental vehicle.
- Customer will receive no credit or refund for unused fuel left in tank at time of return.
- Customers who drive less than 75 miles will automatically be charged a fee of $10.50. If customer chooses to refuel on their own, they must provide a receipt in order for fee to be modified.

Figure D.2: Avis Rental Car

http://www.dollar.com/AboutUs/GeneralPolicies.aspx

Welcome to Dollar

Contact Us

General Policies

1. GENERAL RENTAL REQUIREMENTS *

[…]

I. **Gasoline Policy:** The renter must refill the gas tank of the vehicle within a 10-mile radius of the rental return facility and present a fuel receipt to avoid a refueling charge unless the renter chooses the prepaid fuel option. If the renter chooses the prepaid fuel option, the renter will pay a specified charge as set forth in the rental agreement and have no obligation to return the vehicle with a full tank of fuel. There is no credit or refund given for any fuel in the tank at the end of the rental. If the renter does not choose the prepaid fuel option and does not return the vehicle with a full tank of gas, the renter will be required to pay a fuel charge to compensate DOLLAR for the cost and service of refueling the vehicle. The fuel charge is based on the estimated number of gallons needed to refill the tank multiplied by the rate per gallon charge specified in the rental agreement. DOLLAR locations may use different methods of estimating the number of gallons needed to refill the tank and these methods of estimation necessarily rely on human judgment. Most DOLLAR locations estimate the number of gallons needed to refill the gas tank either (1) by reading the fuel gauge to estimate the approximate amount of fuel needed to refill the tank (for example, one-half tank) and multiplying that number by the manufacturer's specified fuel tank capacity, or (2) if the renter did not purchase any fuel during the rental, by reading the odometer to determine the amount of miles driven during the rental and dividing that number by the vehicle's estimated average fuel efficiency (miles per gallon) based on the manufacturer's fuel efficiency specifications. When renting in Canada, miles and gallons shall be kilometers and liters.

Figure D.3: Dollar Rental Car

Appendix E

Merger Case History

Having pointed out in Chapter 5 some of the weaknesses that are implicit in the merger review process and how this dissertation sheds some light on the problems, it is also be useful to see how these translate into actual policy decisions, to visualize the ultimate importance of improving the process.

In the case of the gasoline industry, it is in practice very difficult to completely isolate the competitive effects of mergers in the lower chain of production (the retail marketing of gasoline), since it is in most cases highly integrated vertically (as discussed in Chapter 2). So, the analysis in this section looks at all the mergers in the petroleum industry between 1981 and 2007, but focuses the discussion on drawing conclusions for the retailing of gasoline, and identifying cases where the decisions of the FTC may be have been improved.

Table E.1 lists all the major merger investigations by the FTC since 1981. In general, the merger of large petroleum firms implies that more than one market is

affected. Column 3 shows which markets are affected for each of the mergers in which the retail gasoline market was under scrutiny. For example, in the Exxon/Mobil merger of 2001, the marketing of gasoline in numerous separate markets in 23 western and southern states along with the marketing of CARB gasoline in California were thoroughly and directly investigated. Column 4 presents the decisions by the FTC in each of the mergers, that affected the retail gasoline market. It must be noted that even when the retail market per se is not explicitly investigated, enforcement actions are sometimes taken to prevent the effects of anticompetitive markets in a more upstream market. For instance, in the merger of Valero and Ultramar Diamond Shamrock Corporation, the FTC asked the new firm to divest 70 USD company-op retail outlets in order to address concerns in the refinery and bulk supply of CARB gasoline in some areas of Northern California.[1]

The FTC does not always see mergers in the petroleum industry as a threat to competition in the retail gasoline market. For example, in the Phillips/Tosco merger of 2001 the two merging parties' businesses did not overlap significantly, and where they did, the FTC considered that their market share was not a cause for concern, so they let the merger happen without any need for action.[2]

More significantly, however, sometimes FTC action can result in a total termination of the merger. Three of the earliest merger reviews by the FTC that raised concerns in the marketing of gasoline and other refined products ended in withdrawals

[1]Consent Order In the Matter of Valero Energy Corporation and Ultramar Diamond Shamrock Corporation - File No. 011-0141 Docket No. C-4031

[2]Statement of the Commission- Phillips Petroleum Corporation/Tosco Corporation - File No. 011-0095

of the tender offers, and thus the merger did not take place. Such were the cases of the attempted Mobil/Marathon merger in 1981, the Gulf/Cities Service merger in 1982 and the Pacific Resources/Shell merger of 1987. In the Mobil/Marathon complaint, the FTC argued that the merger would "enhance Mobil's market power", increasing concentration and prices in already concentrated markets. (FTC, 2004)

A third group of mergers were allowed to take place, but the FTC proposed corrections directed at preventing anticompetitive practices. In the early cases, the decisions that affected the retailing industry were mostly related to problems in the upstream levels of production. The FTC found in these cases that the merger under consideration would directly affect the competitive viability of several levels of the chain, mainly the refinery level and the terminaling of light petroleum products, as well as the marketing level. For example, in both the Chevron/Gulf and the Texaco/Getty mergers, the FTC required the divestiture of refineries and marketing assets in different areas of the country to prevent "a reduction in regional competition".[3] Another later example is related to the divestitures connected with the merger of Phillips and Conoco in Colorado and Utah. They were a result of concerns at the bulk supply level, but not directly related with retailing. So, in all these cases, it is difficult to infer what the FTC's implicit assumptions of the markets were, such as how they were defining the market, because the problems of overlapped significantly at the main levels of production.

[3]Statement of The Federal Trade Commission before the Committee on Commerce, Subcommittee on Energy and Power, U.S. House of Representatives, William J. Baer, Director, Bureau of Competition, March 10, 1999. Available at http://www.ftc.gov/os/1999/03/exxonmobiltestimony.htm

More recent cases that raise similar problems include the Aloha/Trustreet Properties merger in Oahu, Hawaii of 2007. According to the FTC, Aloha and Trustreet (Mahalo) were two of the lowest priced gasoline retailers in Oahu. The Commission argued that the merger would increase their market share significantly, that entry by other firms would be improbable in the short term, and this situation would result in higher prices to consumers. The downstream issue was closely tied with the fact that the merging firms had also significant control of the terminals in the island. By executing a 20 year throughput agreement with a competitor (Mid Pac) the FTC withdrew its complaint arguing the deal would "preserve competition allegedly threatened by the acquisition".[4]

In the Shell/Texaco merger, however, the FTC alleged that the merger would reduce competition at the marketing level, independent of any overlaps with the refinery or terminal level (FTC, 2004). In particular, the FTC noted that in the San Diego, California area, only six vertically integrated companies were in combination selling 90 percent of the gasoline, and that this particular transaction would provide the new merged company with enough market power to harm competition.[5] They noted that entry to the market was very limited due mainly to "slow population growth, limited availability of retail sites, and permitting requirements." So, the

[4]Aloha Petroleum Ltd, FTC File No. 051 0131, July, 2005 (complaint)

[5]The complaint reads: "The effect of the Joint Venture, if consummated, may be substantially to lessen competition in the wholesale and retail sales of CARB gasoline in San Diego County, California, [...] in the following ways, among others:

a. by eliminating direct competition in the wholesale and retail sales of CARB gasoline; and

b. by increasing the likelihood of, or facilitating, collusion or coordinated interaction between the combination of Shell and Texaco and their competitors in San Diego County, California; each of which increases the likelihood that the price of CARB gasoline will increase in San Diego County, California."

Commission required divestitures of retail outlets to a single acquirer to remedy the lessening of competition.

The BP/Amoco merger of 1998 is a good illustration on how sensitive to assumptions policy decisions are, and how this dissertation takes a step towards a sounder understanding of the market. This case generated concerns due to a significant decrease in the Herfindahl-Hirshman Index in the retailing of gasoline in several markets. The divestitures of retail assets ordered by the Commission expanded to about thirty geographic areas, and places operating under contracts were freed to switch to other wholesalers. The main concern in this case was that there would be little flexibility in the choice of wholesaler in those markets by the retailers, although there is documented dissent by at least one Commissioner on this matter. This dissent brings to light the issue that many complaints by the FTC, even when based on deep industry studies, require a degree of speculation in terms of what might happen once the merger takes place, and that new information on the pricing strategies of firms under different scenarios would be a useful addition to the FTC expertise in the matter.

In later cases, upstream competitiveness was also cited as a reason for divestitures in the retail market. In the Exxon/Mobil case, the FTC required the merging parties to divest "approximately 85 owned or leased Exxon stores and assign supply agreements for approximately 275 additional stores in California [...] to remedy the reduction in competition in the refining and marketing of CARB gasoline and navy jet fuel alleged".[6] The FTC argued that Exxon and Mobil had sufficiently

[6]Analysis of Proposed Consent Order to Aid Public Comment, 1999.

large overlaps in certain markets, and potential new entrants would not have enough power to prevent anticompetitive behaviors. An interesting feature of this case is that even though not all the markets under study raised anticompetitive concerns, the requirement was made across the board, being justified by the following statement: "effective relief required maintaining the business and organizational integrity of the divested brands across these broad geographic areas". This type of blanket decision has serious economic implications for markets in which competition is not threatened, and again points out to the necessity to better understand the market.

The Chevron/Texaco merger raised similar concerns, but the FTC requests did not involve station divestitures per se. What the FTC did require, though, was that Texaco should divest all interest in two joint ventures with Shell (Equilon and Motiva) that were responsible for what at the time was the single most important refiner and marketer in the US. This divestiture of interest precluded a reduction in competition in the retail gasoline outlets.[7]

[7]Chevron Corp., FTC Docket No. C-4023, January, 2002 (consent order)

Firms	Year	Gasoline Marketing Directly Investigated	FTC Enforcement Action Regarding Retail Market
Mobil/ Marathon	1981		Termination of Merger (retail market concerns)
Gulf/Cities Service	1982		Termination of Merger (retail market concerns)
Chevron/ Gulf	1984		Divestiture of all Gulf marketing assets in six states and parts of South Carolina
Texaco/Getty	1984		Divestiture of a refinery and marketing operations in the northeast
Conoco/ Asamera	1986		Termination of Merger (no retail market concerns)
Pacific Resources (PRI)/Shell	1987		Termination of Merger (concerns in retail market in Hawaii)
Sun/Atlantic	1988		Action does not include retail market
Sun/Chevron	1994		No relief required
Tosco/Unocal	1997		No relief required
Arco/Thrifty	1997		No relief required
Shell/Texaco	1997	CARB gasoline marketing in San Diego County, California and marketing of gasoline on the island of Oahu, Hawaii	Divestiture to a single entity of retail outlets with specified individual and combined volume, divestiture of either Shells or Texacos terminal and associated , divestiture of terminal and associated owned retail outlets in each area retail outlets in Oahu
BP/ Amoco	1998		Divestiture of BPs or Amocos owned retail outlets in eight geographic areas; in all 30 areas jobbers and open dealers given option to cancel without penalty
Marathon/Ashland	1998		No relief required
Marathon Ashland/ Ultramar Diamond Shamrock	1999		No relief required
Exxon/ Mobil	1999	Gasoline marketing in at least 39 metro areas in the Northeast (Maine to New York) and Mid-Atlantic (New Jersey to Virginia) regions of the U.S. , five metro areas in Texas, in Arizona (potential competition), marketing of CARB gasoline in California, gasoline marketing assets on Guam	Divestiture of all Exxon (Mobil) owned outlets and assignment of agreements in the Northeast (Mid-Atlantic) region, divestiture of Mobil's retail outlets in Texas, Termination of Exxon's option to repurchase retail outlets in Arizona, divestiture of all of Exxon's marketing assets in CA and Guam
BP/ARCO	2000		FTC filed in federal District Court, then reached consent; divestiture of all of ARCOs Alaska assets
Valero/UDS	2001		Divestiture of UDS 70 owned and operated retail outlets
Phillips/Tosco	2001		No relief required
Chevron/ Texaco	2001	Gasoline marketing in numerous separate markets in 23 western and southern states and marketing of CARB gasoline in California	Divestiture (to Shell, the other owner of Equilon) of Texacos interests in the Equilon and Motiva joint ventures
Shell/Pennzoil Quaker State	2002		Action does not include retail market
Phillips/ Conoco	2002		Divestiture of all of Phillips marketing assets in eastern Colorado and northern Utah
Sunoco/Coastal Eagle Poing	2004		No relief required
Shell/Buckeye	2004		Action does not include retail market
Magellan/ Shell5	2004		Action does not include retail market
Aloha/Trustreet	2005	Gasoline marketing in Hawaii and Oahu	Complaint resolved with 20 year terminal throughput agreement for new gasoline marketer
Chevron/Unocal	2005	Marketing and refining of CARB RFG in California and smaller markets therein	Chevrons constrained from enforcing Unocals patents on CARB RFG
Valero/Kaneb	2005		Action does not include retail market
Western Refining/ Giant Industries	2007		Action does not include retail market
Kinder Morgan/Carlyle Group and Riverstone Holdings	2007		Action does not include retail market

Table E.1: Selected Mergers Surveyed by FTC Since 1981

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