Measuring the Effects of Sales Below Cost Laws in Retail Gasoline Markets

by

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ABSTRACT

The retail gasoline market in some states is regulated by laws that prohibit the sale of gasoline at prices below the retailer's cost. The stated purpose of these laws is to offer protection from predatory pricing, a practice whereby one firm seeks to eliminate its competition through loss inducing prices. However, the assumption that predatory pricing is occurring in the retail gasoline business is questionable. If predatory pricing is not occurring, the laws may instead protect less efficient firms by establishing a price floor that results in higher prices for consumers.

To test this hypothesis, retail margins in states with and without such laws are examined. The results suggest that retail margins tend to be slightly higher in states where sales below cost laws are effective. These results are not consistent with the idea that predatory pricing is a frequently occurring phenomenon in the retail gasoline sector.

CHAPTER 1

INTRODUCTION

Legislation that has the intent of protecting consumers is often predicated on the fear of market power and monopoly prices. Since predatory pricing may ultimately lead to higher prices, it is one of the strategies that laws supposedly guard against. In the United States, this concern dates to the conception of antitrust laws, most notably the Sherman Act (U.S.C., title 15, sec. 1-7) of 1890.[1] A current example is found at the state level where laws in 11 states explicitly prohibit the sale of gasoline at prices below cost. It is argued that absent these laws, firms would temporarily lower prices with the intent of eliminating competition. The ultimate objective is monopoly profits after the victims have departed the market.

If predatory pricing is occurring in the retail gasoline business, such laws, if effective, could protect competition and consumers. But if the structure of the industry is not conducive to predatory pricing, the laws could instead lead to inefficiency by restricting competition and decreasing social welfare. In this case, it is likely that the laws are the result of special interest groups, motivated by a concern for their own well-being.

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[1]Robert H. Bork, The Antitrust Paradox, (New York, NY: Basic Books, Inc., 1978), 19.

These laws are referred to as Sales Below Cost (SBC) laws and the objective of this thesis is to measure the effects of gasoline specific SBC laws on prices paid by consumers. Chapter 2 of this thesis provides an understanding of the relationship between predatory pricing and SBC laws. The analysis presented offers an indication of the likelihood of predatory behavior in the retail gasoline business. By definition, predatory pricing requires a level of prices that are below some measure of cost. It is therefore necessary for SBC laws to define this level in a measurable way. But if such a definition is restrictive in terms of eliminating the low prices of more efficient firms, retail margins could be higher.[2] In providing a definition, we appeal to economic theory and utilize a rule developed by Phillip Areeda and Donald F. Turner.[3] By comparing Areeda and Turner's rule with the SBC laws' definition of predatory pricing, a sense of whether these laws are pro or anti consumer is provided.

Following this analysis, it is argued that these laws are unlikely to enhance competition. Instead, they create a binding price floor so that retail margins will be higher in states with gasoline specific SBC laws. It should be emphasized that this hypothesis is conditional on the premise that SBC laws do in fact constrain behavior. Thus, in addition to the above, it is hypothesized that if the laws generally constrain pricing behavior retail prices in states with SBC laws will respond more quickly to increases in wholesale prices.

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[2]The reason for using the retail margin is explained in Chapter 3.

[3]Phillip Areeda and Donald F. Turner, "Predatory Pricing and Related Practices Under Section 2 of the Sherman Act," Harvard Law Review 88:697-733 (1975).

The data to empirically test the hypothesis is described in Chapter 3. In addition, evidence of the laws' effects are obtained by examining related legal cases. Further evidence is sought by comparing the descriptive statistics of states with and without SBC laws. A graphical analysis for Montana is also utilized. Given this preliminary examination, Chapter 4 offers empirical tests of the effects of the SBC laws. Models are developed to test the hypothesis and their results are presented. Conclusions are also drawn concerning predatory pricing in the retail gasoline business. Chapter 5 summarizes the connection between the theory of predatory pricing, implications of SBC laws, and the results of the empirical tests. The results do not support the notion that SBC laws protect consumers.

CHAPTER 2

PREDATORY PRICING THEORY AND IMPLICATIONS OF SALES BELOW COST LAWS

Sales Below Cost Laws and Predatory Pricing

Proponents of Sales Below Cost (SBC) laws have often argued that these laws are necessary because of a perceived threat of predatory pricing. State legislators indicate concern over a decrease in competition due to a decrease in the number of independent gasoline retailers.[1] It is argued that oil companies, refiners, and other petroleum marketers have the capability and willingness to set their prices below cost for the purpose of eliminating their competition.

These predatory pricing practices are generally alleged to follow a particular pattern. First, the retail price of a gallon of gasoline is set below a level that allows an individual retail outlet to recoup the costs incurred in selling a gallon of gasoline. Wholesale gasoline prices and taxes constitute the majority of these costs, but the additional costs of doing business, such as labor, are included. Second, marketers with multiple retail locations use profits from one location to subsidize below cost prices at

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[1]See, Montana. Montana Retail Motor Fuel Marketing Act, Code, Annotated 30-14-802, and Alabama. Motor Fuel Marketing Act, Statutes, Annotated 8-22-2.

another retail location, or individual retail outlets use profits from non-motor fuels products to subsidize prices on motor fuels. The sale of cigarettes, for example, may be used to subsidize the price of motor fuels. Third, vertically integrated oil companies use profits from upstream operations to subsidize motor fuels prices at their retail stations. For example, Exxon would use profits from its refinery operations to subsidize prices at Exxon owned stations.

These alleged practices describe a situation in which a company is willing to incur additional costs for a period of time so that its competitors can be eliminated. In the short run, prices are lowered below costs and are subsidized by other products, outlets, or the wealth of the predator. The intended victim must follow the lower prices, thus incurring losses. The predator likewise incurs losses during this period, but is capable of maintaining these losses for a longer period of time than the victim. Eventually, the victim is unable to endure the costs of the predatory campaign and is driven out of business. In a simple market with only two competitors and no entry into the market, the predator supposedly has sufficient market power to capture monopoly profits. The losses incurred during the predatory campaign are presumably recaptured by higher monopoly prices in the post predation period.

The assumption that such predatory practices are occurring should be prefaced with several important questions. First, is it rational for a firm to engage in a predatory campaign, and if so, under what conditions? Second, how can it be determined if the pricing policies of a particular company imply predatory intent? Answers to these questions require a measure of cost and a definition of when prices below that measure of

cost are predatory.

The SBC laws relating to motor fuels products do not deal explicitly with the first of these questions. However, since the underlying assumption is that predatory practices occur frequently enough to warrant legislative action, it could be assumed that the general belief is that predatory behavior is a rational strategy and that the conditions necessary for this practice to be successful are present. The majority of the laws do, however, define cost and a make a price below this level predatory.

Economics and Predatory Pricing

Economic theory offers guidance for analyzing the issue of predatory pricing. A starting point is to ask the question - what are the conditions under which predatory pricing is likely to occur? Several necessary conditions are generally accepted.

First, the predator firm must have an advantage over the intended victim. If both firms are identical, in terms of their cost functions, the predator will incur greater losses during the period of predation than the victim. As the predator decreases price, the victim must follow or risk losing business. When this happens, however, a price taking firm will also decrease the quantity it is willing to sell. Since the quantity demanded at the lower price is greater and the victim is selling a lower quantity, the predator must increase sales.[2] Thus, the predator's losses will be greater than those of the victim. If competing firms realize this, the threat of predatory pricing is not credible. Moreover, the predator

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[2]If the price elasticity within the industry is relatively low in the short run this effect may be weak.

must realize this as well. Therefore, when the firms involved are identical, the victim would be better off than the predator during and after the predatory campaign, making it highly unlikely that predatory behavior would occur.

On the other hand, if the predator has a cost advantage over a competitor, she can conceivably set a price that results in losses during the period of predation that are less than those of the victim. If the victim cannot incur losses for as long as the predator, predation may be successful. The threat of predatory pricing then becomes credible, and may be a rational, wealth maximizing strategy.

The cost advantage does not, however, guarantee that the victim of a predatory campaign will exit the market. Several factors may affect this decision. Most notably, predatory pricing is illegal under U.S. antitrust law.[3] Section 2 of the Sherman Act (U.S.C., title 15, sec. 1-7) prohibits actions to monopolize a market. The Robinson-Patman Act (U.S.C., title 15, sec. 13), also deals with sales at low prices for the intent of eliminating competition. Since firms found guilty of predatory behavior may be subject to treble damages in private suit, the antitrust statutes can act as a deterrent to predatory pricing. Second, the acquisition of outside financing is generally available. If the victim believed that the predatory prices could not be maintained for a long period of time, it may be in her best interest to obtain outside financing until prices returned to their normal level. Finally, the argument can be made that the victim may maintain a presence

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[3]The gasoline SBC laws are industry specific laws that go beyond the Sherman Act (U.S.C., title 15, sec. 1-7) and Robinson-Patman Act (U.S.C., title 15, sec. 13) to protect independent gasoline dealers.

because she realizes the lower prices as predatory and not a change in the market or the level of competition. McGee argues that in such a case, a victim of predatory pricing would certainly want to maintain her presence since prices will, at worst, revert back to their previous levels.[4]

Besides the predator having a cost advantage, the second condition that must be met is that the future expected benefits of predation must outweigh the costs. Predatory pricing strategies are costly, both to the predator and the victim. It would seem plausible, therefore, to expect that a firm considering a predatory pricing strategy would not do so if the costs were greater than the expected gain. The question then becomes - what are these costs and is their magnitude offset by the future gains? The higher these costs appear to be, the less likely is predatory behavior. The magnitude of the costs will largely depend on the structure of the industry and the length of the predatory period. However, it is possible to obtain a general perspective of the potential costs facing a would-be predator.

The most obvious of these costs is incurred through setting a price that yields less than a normal rate of return. It has already been pointed out that these costs will be heightened by the need on the part of the predator to expand output. Of additional interest, however, is the discounted value of future profits. Correctly analyzing the situation faced by the predator requires the realization that one dollar received in the future does not equal one dollar today. In present value terms, and at an interest rate of

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[4]John S. McGee, "Predatory Pricing Revisited," The Journal of Law and Economics 23, no. 2 (Oct. 1980): 296.

10 percent, one dollar received one year from now is worth slightly less than 91 cents. If that same dollar is not received until 10 years from the present date, it is worth a little less than 39 cents. As you go further out in time long term predatory practices become increasingly costly and it becomes less likely that future benefits will outweigh the costs of predation. The U.S. Supreme Court's 1986 decision in Matsushita Electric Industrial Co., Ltd. v.Zenith Radio Corporation et al. 106 S. Ct. 1348 (1986) exemplifies this point. U.S. firms charged that below cost pricing had been used by several Japanese firms with predatory intent. The allegation that this practice had been occurring for 20 years led the Court to rule in favor of Matsushita, stating that it was unlikely that any firm could carry out a predatory strategy over a period of 20 years.[5]

Additionally, if the predatory strategy is to be successful, the current competition must not only be driven out of business, but must be kept from re-entering the market at some point in the future. Likewise, other potential competitors must be discouraged from entering if the current competition is eliminated. Realizing that she must somehow limit future entry, the predator must make it difficult, or preferably impossible, for the competitor to return or a new competitor to move in. Even if the predation is successful, the assets of the firm will remain and offer an opportunity for a relatively easy return by the victim or someone else. A solution to this dilemma is for the predator to not only eliminate the competitor, but her assets as well. Unless the value of the assets have for some reason been substantially depreciated, purchasing them is likely to be a costly

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[5]Matsushita Electric Industrial Co., Ltd. v Zenith Radio Corporation et al., 106 S.Ct. 1348 (1986).

endeavor. Yet, to protect the market power the predator fought for, she must either incur this cost, or somehow make the assets unavailable to others.

It follows from the above that if the industry is characterized by barriers to entry, predation may be more attractive. Given substantial barriers to entry, a firm that gains monopoly power will find it easier to protect its position when prices are eventually elevated. The barriers to entry or advantages possessed by the incumbent firm have been classified in three ways by Joe Bain.[6] Bain argues that entry can occur easily in the absence of 1) an absolute cost advantage, 2) advantages resulting from product differentiation, and 3) significant economies of large scale. As an industry moves away from a definition of easy entry, an incumbent firm will be characterized by at least one of these three advantages. Each of these advantages implies that a potential entrant will face a relatively higher level of costs than the incumbent currently incurs or has incurred. If this is true, the new entrant will have difficulty if the incumbent firm lowers price even to the level of its current average costs. A similar result may occur if the industry is characterized by high sunk costs. In the presence of a credible predatory threat, a potential entrant may be discouraged from entering the market if the firm faces the future probability of later being driven from the market and thus forfeiting the resources associated with the sunk costs.[7]

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[6]Joe S. Bain, Barriers to New Competition (Cambridge: Harvard University Press, 1956), 12.

[7]Dennis W. Carlton and Jeffrey M. Perloff, Modern Industrial Organization, 2d ed. (New York: Harper Collins College Publishers, 1994), 387.

With these conditions and their caveats in mind, we now consider the relationship between costs and the determination of when a price is predatory. The difficulty of accurately measuring costs and deciding which costs to consider has led to considerable debate over this issue. At the heart of this debate is a concern over destroying legitimate competition through a definition of cost that fails to capture true predatory intent. Motivated by this concern, Phillip Areeda and Donald F. Turner sought to apply economic analysis to a workable definition of predatory pricing.[8] In doing so they hoped to offer a well reasoned means by which a predatory price could be distinguished from competitive pricing. Their analysis and the resulting rule they propose for the determination of a predatory price is worth examining as it has been used in practice by the courts.[9]

The Areeda and Turner rule, as it has become known, is based on the relationship between price and the basic measures of cost used in economic theory. Following their lead, a graphical representation of average cost, average variable cost, and marginal cost will be utilized. Figure 1 shows the typical cost functions for a firm. In a perfectly competitive market, each firm takes the price as given, and as such, faces a horizontal demand function at the competitive price. Profit maximization requires that price equals marginal cost. In the long run, all firms earn zero economic profits so that the competitive price will be dictated by the intersection of marginal cost and the local

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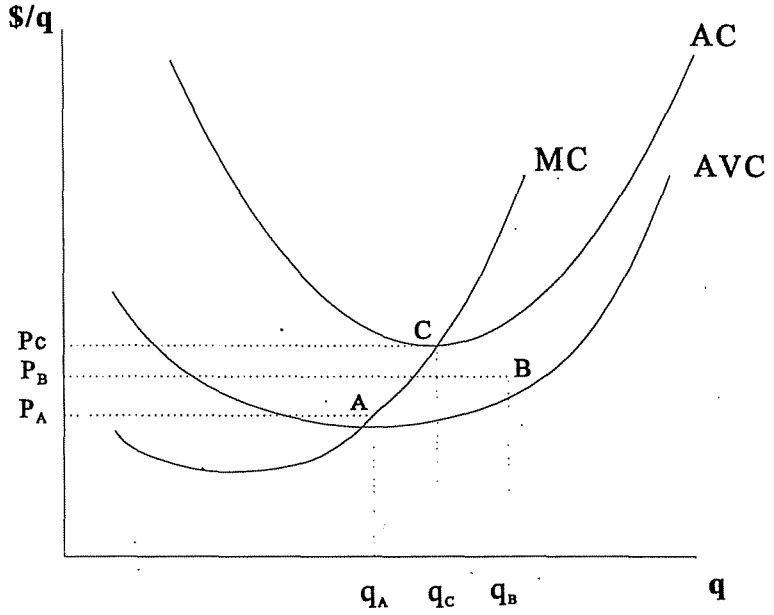
[8]Areeda and Turner, 697-733.

[9]Carlton and Perloff, 389.

minimum of the average cost curve. Thus, in a perfectly competitive market, the price will be P_c as indicated in Figure 1. The profit maximizing monopolist, on the other hand, can affect price by producing the quantity at which marginal cost equals marginal revenue. She may then receive a higher price associated with a lower quantity. Prices at these profit maximizing (or loss minimizing) levels should not be considered predatory.

Figure1. The Cost Functions of a Typical Firm



On the other hand, prices below this level may indicate a voluntary sacrifice of short run profits. The incentives of such a firm may be legitimately called into question, and suggest that predatory pricing has occurred. Areeda and Turner argue the necessity of such a condition, but guard against its sufficiency. It is possible that a firm could

legitimately choose to price below the profit maximizing level. An example given by Areeda and Turner are new firms utilizing low prices to establish themselves in a market.[10] Additional qualifications are therefore necessary.

Their analysis initially focuses on prices that are below the profit maximizing level and either at or above average cost. A price at average cost indicates that a firm's total revenues exactly offset its total costs. As before, the potential exists that firms will be eliminated by such prices, perhaps intentionally. These are less efficient firms than the predator firm and will suffer greater losses. But such a pricing scheme is also consistent with competition. Areeda and Turner argue that even in cases when a price above average cost is exclusionary, it should not be considered a violation of antitrust laws.

Prices below average cost indicate that a firm is operating at a loss. Areeda and Turner are careful to point out that this condition does not necessarily imply predatory intent. In this case, a firm can be operating under conditions of loss minimization instead of profit maximization.[11] It is, of course, difficult in practice to determine when a firm may be trying to minimize its losses versus attempting to eliminate its rivals. Since such prices may indicate the possibility of predatory intent, and since equally efficient rivals will suffer losses under these conditions, a more precise definition of cost is needed.

To accomplish this, Areeda and Turner further delineate prices into two

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[10]Areeda and Turner, 703.

[11]The term loss minimization is used in place of profit maximization only because price is below average cost. As such, a firm is operating at a loss and the optimal policy is to minimize losses. Loss minimization and profit maximization both imply that a firm is producing its optimal output.

categories. The first includes prices at or above marginal cost. Referring to Figure 1, this would coincide with a price/quantity combination such as point A. Equally efficient firms will be operating at a loss due to the pricing practices of the predator. However, as has been previously noted, it is not likely that equally efficient firms will be driven out under this condition. A possible exception is a firm without comparable financial resources.[12] The assumption that outside financing is not available, however, has limited support. Establishing a price floor above marginal cost would therefore encourage inefficiency and adversely affect competition. For this reason, Areeda and Turner argue that prices in this range should not be considered predatory.[13]

The second case includes prices that are below marginal cost. It is possible that price is below marginal cost and yet above average cost. In this case, neither the firm, nor its equally efficient rival are operating at a loss, even though the social optimum is not being reached. As such, prices above average cost remain non-predatory in terms of anti-trust law.

Prices that are below both average cost and marginal cost potentially imply a different story. This corresponds with a price/quantity combination such as point B in Figure 1. As previously, this scenario could exclude less efficient rivals while firms that

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[12]Areeda and Turner, 710.

[13]Areeda and Turner make several additional arguments to support this position. Prices at marginal cost imply that the social optimum is being reached. Forcing a firm to charge a higher price would decrease the quantity sold and create a deadweight loss. Also, such a policy would require that a price floor be created that was no higher than the loss-minimizing level of the firm. Calculating this price would impose prohibitively high administrative costs. (Areeda and Turner, 711.)

are as efficient will not suffer greater losses. However, at these levels, the additional increment to total cost of the last unit produced will exceed its price. The incentives of a firm selling at this price level can increasingly be called into question since it could reduce these losses by selling a lower quantity. Also, when price is less than marginal cost the social optimum is not being reached and a price floor above this level would decrease the loss to society. These conclusions lead Areeda and Turner to consider such prices as predatory.[14]

A potential argument offered in defense of such a price level is that the accused firm is meeting the lawful price of its competition. Most of the SBC laws included in this study allow this defense. Areeda and Turner argue that such a defense should not be valid for a price below both average cost and marginal cost. A firm that desires to enter a market may legally utilize such prices to obtain a market share. However, an incumbent firm, following the low price in an attempt to thwart new entry, is threatening legitimate competition.

This leaves the final, necessary point concerning the Areeda and Turner rule. While defining marginal cost in economic terms is not exceedingly difficult, measuring marginal cost in practical terms is. That is, determining the additional increment to cost of an additional unit of output is not readily obtainable from typical accounting records. As such, the application of a marginal cost rule to real world settings is problematic. Areeda and Turner suggest instead the more observable average variable cost be used as a

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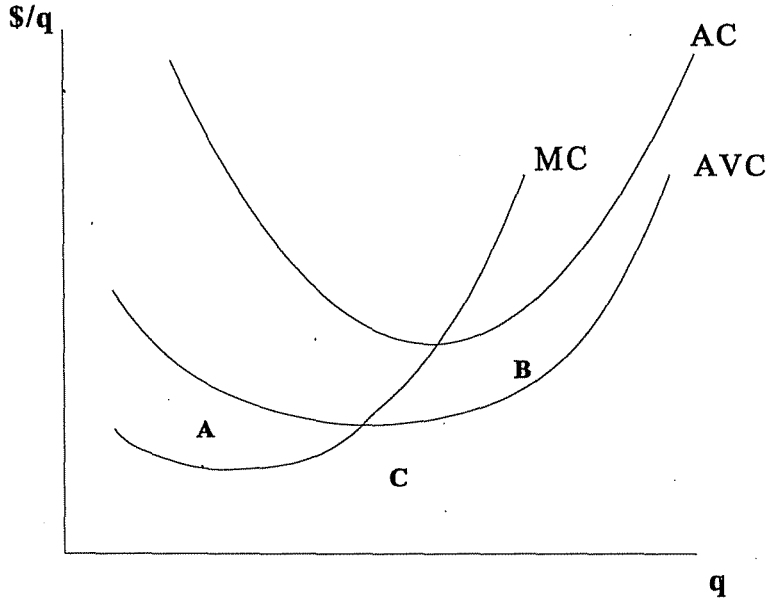
[14]Areeda and Turner, 712.

proxy for marginal cost. An average variable cost rule will either be more prohibitive than, identical to, or less prohibitive than a marginal cost rule. Figure 2 shows the same cost functions as in Figure 1, but with three points (marked A, B, and C) to indicate price ranges for these three cases. Prices like C will conform with the marginal cost rule and using average variable cost as a proxy will have no effect. However, at point A, average variable cost is above marginal cost. The average variable cost rule will thus classify prices as predatory when it should perhaps not. A firm cannot be minimizing its losses, however, when price is less than average variable cost. Its optimal choice is to shut down. This would partially diminish the restrictiveness of an average variable cost rule.

At the point marked B, the opposite case prevails. Marginal cost is now above average variable cost and the average variable cost rule will allow prices that may be predatory. Areeda and Turner point out that predatory pricing under this scenario is particularly unlikely. With the typical cost functions, as depicted in Figure 2, the output implied within the range where marginal cost is greater than average variable cost indicates that the firm is operating near, or beyond, the optimum for that firm. Additional output will push the firm beyond the optimal capacity and thus force it to utilize more costly resources. As indicated previously, a predatory scheme involving lower prices will force the predator firm to increase output. However, if it is realized that additional output is increasingly costly, the likelihood of predation decreases. For these reasons, Areeda and Turner argue that an average variable cost rule is unlikely to have adverse effects on competition.

Figure 2. Price/Quantity Combinations Under the Average Variable Cost Rule



The rule's foundational characteristic is that efficiency matters. Competition that excludes relatively inefficient firms can be efficiency enhancing, maximizing social welfare. However, debate exists over Areeda and Turner's position and their analysis. The disagreements are based on two points. First, some writers have objected to the concept that less efficient firms don't matter in terms of anti-trust law. Connectedly, it has been argued that pre-existing monopolies will be capable of deterring entry through strategic behavior. Second, there is concern that social welfare maximization needs to take a more preeminent focus in the definition of predatory pricing.

The ability to deter new entrants partly determines the probability of predatory pricing. If a firm has monopoly power, it must maintain a credible threat by convincing other firms that they will lose money by entering. To accomplish this, the monopolist may seek to construct plants and purchase equipment so that in the advent of entry, the quantity it sells will yield a price that is unacceptable to an entrant.

Williamson emphasizes this strategic consideration and modifies it to account for the existence of rules such as Areeda and Turner's average variable cost rule. He, however, proposes three alternative rules.[15] The first is referred to as the "Output Restriction Rule". A monopolist would not be allowed to increase output above the level that existed before the probability of entry until after a 12-18 month period during which the entrant could become established. The second rule would allow the incumbent firm to increase output to the level at which price was greater than or equal to short run marginal cost. Finally, a monopolist would be allowed to increase quantity to the point at which price was at or above short run average cost.

The monopolist's strategy is to choose an initial level of output based on the current rule. For example, under the output restriction rule, the dominant firm will elect to initially produce a quantity such that the residual demand curve of a potential entrant is just tangent to its average cost curve. Thus, the best the entrant could do is break even. Under the second or third rule, the monopolist's initial quantity can be less. If entry

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[15]Oliver E. Williamson, "Predatory Pricing: A Strategic and Welfare Analysis," The Yale Law Journal 87, no. 2 (1977): 295-301.

occurred, the firm could increase quantity such that the price remained legal, yet was sufficient to deter entry. This would result in a residual demand curve determined by the lowest allowable price. Williamson suggests that the appropriate rule is that which yields the greatest level of social welfare.[16]

Scherer, likewise expressed disagreement with the Areeda and Turner rule and in part focuses on the issue of entry deterrence.[17] He argues that if a monopolist has an advantage because of economies of scale, the entrant may possibly face a minimum level of output below which it cannot profitably enter. The monopolist realizes this and creates a credible threat to increase output in the presence of entry. Its total output plus the entrants minimum level of output would drive price below the minimum of average cost. The monopolist may thus price above average cost and yet such pricing can be exclusionary.

Additionally, Scherer considers the situation when a firm is operating with excess capacity.[18] If price is also below average cost, the firm is operating at a loss. Scherer again assumes a pre-existing monopoly and then searches for plausible reasons for a firm to structure its plant so as to have excess capacity. One reason is that the firm has strategically positioned itself for the purpose of entry deterrence. Moreover, he argues that maintaining such excess capacity during non-predatory periods would create

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[16]Ibid., 307.

[17]F.M. Scherer, "Predatory Pricing and the Sherman Act: A Comment," Harvard Law Review 89 (1976):869-889.

[18]Ibid., 875

unnecessary welfare losses.

Scherer also disputes Areeda and Turner's reliance on short run marginal cost for determining the gains, or losses, in social welfare of different price levels.[19] The basis of this argument is that pricing policies should be judged, in part, by their divergence from socially optimal levels. Prices that are above average cost and below marginal cost, for example, should be judged on a "proper resource allocation" criteria rather than on the relative efficiency of firms.[20] The rule derived from this is based on current and long run welfare losses. As such, the discounted value of future losses (e.g., the deadweight loss to society of monopoly prices) must be added to any current losses resulting from deviations of price from marginal cost.

The above challenges to the Areeda and Turner rule assume a pre-existing monopoly and, as such, focus on entry deterrence. It is unlikely, however, that such strategic behavior would be successful if both firms have identical cost functions since the incumbent firm cannot create a credible threat.[21] Also, a rule to determine predatory pricing based on long run social welfare is likely to be as, or more, difficult to determine in practice as a marginal cost rule. A rule based on social welfare, if enforceable, may also be excessively restrictive in cases where price exceeds average cost.

The Areeda and Turner rule may, likewise, be difficult to define and enforce in

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[19]Ibid., 885.

[20]Ibid., 884.

[21]Carlton and Perloff, 396.

practice. The analysis does, however, provide a generally accepted framework that provides an opportunity to identify predatory pricing. For this reason it is a useful tool to apply to the retail gasoline industry as well as to gasoline SBC laws. If Areeda and Turner are going to err, they choose to err on the side of not adversely affecting legitimate competition by adopting a rule that is unnecessarily restrictive. Some may argue that the average variable cost rule is therefore too lenient. In light of the weak evidence supporting a preponderance of actual predatory pricing cases, Areeda and Turner's analysis seems appropriate.[22]

Applying the Areeda/Turner Rule to SBC Laws

How then can this general theory of predatory pricing and the determination of a predatory price be applied to the gasoline SBC laws? First, it may be of use to look at the three necessary conditions for predatory pricing and their relevance to this market. This will not indicate whether predatory pricing is occurring within the industry. Rather, it will offer an idea of the probability that such actions are likely to occur and permit conclusions to be drawn about the effects of the SBC laws.

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[22]There are a limited number of cases in which firms have been found guilty of predatory pricing. See, for example, Frank H. Easterbrook, "Predatory Strategies and Counterstrategies," The University of Chicago Law Review 48, no. 2 (1981): 313,4. Studies of such cases often indicate that predation in terms of pricing below cost is a rare occurrence. A counter example, however, is given by Malcolm R. Burns, "Predatory Pricing and the Acquisition Cost of Competitors," Journal of Political Economy 94, no.2 (April 1986):266-296. He empirically examines the record of the American Tobacco Company's purchases of its rivals between 1891 and 1906 and finds evidence of predatory pricing.

It has been argued that a predator firm must have a cost advantage over its rival. Conceivably, such an environment may exist in the retail gasoline industry. It is the larger firms that are most often accused of predation on the smaller, independent firms and it is possible that these firms have lower costs than their rivals. Larger firms may be able to supply a network of their stations more efficiently than a single independent firm can obtain its supply. Volume discounts may also favor larger competitors. It is important to note, however, that a cost advantage does not imply the ability nor the desire to engage in predatory behavior. The indication is only that large firms may be more efficient under certain circumstances.

To be successful at predation future expected benefits must exceed the costs of predation. Several of these costs were described above and the importance of discounting values was noted. Appealing to the belief that firms and individuals act in a rational manner allows one to infer that a firm will not choose to undertake a predatory strategy if the costs outweigh the expected benefits. Unless it is expected that the rival will be driven from business in a relatively short period of time, these costs are likely to be quite high relative to the expected gains.

As was pointed out previously, the predator firm will have to increase the volume it is willing to sell to lower price. However, industry wide demand has been shown to be quite price inelastic in the short run.[23] Thus, it could be argued that the increase in quantity demanded due to a decrease in price would be inconsequential. But, if the rival

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[23]Carol Dahl and Thomas Sterner, "Analyzing Gasoline Demand Elasticities: A Survey," Energy Economics July (1991): 203-210.

firm decreases the quantity it sells at the lower price, the predator firm's losses will be greater than that associated with its typical sales volume.

The primary costs associated with predation in the retail gasoline industry are the returns relinquished because of the lower price. It is likely that these costs can be computed with a high degree of certainty. The future profits with which these costs are compared will not be as certain. One reason for this uncertainty is the difficulty of predicting the likelihood of deterring entry. Gasoline retail outlets contain rather specialized assets in the form of their pumps and storage tanks. As a result, even if the rival firm goes out of business, the most likely buyer of the property would be someone interested in operating the same type of business. The predator firm would then be forced into a position where it would have to consider either purchasing the property or risk allowing the potential of a new entrant.

The likelihood of deterring entry in the retail gasoline business for any meaningful length of time appears small. The higher prices that will exist after predation will certainly attract potential competitors. Moreover, the costs of building a new retail gasoline outlet, or of purchasing an existing outlet, is not prohibitive. Thus, the retail gasoline business does not appear to be characterized by any significant entry barriers that could substantially restrict the number of retail outlets in a given location. Advantages may exist for larger firms in certain geographic areas, but this is not indicative of predatory practices. Although the possibility of predatory practices within the retail gasoline industry cannot be ruled out, the probability that it will be successful appears remote.

The use of the Areeda and Turner rule to detect predatory pricing allows a generally accepted framework by which the SBC laws can be compared. It is common for SBC laws to define cost by one of two methods. The first, and most common, is to list the relevant components of cost. This can differ between states, depending on the definition of "the cost of doing business". The second method is to state a minimum markup (typically 6 percent) as the legitimate cost of doing business.[24] This amount is then added to the delivered cost of the fuel, which includes the wholesale price and taxes. These various definitions of cost can be compared with the average variable cost rule suggested by Areeda and Turner and two observations can be made. First, those states that mandate a minimum markup as part of the definition of cost have the potential of setting a price floor in the short run that is above average variable cost and perhaps above average cost. The arbitrary nature of a percentage markup seems to preclude certain companies that may, for various reasons, be capable of more efficient operation than others. This appears to be precisely contrary to the care taken by Areeda and Turner to not unnecessarily harm legitimate competition. Second, the explicit definition of cost relied upon by the majority of the laws includes items that would normally be considered fixed costs.[25] For example, rental value of the property is included as an expense in the

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[24]Also, a cost survey within the relevant market area is allowed as sufficient evidence of cost in some states. These surveys are, however, subject to the components of cost as defined within the particular state's SBC law.

[25]Fixed Costs are defined as costs that do not change with the level of output. In particular, Alabama and Massachusetts include depreciation in their determination of cost and most other states include the fair rental value of the land and buildings.

majority of the laws. But this should be considered a fixed cost, not a variable cost.

These two observations seem to point to a common result. If Areeda and Turner's analysis is correct, the price levels established by the SBC laws may exclude legitimately competitive behavior on the part of some companies within the industry. The possibility of including fixed costs in an equation that determines a predatory price may create a price floor that is above average cost for some firms. In this case, the laws may have the effect of causing retail prices, and therefore retail margins, to be higher than they otherwise would be.

Alternative Explanations for SBC Laws

Although SBC laws were supposedly designed to promote efficient pricing by reducing the threat of predatory pricing, there are other, more plausible, rationales for their existence. If independent dealers are struggling to compete due to changing market conditions conducive to large scale ownership, the laws may instead protect their interests. Analysis of the legislative history of the Montana SBC law, for example, indicates that independent petroleum marketers and retailers initiated and supported the bill through its passage. In Montana, refiner ownership of retail outlets is uncommon.[26] Independents, instead, accuse chain retailers of attempts to monopolize local markets.[27]

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[26]Motor Fuel Pricing Problems, prepared by Paul E. Verdon, Staff Researcher, (Helena, MT: Montana Legislative Council, 1990), 11-15.

[27]Mike Dennison, "Restriction on Gasoline Prices Widely Criticized," Great Falls Tribune, 25 Sept. 1995, 2(A).

At a national level, major oil companies are the accused predators.[28] This poses the question of whether the independent's belief of predation is accurate or if SBC legislation is merely protecting less efficient firms.

The key to discerning which explanation is correct is a comparison of retail margins in localities with SBC laws and those where such laws are absent. If the occurrence of predatory pricing is highly unlikely, as argued here, and if firms are either constrained by these laws from pricing below an established level or are afraid to compete in terms of low price, the effect will be higher retail margins.[29] Again, this hypothesis is conditional on SBC laws creating a binding price floor. If the laws are binding so that firms believe they will be accused of illegal pricing, an additional expected result is that retail prices in law states will respond more quickly to increases in wholesale prices than in non-law states. Firms operating with relatively low margins would have an incentive to increase their retail price quickly so as to not be accused of below cost pricing.

Conclusion

The theoretical considerations presented in this chapter began as a general

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[28]Caleb Solomon, "Independent Gas Stations Cry Foul Over Price Wars," Wall Street Journal, 1 April 1991, 7(B).

[29]On the other hand, if predatory practices are occurring and are yielding the alleged results, retail margins should, on average, be higher in states without SBC laws. This alternative hypothesis assumes that by examining cross sectional data, as will be done in this study, the researcher obtains results that reflect long run adjustments.

framework in which the occurrence of predatory pricing could be determined. The analysis of predatory pricing by Areeda and Turner and their ensuing definition of a predatory price was presented as a generally accepted means of determining whether predatory pricing had occurred. The issue of predatory pricing in the retail gasoline industry was then considered. This behavior was determined to be highly unlikely, suggesting that retail margins in states with SBC laws would likely be higher than states without such laws.

CHAPTER 3

DATA DESCRIPTION AND LEGAL REVIEW

Introduction

A price floor that is binding is expected to alter the pricing practices of firms in that industry. But econometric models are necessary to empirically test this hypothesis and determine the magnitude of the effect. Estimation requires data on retail gasoline prices and other variables that may affect price. Retail wages, for example, can vary across localities and their affect on retail price must be accounted for to accurately measure the effects of the SBC laws.

The purpose of this chapter is, in part, to describe the sources and calculations of the data necessary to test the effects of the SBC laws. As described in the previous section, SBC laws may result in higher retail margins. The calculation of the retail margin from the price data is, therefore, critical and requires explanation. Likewise, the data on additional variables that affect price will be described. Of particular interest and relative complexity is the derivation of a variable that will act as a proxy for seasonal demand changes. In addition, specific SBC laws will be described. These laws have resulted in litigation and the major cases are examined. This legal review will offer a better understanding of how the various laws define cost and how actively these laws are enforced. The analysis begins with a brief look at the gasoline distribution system in the

United States.

An Overview of the Gasoline Distribution System

The gasoline distribution system starts at the level of the refinery, where crude oil is converted into a variety of products, one of which is gasoline. The majority of gasoline consumed in the United States is also refined within the U.S., but a small percentage is imported.[1] From these sources, the fuel is sent, typically by pipeline, to a network of marketing terminals from where it is transported via truck to retail outlets. Direct supply outlets purchase fuel delivered from the terminals by the refiner. Such stations may be owned and operated by the refiner or by independent dealers. Alternatively, the gasoline may be purchased at the terminal by an independent business for the purpose of supplying its own independent stations or for reselling to other dealers. People that provide this service are typically referred to as "jobbers". The jobber may also be under contract to a particular refiner to distribute the refiner's brand to branded retail outlets. These outlets may be owned by the refiner, the jobber, or another independent dealer who sells that brand name. Conversely, the jobber may also purchase unbranded fuel for distribution to independent stations operating under a non-refiner brand name. Figure 3 offers a schematic representation of this system.

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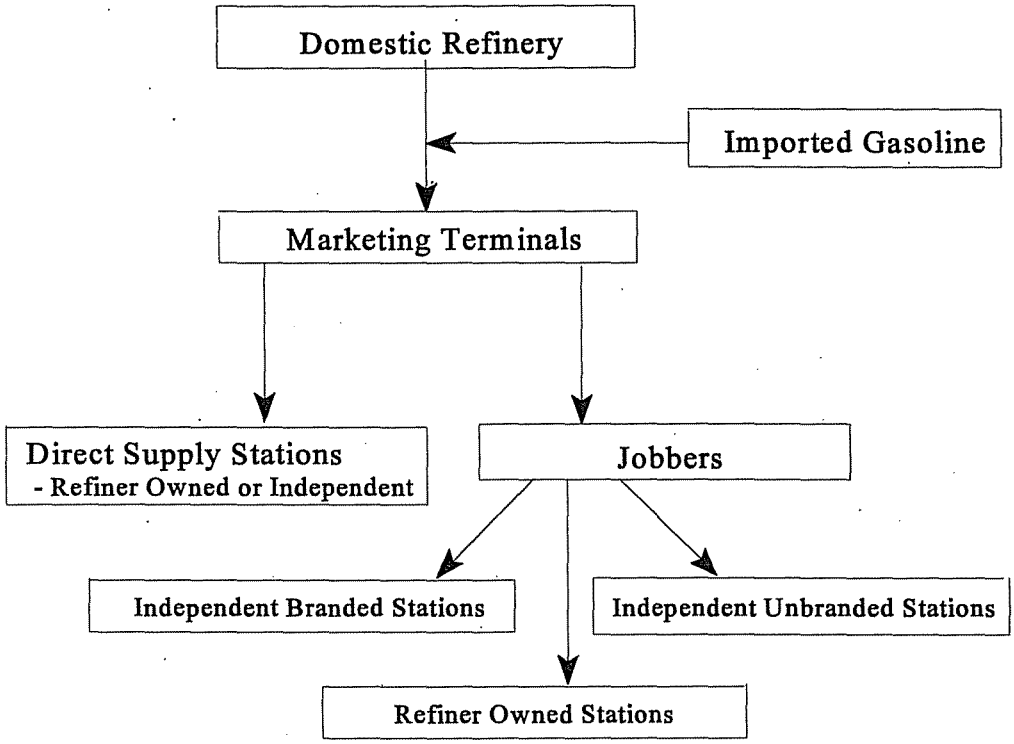
[1]According to the Department of Energy, approximately 3.3 percent of the total, annual finished motor gasoline supplied was imported. Department of Energy, Energy Information Administration, Petroleum Supply Annual 1993 (Washington, D.C.: U.S. Government Printing Office, 1994), Table 2.

Figure 3. The Gasoline Distribution System



The Components of Gasoline Price

The retail price of gasoline is composed of several elements. At a basic level, these components are: 1) the wholesale price, 2) taxes, and 3) the retail margin. The empirical analysis will examine differences in retail margins across cities in the United States. For the period examined, weekly wholesale and retail prices were obtained from

The Oil and Gas Journal.[2] The retail prices are daily averages of self service, unleaded gasoline, reported on a weekly basis from March 23, 1992 to Dec. 27, 1993. The wholesale prices are an average of branded and unbranded rack prices for the day of the reported retail prices. Of the 42 cities represented in the survey, two had observations that appear to be full service, retail prices. These cities were dropped from the sample. The following sections provide a more thorough description of the three components.

Wholesale Price

The most precise measure of the wholesale price paid by a typical gasoline station would be the retailer's invoice cost of the fuel purchased. In the absence of such information, it is necessary to rely on the posted prices given at the city terminals. Wholesale prices are generally reported as one of three distinct types: 1) rack, 2) dealer tankwagon (DTW), or 3) spot. The terminal prices, reported and published daily, are either rack or DTW.[3]

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[2]Severin Borenstein and Andrea Shepard, "Dynamic Pricing in Retail Gasoline Markets," (National Bureau of Economic Research, Research Paper No. 1269, Sept., 1993), and Severin Borenstein, A. Colin Cameron, and Richard Gilbert, "Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes," (Program On Workable Energy Regulation, University of California Energy Institute, PWP-001R, June, 1994), report that retail prices from the Oil and Gas Journal (OGJ) are estimated from wholesale prices. The OGJ confirms this for the period previous to March 23, 1992. From March 23, 1992 to Dec. 28, 1993 (also the time period considered by this study), the OGJ's source for retail prices was the Computer Petroleum Corporation (CPC). The CPC has said that retail prices supplied to the OGJ during this period were surveyed prices from weekly telephone surveys of the given metropolitan areas. Of approximately 40 stations in each city that participate in the surveys, 15 - 20 are chosen randomly to be surveyed on a particular day. The wholesale prices were also collected by CPC during this period.

[3]Some of the other recognized sources for wholesale price data are The Computer

The rack price is the most commonly reported and referenced wholesale gasoline price. It assumes pickup of the fuel at the terminal and is the price commonly paid by jobbers. The rack price is further delineated as either branded or unbranded to signify whether the fuel carries the name of the company responsible for its refining (e.g. Exxon). The difference between branded and unbranded rack prices is often minimal, with branded rack prices generally being higher than unbranded rack prices. The higher branded price reflects the reputation associated with a brand name versus a "generic" fuel.

Dealers who lease stations from, or who are otherwise under a direct contract with a refiner, typically pay the DTW price. Unlike the rack price, the DTW price presumes delivery to the station from the terminal. Dealers paying the DTW price are typically under a long term contract with the refiner.[4]

Spot prices are determined by an auction process at primary trading centers such as New York or Houston.[5] Large quantities of fuel are traded at prices that include minimal storage, transportation, and marketing costs.[6]

The different wholesale prices generally follow a predictable pattern whereby

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Petroleum Corporation, U.S. Oil Week's Price Monitor, Platt's Oilgram Price Report, and The Oil Daily.

[4]Philip E. Sorenson et. al., "An Economic Analysis of the Distributor-Dealer Wholesale Gasoline Price Inversion of 1990: The Effects of Different Contractual Relations," (Washington, D.C.: American Petroleum Institute, 1991), 7-9.

[5]Ibid., 7.

[6]American Petroleum Institute, Policy Analysis Department, "An Overview of Gasoline Prices and Their Determination," (Washington, D.C.: American Petroleum Institute, 1990), 8.

DTW prices are highest, followed by branded rack, unbranded rack, and spot prices respectively.[7] The higher DTW prices not only reflect the cost of delivery to the station, but also a low level of investment risk by the dealer and a high level of contractual commitment from the refiner.[8]

In addition, it should be noted that reported prices do not precisely indicate the actual price paid by either a reseller or a dealer. The actual invoice cost is typically discounted from the posted wholesale price. A source within the industry has indicated that these discounts represent rebates for higher volume purchases, short term incentives to purchase additional product, or perhaps to compensate a branded retail outlet for improvements to the land or building. As noted above, the data used here are an average of branded and unbranded rack prices.

Taxes

An accurate calculation of each city's retail margin requires the careful determination of the total amount of gasoline taxes in each city. Motor fuels taxes are collected by federal, state, and local governments and, as such, differ from state to state and potentially between cities within the same state. All states impose a per gallon tax. In addition, some states have instituted state sales taxes that apply to some or all motor fuels sales. County and local governments likewise may have sales or per gallon taxes. Additional motor fuels taxes may be imposed at the state level, but are not always

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[7]Ibid., 11.

[8]Sorenson et. al., 9.

referred to as motor fuels taxes. The petroleum products gross receipts tax in New Jersey is one example. Environmental protection fees are also often imposed by states on sellers of motor fuels. However, because these fees are not always based on a per gallon basis, they are not included in our measure of taxes.

For each city in the sample, it was necessary to determine the applicable taxes. Several published sources were consulted for this information.[9] In addition, state departments of revenue and taxation were consulted whenever sources did not coincide as well as to determine the correct calculation methods of any taxes applied as a percentage of sales (sales tax).

Taxes imposed on a per gallon basis are easily handled, all that is necessary is that one subtract the amount of the tax from the retail price to arrive at a net of tax price. However, for those states and cities that impose a sales tax on gasoline, additional calculations are required. The problem arises because states and localities can differ as to the base upon which the sales tax is computed. Some states include the federal and state per gallon taxes when computing the state and/or local sales tax. Other states take a credit for the state and/or federal per gallon tax before computing the sales tax. Accordingly, it is first necessary to determine the basis upon which the sales tax is

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[9]Sources include the U.S. Department of Transportation, Federal Highway Administration, Monthly Motor Fuel Reported by States (Washington, D.C.: U.S. Government Printing Office, 1992, 93) various issues, Table MF-121T; The Road Information Program, 1993 State Highway Funding Methods (Washington D.C.: TRIP, 1993), 13; American Petroleum Institute, State Governmental Relations Department, "State Gasoline Excise Tax Rankings - May 4, 1993" (Washington, D.C.: American Petroleum Institute, 1993).

computed.

To illustrate how taxes were measured, consider the city of Atlanta on June 7, 1993. The relevant price and tax data in cents per gallon and on a percentage basis are as follows:

Wholesale Price = 55.3
Retail Price = 96.2
State Tax = 7.5
Federal Tax = 14.1
State Sales Tax = 4%
Local Sales Tax = 1%

Here, the sales tax on gasoline is calculated after taking a credit for the state tax of 7.5 cents. Also, the local sales tax is administered by the state, so that the taxes can be simultaneously computed as a 5 percent sales tax. The price per gallon net of tax includes the margin, which is unknown. Calculation of the sales tax without prior knowledge of the margin, therefore, requires one to work backwards from the retail price. Crediting the state tax from the retail price yields the sales tax base. It is then possible to determine the taxable selling price as shown in Table 1. The per gallon sales tax is the difference between the sales tax base and the taxable selling price. Appendix C details the motor fuels taxes for each city.

Retail Margin

Subtracting the wholesale price and all applicable taxes from the retail price yields the retail margin. This amount represents, on a per gallon basis, the additional costs of operating a retail station such as payroll, rent, or depreciation and any profits. Differences in costs between cities will therefore affect the retail margin. Thus, it is

Table 1. Calculation of Gasoline State Sales Tax

Retail Price		96.20
Tax Credits:		
Federal Tax	0.00	
State Tax	7.50	
Total Tax Credits		(7.50)
Sales Tax Base		88.70
Taxable Selling Price (Adjusted Retail Price/1.05)		(84.48)
Sales Tax		4.22

important to control for these costs if we are to measure the effect of SBC laws. Other studies of the retail gasoline business have also used retail margins as the dependent variable. Borenstein uses retail margins to test whether there is price discrimination, based on a customer's willingness to switch stations, in the retail gasoline market.[10] He points to the retail margin as appropriate because he is concerned with the dealer's costs per transaction. In addition, Borenstein and Shepard study "implicit collusion" in the retail gasoline market and use retail margins as their dependent variable.[11]

Variables that Affect the Retail Margin

In the long run, the retail margin will be determined by the costs of operating a

[10]Severin Borenstein, "Selling Costs and Switching Costs: Explaining Retail Gasoline Margins," Rand Journal of Economics 22, no. 3 (Autumn 1991):354-369.

[11]Borenstein and Shepard, (1993).

station, and these costs can differ between cities.[12] Labor costs are one such cost. As a proxy, we have computed an average retail wage for each city. This information was obtained from the 1992 census of retail trade.[13] Data for the first quarter payroll for all retail establishments was divided by the number of paid employees for the corresponding pay period. It is expected that the retail margin will be positively affected by differences in the retail wage between cities.

In the long run, the cost of building, buying, or leasing a retail outlet will also affect the margin. In the absence of data specific to the retail gasoline business, the median value of housing for the metropolitan statistical area has been used as a proxy. This property value estimate is from the 1990 census of population.[14] It is expected that higher property values will result in higher retail margins.

Margins may also be affected by the cost of transporting fuel. If higher population densities are correlated with a higher density of retail outlets, firms in such demographic areas may be capable of more efficient distribution. Margins will, as a result, be lower. Also, sources in the industry indicate that higher population areas are

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[12]Variables that change over time as well as across cities would be preferable, but this information is not available.

[13]Department of Commerce, Economics and Statistics Administration, 1992 Census of Retail Trade (Washington, D.C.: U.S. Government Printing Office, 1994), Table 5. The retail census also includes payroll information for gasoline service stations (SIC 554) by city. This data was also used in the regression equations with similar results.

[14]Department of Commerce, Economics and Statistics Administration, County and City Data Book: 1994 (Washington, D.C.: U.S. Government Printing Office, 1994).

more likely to have refiner owned stations. Since population and population density are highly correlated, the population density variable will take into account differences in types of ownership between cities and account for overestimation of margins due to the use of an average of branded and unbranded rack prices.[15] Density is measured as population per square mile. The population estimates are for 1992, based on the 1990 census of population.[16] The land area is also based on the 1990 census.

Seasonal changes in the quantity of gasoline demanded may also affect the retail margin. Sources within the industry agree that margins tend to be low, on average, during the winter. Starting in June and peaking in late July and early August, the margins increase in response to the higher demand recorded during this period. Although typical for the industry, this pattern can vary between cities. This indicates a market in which firms increase price in response to temporary increases in demand.[17] Likewise, retail prices will decline in periods of slack demand. In the presence of high fixed costs, these temporary changes in demand do not induce either exit or entry of firms.

Several sources of data on the quantity of gasoline sold are available. Two of these are from the Federal Highway Administration (FHA). The publication, Monthly

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[15]The average wholesale price is better represented as some weighted average of rack and DTW prices, depending on the number of refiner-owned stations. Since DTW prices are generally higher than rack, the margin will thus be overestimated when using an average of branded and unbranded rack prices.

[16]Department of Commerce, County and City Data Book: 1994.

[17]Over the long run, however, prices would likely approximate average cost. See, for example, American Petroleum Institute, An Overview of Gasoline Prices and Their Determination, 1.

Motor Fuel Reported by States, records the number of gallons sold each month and is based on wholesale distributors' state tax reports.[18] The reported quantities, however, reflect time lags of up to six weeks before actual consumption. In addition, during the time period under consideration, several of the reported quantities appear to be inaccurate.[19] Highway Statistics, another FHA publication, also reports monthly quantities in a table entitled "Highway Use of Gasoline by Months". This data is also compiled from state tax reports, but are estimates of highway use of gasoline derived by subtracting an estimate of non-highway use from total use.[20]

An additional source is the Energy Information Administration's (EIA) Petroleum Marketing Monthly.[21] These sales volumes are derived from EIA surveys of prime suppliers' sales to local distributors and retailers for consumption in a particular state. Prime suppliers include refiners, importers, and other firms that sell gasoline across state lines. As such, this data may also reflect a time lag between the reported date and actual consumption. The use of this data is also made difficult by the implementation of a

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[18]Department of Transportation, Federal Highway Administration, Monthly Motor Fuels Reported by States, various dates, Table MF-33GA.

[19]These inaccuracies are the result of reporting methods in several states that combine part of one month's total with the following month and are not a result of reporting errors on the part of the Federal Highway Administration.

[20]Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, D.C.: U.S. Government Printing Office, 1993), Table MF-26.

[21]Department of Energy, Energy Information Administration, Petroleum Marketing Monthly (Washington, D.C.: U.S. Government Printing Office, 1993), Table 47.

different survey method at the beginning of 1993.

These sources create two additional complications. First, city level data are not available. The data are totals for an entire state. Seasonal demand for gasoline within a particular city may differ from the statewide totals, yielding an inaccurate representation of the seasonal pattern. Second, the data are monthly totals whereas the price data are daily averages reported on a weekly basis. As such, a method of matching prices and quantities must be formulated. To accomplish this, weekly values for quantity are interpolated in such a manner as to preserve the seasonal trend in each state.[22] These quantities are then normalized about each state's mean quantity. The rationale for normalizing the quantity variable is two fold. First, the estimation model uses time series cross sectionally pooled data and we desire a comparable measure for each city in the sample. Second, the use of normalized quantities negates the problem of collinearity that would otherwise result from high correlation between population and thus, population density, and quantity consumed.

Adding the quantity variable to the regression equation, however, creates the potential for simultaneity bias. In this case, the retail margin is a function of quantity and the other independent variables. But quantity is a function of the retail price and therefore of the retail margin as well. The usual procedure for handling this problem is to utilize an instrument for the quantity variable that is purged of any price effect.

To illustrate the procedure used in this study to purge the quantity/seasonality

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[22]See appendix A for a detailed description of the interpolation of the weekly quantity values.

variable of any price effect, consider the supply and demand functions shown in Figure 4. Let P_0 and Q_0 be the initial equilibrium condition. If the demand function were to shift out to D_1, the new equilibrium price and output would be P_1 and Q_1. Because the supply function is upward sloping, price has increased. If price did not rise, a situation comparable to having a perfectly elastic supply function, then the quantity demanded would have been $\hat{Q}_1$. Thus, purging the price effect from this increase in demand amounts to obtaining an estimate of the quantity $\hat{Q}_1$. Likewise, if demand were to decrease, an estimate of $\hat{Q}_2$ would be called for. It is apparent from the figure, however, that if one is to construct a quantity/seasonality variable that is purged of price effects, information on the underlying demand function is required.

Consider a demand function for gasoline of the functional form,

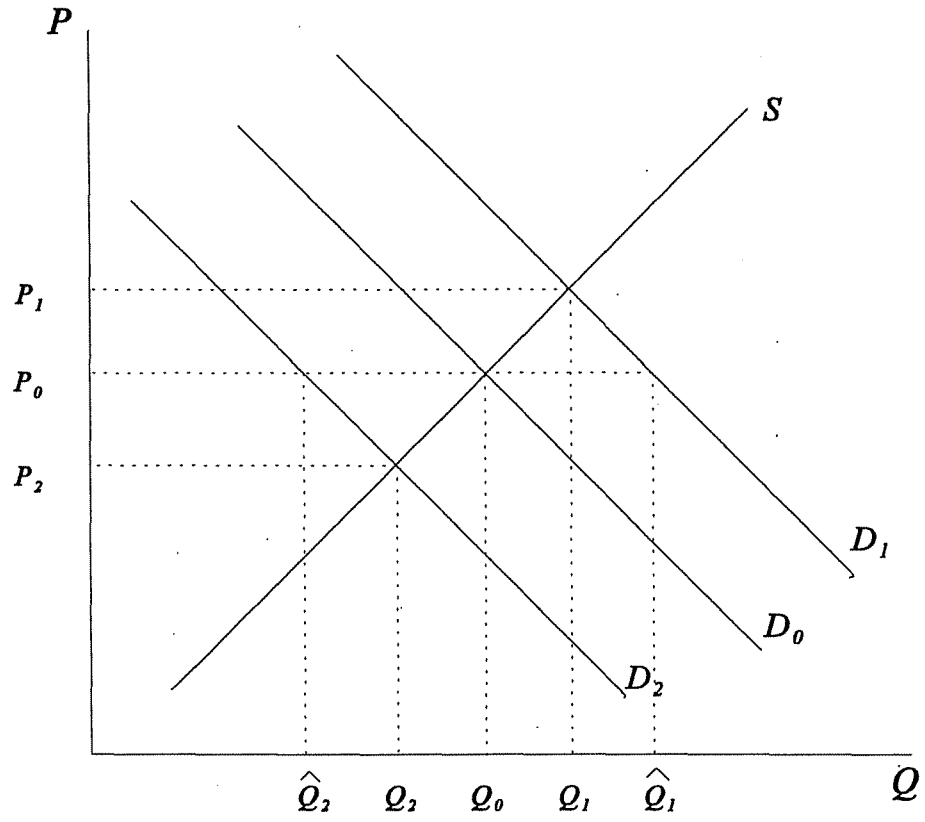
$$Q_i = P_i^{\eta} k_i \,, \tag{3.1}$$

where Q is the observed weekly quantity detailed in appendix A, P is the observed retail price, η is the price elasticity of demand, and k is a vector of exogenous variables affecting the quantity demanded. By normalizing the retail prices about the mean price for each city, equation (3.1) can be written as:

$$Q_i = \left(\frac{P_i}{\bar{P}_i}\right)^{\eta} k_i \tag{3.2}$$

Conceptually, $\bar{P}_i$ is equivalent to P_0 in Figure 4. Taking the natural logs of both sides and transferring terms yields the following transformation:

Figure 4. Supply and Demand Illustration of Quantity Purged of Price Effects



$$\ln Q_i - \eta \ln P_i + \eta \ln \bar{P}_i = \ln k_i \qquad (3.3)$$

Note that the left side of this equation will be larger or smaller than the observed Q_i, depending on whether the retail price is above or below its mean. It can readily be seen that if the retail price equals the mean price, or if the price elasticity is zero, the left side equals the observed Q_i. As such, the left side of equation (3.3) represents quantity corrected for any price-effect. Because k is assumed to be exogenous, the price effect

corrected quantity, $\hat{Q}_i$, can be represented in equation form as:

$$\ln\hat{Q}_i=\ln Q_i-\eta\ln P_i+\eta\ln\bar{P}_i=\ln k_i \tag{3.4}$$

Using equation 3.4, values of $\ln\hat{Q}$ can be computed, given an acceptable range of short run, price elasticities.[23] Taking the inverse log of $\ln\hat{Q}$ yields $\hat{Q}$, which can then be divided by $\bar{Q}$. This normalized value is included in the regression equation as a measure of seasonality that is purged of price effects.

Sales Below Cost Laws

Sales Below Cost laws originated with California's "Unfair Trade Practices Act" of 1933 and have subsequently been enacted in various forms in 38 states.[24] These laws frequently encompass all retail sales and thus apply to the retail sale of gasoline.

SBC laws that relate directly to motor fuels are either independent from the general SBC laws or are included as specific provisions within the general laws. These gasoline specific laws are of special concern for this thesis. According to a 1991 study conducted by the American Petroleum Institute (API), a total of 9 states had such laws.

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[23]Elasticity values of -.1 and -.2 were used in computing $\hat{Q}$. See chapter 4 for the empirical results. Borenstein and Shepard (1993) follow a similar approach and use a similar range of elasticity values.

[24]Department of Energy, Minimum Markup Laws in Gasoline Marketing: An Economic Analysis and A Legal, Economic, and Legislative Review, prepared by Synergy, Inc., March 1985 (Washington, D.C.: U.S. Government Printing Office), 1. This report analyzes the effects of general sales below cost laws on gasoline marketing. Their analysis includes a review of each state law, using some of the same categories as this study.

Since that study, gasoline SBC laws in Georgia and Michigan have been repealed. Missouri and Montana have initiated new laws, while Colorado and Tennessee added sections to previously existing laws making illegal the sale of motor fuels at prices below cost. Currently, a total of 11 states have gasoline specific SBC laws. Eight of these states, and a total of nine cities, are represented within the sample used in this study.[25]

The gasoline SBC law for each of these eight states and Montana will now be analyzed. The definition of cost is of primary concern, but additional factors that further define the relative strength of each law will also be examined. The first of these is the penalty incurred for a violation. As the penalties become more severe, retailers will be more sensitive to maintaining legal or non-threatening prices. Second, if a law allows for private litigation the law may be enforced more frequently. Third, most gasoline SBC laws allow a defendant to meet the equally low price of a competitor without being in violation. This would lessen the hypothesized effects of the law. Fourth, most SBC laws require evidence of a defendant's intent to injure competition. The legal debate surrounding this requirement is whether harming an individual competitor constitutes injuring competition. The existence of such a clause and the state's legal position on this issue will affect the ability of the authorities to achieve a conviction. We now turn to the analysis of each law.

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[25]Maine and North Carolina also have gasoline specific SBC laws, but are not represented in the sample considered by this study.

Alabama

Alabama's Motor Fuel Marketing Act was passed in 1984.[26] Cost is defined as the lesser of the invoice or replacement cost, plus all taxes, inspection fees, freight charges, and the cost of doing business.[27] A survey within the relevant market area may also be used to establish cost. Penalties for infringement of the law are up to $1,000.00 for each day on which a violation occurs. Private individuals may also sue for injunctive relief and damages. The meeting competition defense is allowed and the defendant's intent to injure competition must be proved.

Colorado

Colorado's Unfair Practices Act is a general sales below cost law that was amended in 1993 to specifically include sales of motor fuels.[28] The amendment became effective on July 1, 1993. Cost is defined as the lesser of invoice or replacement cost, plus the cost of doing business. This is further defined as including all costs incurred in the operation of the business such as labor, rent, executive salaries, and depreciation. The penalty for each violation of the law is a fine of between $100.00

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[26]Alabama. Motor Fuel Marketing Act, Statutes, Annotated (1984) 8-22.

[27]Under the Alabama Code, the "cost of doing business" is defined as including, but not limited to: labor, rent, interest on borrowed capital, depreciation, selling cost, maintenance of equipment, transportation or freight cost, losses due to breakage or damage; credit card fees; credit losses, licenses, taxes, insurance, and advertising.

[28]Colorado. Unfair Practices Act, Revised Statutes, Annotated (1993) 6-2-105(1b).

and $1,000.00, or imprisonment of up to 6 months, or both. In addition to civil action brought by the state, private parties may sue for damages. The defendant is allowed, however, to meet the legal price of a competitor. Violation of the law also requires an intent by the defendant to injure his competitors or destroy competition.

Florida

Florida's Motor Fuel Marketing Practices Act was enacted in 1985.[29] For a non-refiner (retail station not owned by a refiner), cost consists of the invoice cost, all applicable taxes, inspection fees, freight charges, direct labor costs, and the reasonable rental value of the retail outlet, less credit card allowances, trade discounts and rebates received. Refiner cost is likewise defined with the exception that the invoice cost is replaced with the posted terminal price. Penalties for violation of the law are up to $5,000.00, with each day on which an infraction occurs considered a separate offense. The aggregate of this penalty may not exceed $100,000. Violations of the Act are investigated by the Department of Agriculture and Consumer Services and the Department of Legal Affairs is authorized to bring civil action. Private individuals are also allowed to sue for treble damages. The meeting competition defense is allowed and intent to injure competition must be present. Competition is defined so that injury to an individual competitor would be sufficient evidence of such intent.

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[29]Florida. Motor Fuel Marketing Practices Act, Statutes, Annotated (1985) 526.301-3135.

Massachusetts

Massachusetts passed a general sales below cost law in 1932. A gasoline specific law prohibiting sales below cost was enacted in 1950.[30] This law's definition of cost includes the cost of motor fuel plus the cost of doing business. A cost survey is also a permissible means of establishing cost. The state is authorized to bring civil action and collect penalties of up to $1,000.00. Private parties, on the other hand, are allowed to bring suit for alleged violations, but only for the purpose of obtaining an injunction. A firm is allowed to meet the equally low price of a competitor. Under the general SBC law, intent to injure competition is required for a violation to have occurred. The gasoline specific law does not have such a provision.

Missouri

The Missouri Motor Fuel Marketing Act came into effect on Aug. 28, 1993.[31] Cost is defined as the lowest invoice cost or transfer price, less trade discounts, plus taxes, freight charges, and the "cost of doing business". This last term is further defined as including, rental value, licenses, taxes, utilities, insurance, and non-managerial labor. The state Attorney General is responsible for investigating violations of this law, which may result in penalties of between $1,000.00 and $5,000.00 for each day of

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[30]Massachusetts. Unfair Sales Act for the Retail Sale of Motor Fuels, General Statutes, Annotated (1950) 295P-W.

[31]Missouri. Missouri Motor Fuel Marketing Act, Code, Annotated (1993) 416.600-640.

infraction. In addition, private individuals may bring civil action for the purpose of obtaining an injunction or to recover treble damages. A defendant is allowed to meet the equally low price of a competitor. Also, a violation requires the seller's intent to injure competition.

Montana

The Montana Retail Motor Fuel Marketing Act became effective in 1991.[32] The law forbids the selling of motor fuel at less than its delivered cost plus the cost of doing business. The delivered cost of motor fuel includes the lower of invoice or replacement cost, less all trade discounts, plus all transportation costs and all applicable taxes. For a refiner selling at retail, the invoice cost is replaced with the posted rack price. In the absence of proof of lesser cost, the cost of doing business is defined as 6 percent of the delivered cost of motor fuel for retail sales. Violations of this law may result in a civil penalty of up to $1,000.00 per day. The Department of Justice or a county attorney are authorized to bring civil action for any suspected violation. Private parties injured by a violation may file suit for injunctive relief and actual damages. A meeting competition defense is included. Also, the effect of injuring or destroying competition is required for the action to be illegal. *Prima facie* evidence of such intent is given by advertisement to sell, or the sale of, motor fuels below cost.

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[32]Montana. Montana Retail Motor Fuel Marketing Act, Code, Annotated (1991) 30-14-801-806.

New Jersey

New Jersey's law regulating the sale of motor fuels originally took effect in 1938. In 1953, this act was amended and became known as the Unfair Motor Fuels Practices Act.[33] Minor amendments were again added in 1981. Sales at prices below cost is one of several practices considered illegal under this law. Cost is defined as the invoice cost plus the expense of selling motor fuel. The specific components of this expense are not specified. The State Tax Commissioner is solely responsible for initiating civil action. Penalties of between $50.00 and $200.00 per offense may be given and the retailer's license may be suspended for 5 to 30 days. In lieu of these penalties, an offender may be imprisoned for up to 30 days. This law does not provide a meeting competition defense nor does it require the intent to injure competition or a competitor.

Tennessee

Tennessee's Petroleum Trade Practices Act was enacted in 1977. A section within this act, making sales below cost illegal, was subsequently enacted in 1988.[34] The definition of cost comes from Tennessee's Unfair Sales Law, which applies to all retail sales.[35] It is defined as the lower of the purchase price or replacement cost, less trade discounts, plus a 6 percent markup in the absence of proof of lesser cost. The minimum

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[33]New Jersey. Unfair Motor Fuels Practice Act, Statutes, Annotated (1953) 56:6-20.

[34]Tennessee. Petroleum Trade Practices Act, Code, Annotated (1977) 47-25-611.

[35]Tennessee. Unfair Sales Law, Code, Annotated (1937) 47-25-201.

markup is given as a rule in determining *prima facie* evidence of a sale below cost, although the defendant may still offer evidence to the contrary. Penalties of up to $1,000.00 for each day of violation may be incurred. Private parties are entitled to collect treble damages. The law is not binding, however, if a price is set to meet the equally low price of a competitor. Also, a violation requires the intent to injure competition.

Utah

Utah's Motor Fuel Marketing Act was enacted in 1981 and amended in 1987.[36] Cost is defined as the lowest invoice cost (or the lowest transfer price for a refiner owned station) within 5 days of the alleged infraction, less trade discounts, plus freight charges, taxes, and the "reasonable cost of doing business".[37] In the absence of proof of lesser cost, this is presumed to be 6 percent of the posted retail price. The civil penalty is up to $5,000.00 per violation. In addition, private parties injured by such violation may bring suit for injunctive relief and may be awarded treble damages. A firm is allowed to meet the equally low price of a competitor as an exemption from the law. Also, the intent to injure competition must exist for a violation to have occurred.

The Effects of SBC Laws: A Preliminary Analysis

Initial evidence of the impact of SBC laws on the pricing behavior of firms can be obtained by several means. If the number of legal cases is relatively large, it may indicate

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[36]Utah. Motor Fuel Marketing Act, Code, Annotated (1981) 13-16-1-6.

[37]Ibid., 13-16-2.

the laws are actively enforced. Alternatively, if the number of cases is low, it may indicate that enforcement is lax or that selling below cost seldom occurs in regulated states. The latter may occur because of the threat of litigation. More importantly, the cases and their rulings are *prima facie* evidence of what is occurring in practice. A Lexis search, and additional research, indicates a total of 6 cases resulting from SBC laws since 1985. A case in Montana is currently being prosecuted. Of the 6 cases, 4 have occurred in Alabama, perhaps indicating stronger enforcement in that state. Two of the cases have resulted in convictions.

The earliest case during this period occurred in Alabama in 1986. In Star Service & Petroleum Company, Inc. v. State of Alabama, the state accused Star Service of selling motor fuels at prices below cost with the intent of injuring competition.[38] The Circuit Court ruled in favor of the state and granted injunctive relief. Star Service appealed, disputing the accusation of below cost selling by claiming that the Alabama Motor Fuels Marketing Practices Act allowed pooling regular and unleaded gasoline in the calculation of cost. The court ruled that a separate determination of cost was required for each grade of fuel.

The State of Alabama also brought legal action against a motor fuel marketer in 1987. State of Alabama v. Mapco Petroleum, Inc. was dismissed by the circuit court on grounds that the Motor Fuel Marketing Practices Act was unconstitutional.[39] Upon appeal by the State, the Alabama supreme court reversed this decision, thus upholding the

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[38]Star Service and Petroleum Co., Inc. v. State, 518 So.2d 126 (Ala. Civ. App. 1986).

constitutionality of the law. It determined that the law did not infringe on individual rights in such a manner as to preclude lawful competition. The only section of the law that was deemed unconstitutional was that which allowed a plaintiff to prove a *prima facie* case by showing the defendant's price had been below the plaintiff's costs.

A second conviction was handed down under the Alabama Motor Fuel Marketing Practices Act in 1990. In Money Back, Inc. v. Charles Gray, d/b/a Hilltop Chevron Tire and Service Center, Money Back, Inc. was accused of selling motor fuel at below cost.[40] The dispute originated during a "price war" in which both the plaintiff and the defendant admit to pricing illegally. The defendant, however, also admitted to having the lowest price of any competitor in that market. The plaintiff sued for an injunction and for compensatory damages of $5,409.00. The circuit court ruled in favor of the plaintiff on the basis that the sales were made "with the intent of injuring competitors or destroying or substantially lessening competition".[41] Treble damages of $16,227.00 and attorney's fees and court costs of an additional $8,415.84 were awarded. Upon appeal to the state Supreme Court, the ruling was upheld, but treble damages were lessened to $9, 786.00. This reflected the court's decision that damages awarded to reflect a speculative "upward trend" in the plaintiff's business were not allowable. Under this ruling, the court also determined that the plaintiff was not required to prove that the defendant's intent was

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[39]State ex. rel. Galanos v. Mapco Petroleum, 519 So.2d 1275 (Ala. 1987).

[40]Money Back, Inc. v. Gray, 569 So.2d 325 (Ala. 1990).

[41]Ibid.

unlawful.

The most recent case under the Alabama law occurred in 1992. Several Alabama jobbers sued Mapco, Inc., an independent, unbranded refiner and retailer operating in Alabama.[42] Mapco was accused of selling gasoline below cost for a period of 596 days at one location and 821 days at another. A counterclaim was made by Mapco against the plaintiffs on the grounds of violations of the Sherman Act (U.S.C., title 15, sec. 1- 7), Robinson-Patman Act (U.S.C., title 15, sec. 13) the Alabama Motor Fuel Marketing Act, and the Alabama Unfair Trade Practices Act. The case was then removed to federal court where the decisions were in favor of Mapco in the original case and McGuire in the counterclaim. This ruling also found that the Alabama law required only injury to a competitor as sufficient evidence of a violation. However, the lack of intent to injure a competitor was an allowable defense. Also, the meeting competition defense was not valid if the defendant priced below a competitor's price.

The most recent case was in Tennessee and was decided on March, 15 1993. In Ghem, Inc. v. Mapco Petroleum, Inc., Ghem, Inc. accused Mapco Petroleum, Inc. of selling unleaded gasoline at prices below cost on several specific dates over an 8 month period.[43] The Tennessee Supreme Court requested that several questions be certified by the U.S. Circuit Court of Appeals concerning determination of a violation of the Tennessee Petroleum Practices Act (T.C.A. Sec. 47-25-611). In conjunction with this

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[42]McGuire Oil Co. v. Mapco, Inc., 612 So.2d 417 (Ala. 1992).

[43]Ghem, Inc. v. Mapco Petroleum, Inc., 850 S.W.2d 447 (Tenn. 1993).

request, the defendant was granted its motion for Summary Judgement on this case. Several key elements resulted from the ruling. Although the court found sufficient evidence that Mapco had made sales at prices below cost, it determined that Ghem had provided no evidence of Mapco's intent to injure or destroy competition within the relevant market. As such, damage to an individual competitor from prices below cost did not constitute or imply illegal activity by the defendant. Injury to competition would be indicated by an "actual or threatened net decrease" in the number of competitors.[44] This ruling was based on the necessity of "anti-trust injury" as an element in determining illegal pricing. "Anti-trust injury" was defined to include injury that results from anti-competitive acts that the law was intended to eliminate. Thus, for a firm to be convicted of predatory pricing, the plaintiff must show that any injury incurred was the result of an attempt to monopolize the relevant market.

The constitutionality of Utah's Motor Fuel Marketing Act was also challenged in 1990. The State of Utah v. Rio Vista Oil, Ltd., began in June of 1986 with a civil action brought against Rio Vista Oil by the state on charges of below cost sales.[45] The district court ruled that the law was unconstitutional in that it disallowed a defendant "due process" under both the State of Utah and Federal constitutions. This arose from several specific issues. First, the law prohibited all sales below cost without allowance for the defendant to show lack of intent to injure competition. Second, the law did not allow for

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[44]Ibid.

[45]State v. Rio Vista Oil, Ltd., 786 P.2d 1343 (Utah 1990).

a defendant to price below cost for the purpose of meeting the price of a competitor. Third, violations of the law were difficult to determine due to its ambiguous definition of cost. The state appealed this decision and the Utah Supreme Court reversed the lower court's decision, thus upholding the constitutionality of the law. It ruled that the district court erred in its interpretation of these three issues and that the defendant's due process had not been infringed upon.

These cases indicate that the laws are utilized, but in a limited fashion. This amount of litigation may, however, be sufficient to affect margins based on the threat of penalties. The effect may be observable in the descriptive statistics of the sample when it is split according to states with and without SBC laws. If SBC laws are binding, we would expect the minimum value of retail margins in states with SBC laws to be higher than in states without SBC laws. The statistics in Table 2 are consistent with this hypothesis as the minimum is -3.000 in non-law states and 4.000 in law states. Moreover, this is not the result of a single observation, 34 observations in 14 different cites are below the minimum margin of states with SBC laws. It is noteworthy that the difference between the two means is statistically significant. ($t = 7.48$)

Table 2. Comparison of Descriptive Statistics of Law and Non-Law States

Margin(¢)	Observations	Mean	Minimum	Maximum
Non-Law	3100	15.516	-3.000	37.522
Law	620	17.394	4.000	33.700
Total Number of Observations = 3720				

This demonstrates a difference in the pricing behavior of firms in these two groups and provides evidence of a binding constraint. Further evidence is provided by a detailed look at retail and wholesale price data for five cities in Montana.[46] The Montana SBC law allows for a minimum markup as an alternative method of defining cost. By comparing this definition of cost with the retail margin for each city, several inferences can be drawn. If margins are consistently below the minimum markup for extended periods of time, it is likely the laws have no effect. But, if the margins are generally above the minimum markup, there are two possible explanations. Either the laws are, again, ineffective or they may have effect due to the threat of litigation.

The retail price data for this analysis is from the American Automobile Association (AAA). These prices were surveyed on either a biweekly or monthly basis. The wholesale price data were obtained from Exxon, Inc. and are monthly averages of branded and unbranded rack prices. Calculating a retail margin using average biweekly (or monthly) retail prices and monthly average wholesale prices is less than ideal. To match the two series, average monthly retail prices were computed. For months with more than one retail price observation, a mean price was computed of that month's observations. If only one survey occurred during the month, an average was calculated of the previous month's last observation, the current observation, and the following month's first observation. In cases where only one observation occurred in consecutive months, the average was computed with the previous month's observation, the current

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[46]Montana is not included in the data set used to empirically test the hypotheses in the next chapter.

observation, and the following month's observation. During the one month in which the survey was not conducted, the mean of the adjoining month's observations is that month's average retail price.

The minimum markup is calculated as a percentage of the delivered cost of fuel. In Montana, this is 1 percent for wholesalers and 6 percent for retailers. The retail markup is therefore 6 percent of the sum of the rack price, taxes and the 1 percent markup at the wholesale level. In equation form this is:

$$Retail\ Markup = .06((Rack\ Price + Taxes) + .01(Rack\ Price + Taxes)) \tag{3.5}$$

Figures 6 through 10 below show the graphical comparisons of retail margins and minimum markups for each of the five cities. In each case, the margins are typically above the minimum markup. Margins infrequently go below this level and, if so, for limited periods of time. This may be attributable to the threat of litigation, in which case SBC laws would appear to be effective.

Conclusion

The small amount of litigation evident in most SBC law states would not seem to be indicative of a binding price floor. However, the fact that litigation is not an every day event does not by itself imply that the laws' effects on retail margins are inconsequential. The fear of penalties in SBC states may be sufficient to alter behavior. The descriptive statistics of law and non-law states and the analysis of the Montana data are consistent with this premise. However, to examine this further and obtain a measurement of the

effect of the SBC laws, it is necessary to control for the other variables that may also affect the retail margin and vary between cities. The empirical analysis presented in the next chapter controls for these other variables.

Figure 5. Retail Margins and Minimum Markups for Billings, MT

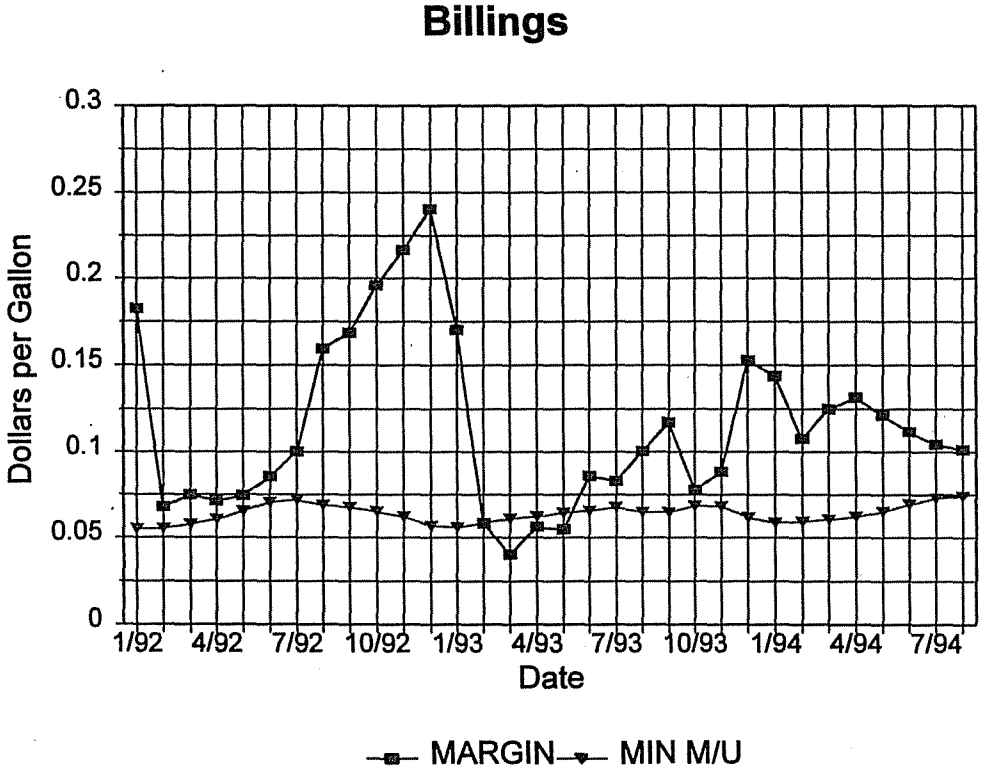


Figure 6. Retail Margins and Minimum Markups for Bozeman, MT

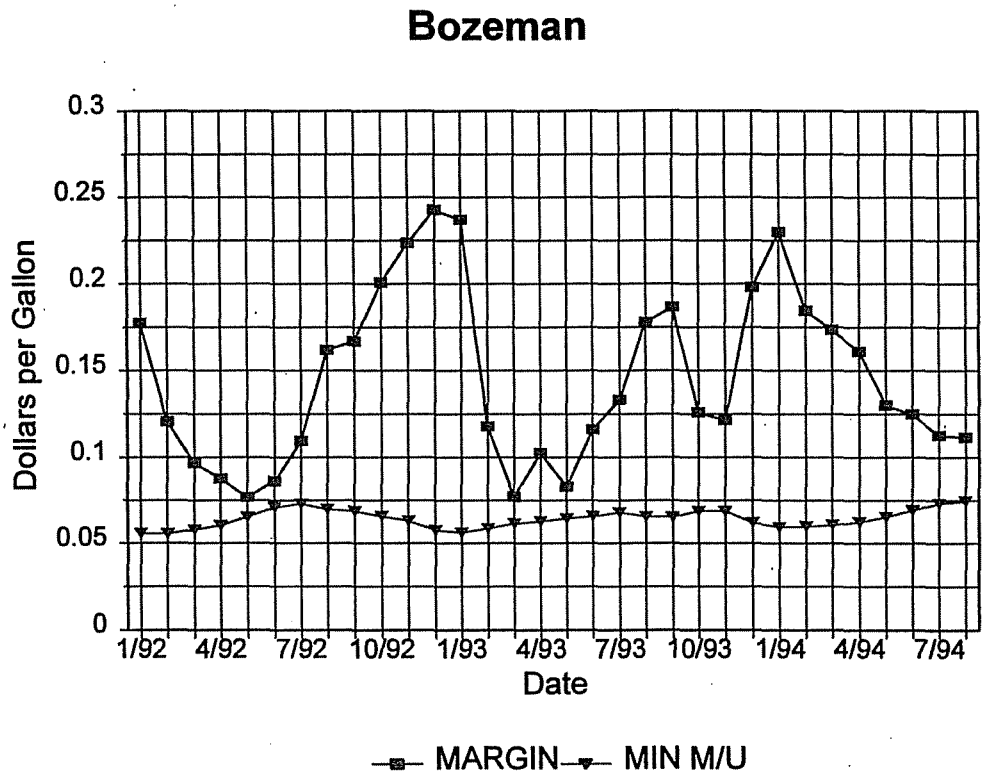


Figure 7. Retail Margins and Minimum Markups for Great Falls, MT

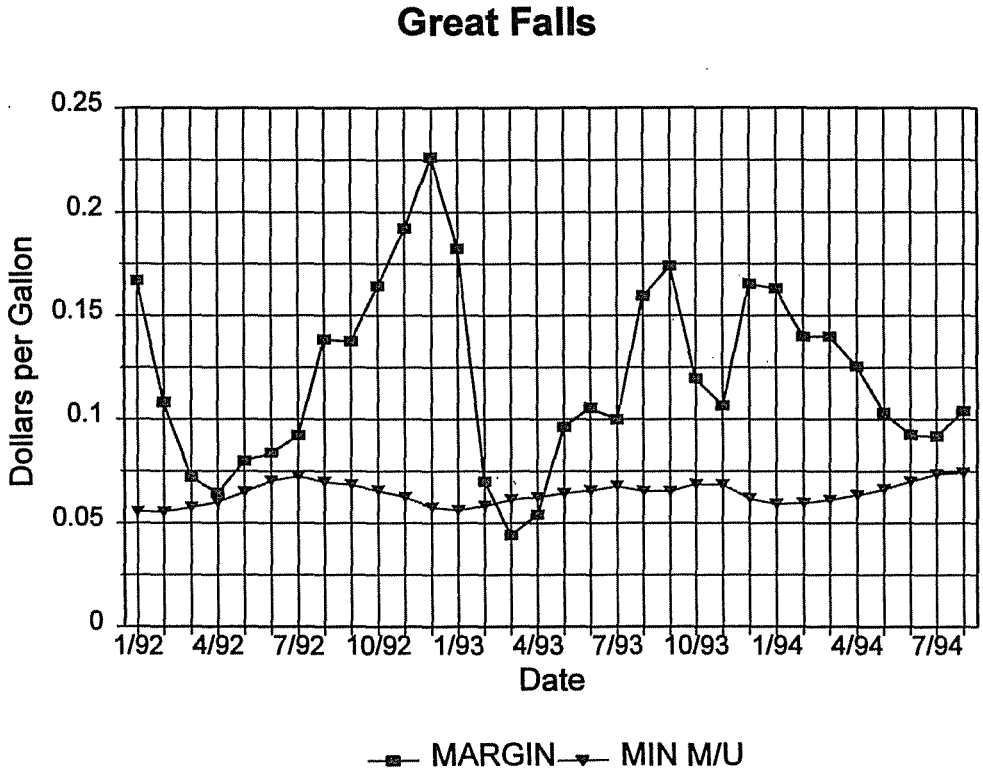


Figure 8. Retail Margins and Minimum Markups for Helena, MT

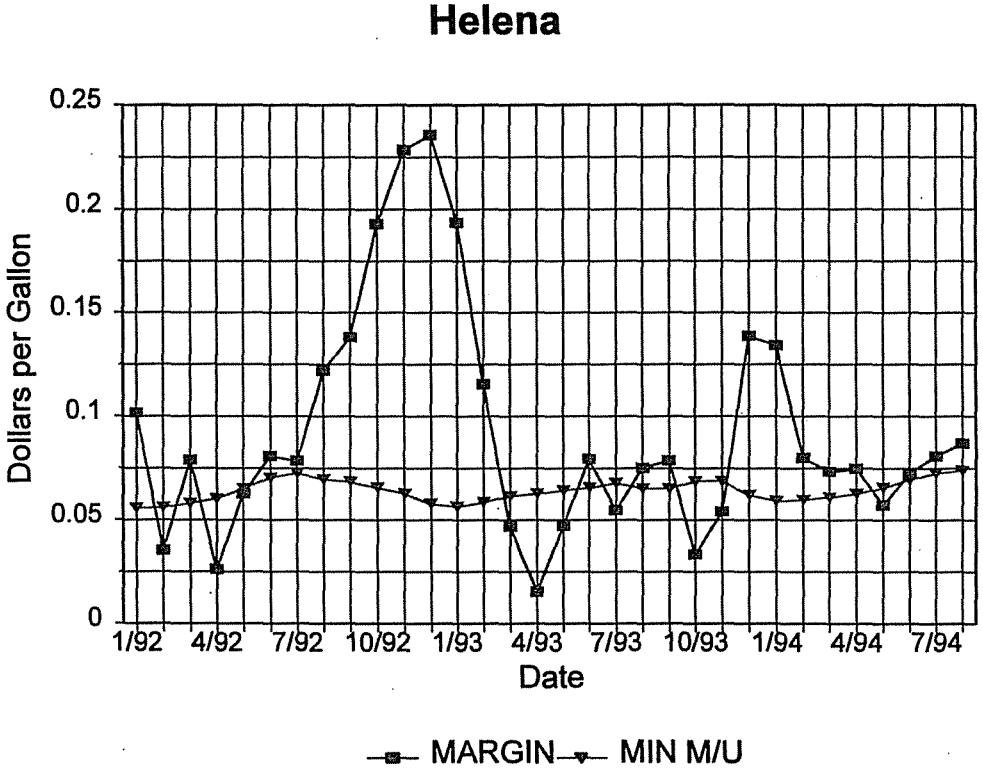
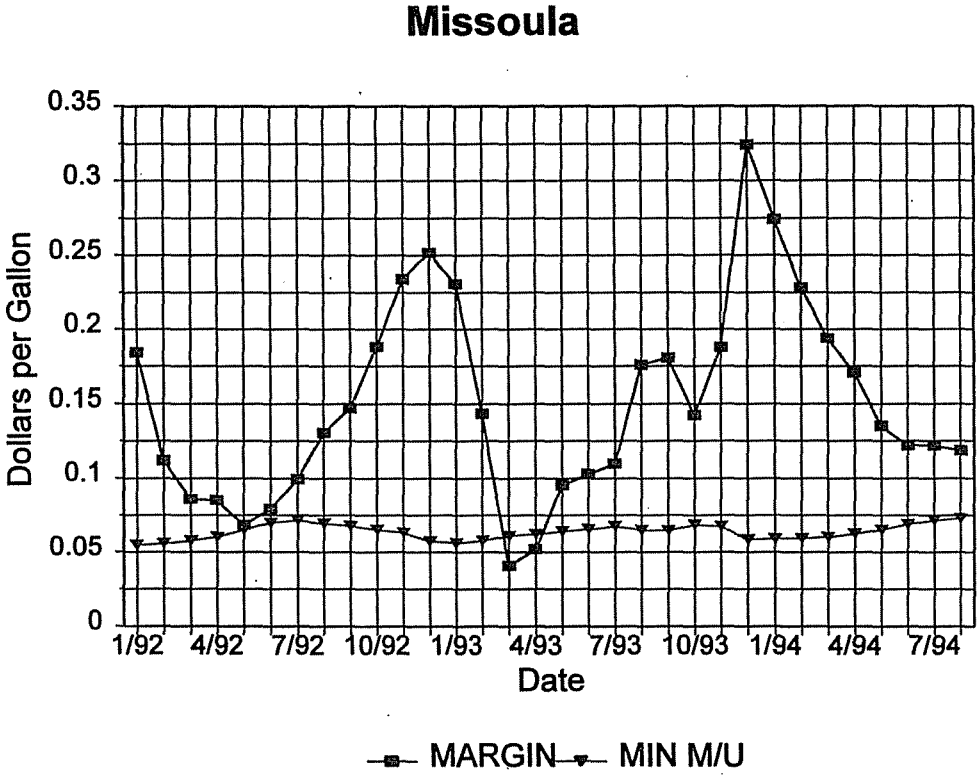


Figure 9. Retail Margins and Minimum Markups for Missoula, MT



CHAPTER 4

EMPIRICAL TESTS AND RESULTS

Introduction

The purpose of this chapter is to empirically test for the effect of the SBC laws. The analysis begins with the econometric specification of the models used in undertaking the various tests. Several models are constructed. The first of these include 92 weekly, time dummy variables to account for a seasonal pattern in the retail margins. The issues of asymmetric response to changes in wholesale prices and the lag structure of prices are also empirically examined.

Econometric Considerations

The use of pooled data presents several problems. For example, this is time series data and the error terms may be serially correlated. Indeed, diagnostic tests performed on margin data for each city indicated the presence of first order autocorrelation that varies across cities. Additionally, in cross sectional data there is the potential problem of heteroscedastic errors. Application of the Bruesch-Pagan test rejects the hypothesis of homoscedasticity.[2] Estimation of the models therefore requires correction for an error

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[2]T.S. Breusch and A.R. Pagan, "A Simple Test for Heteroscedasticity and Random Coefficient Variation," Econometrica 47 (1979): 1287-1294.

term with the following specification.

$$E(\varepsilon_{it}^2)=\sigma_i^2$$
$$\varepsilon_{it}=\rho_i\varepsilon_{i,t-1}+\mu_{it}$$
$$with \quad \mu_{it}\sim N(0,\sigma_{\mu i}^2)$$

The estimation procedure uses the method described in Kmenta (1986) to correct for cross-sectional heteroscedasticity and first order autocorrelation with pooled data.[3]

Model Specification and Results

Measuring the Effect on Retail Margins

The model used to test the hypothesis that SBC laws may result in higher retail margins is

$$Margin_{it}=\beta_0+\beta_1 Retwage_{it}+\beta_2 Prval_{it}+\beta_3 Popden_{it}+ \beta_4 NSS_{it}+\beta_5 LAW_{it}+\sum_{t=1}^{T-1}\gamma_{it}W_{it}+\varepsilon_{it}\ , \tag{4.1}$$

where Margin = the retail margin,
Retwage = the retail wage,
Prval = the property value,
Popden = the population density,
NSS = a dummy variable that takes a value of 1 for cities within states that prohibit the sale of self service gasoline and 0 otherwise,[4]
LAW = a dummy variable that takes a value of 1 for cities within states that have a gasoline specific SBC law and 0 otherwise, and
W_t = a weekly dummy variable for time t (T=93).

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[3]Jan Kmenta, Elements of Econometrics, 2d ed., (New York: MacMillan Publishing Company, 1986), 618-622.

[4]New Jersey and Oregon prohibit the sale of self service gasoline. In this sample, Newark and Portland are affected by this law.

Table 3 lists the regression results. The coefficient on LAW is positive and significant, indicating that gasoline SBC laws increase retail margins, on average, by approximately .8 cents. With the exception of the retail wage, all other variables have the expected signs and are statistically significant at the 5 percent level or greater.[5] Of additional interest are the substantially higher margins in states that prohibit the sale of self service gasoline.

Table 3. The Effect of SBC Laws on the Retail Margin

Dependent Variable = Margin		
Independent Variables	Estimated Coefficient	*t* - statistics
Retwage	-0.007	-0.545
Prval(,000)	0.040	6.053***
Popden(,000/sq mile)	-0.113	-2.148**
NSS	5.810	5.732***
LAW	0.841	1.976**
Adjusted R^2 = .49 Number of Observations = 3720	Denotes significance at: *** = 1%, ** = 5%	

It is a reasonable assumption, however, that the effect on margins is greater if the laws are actively enforced. As was shown in Chapter 3, four of the six recent cases occurred in Alabama. Thus, if active enforcement increases the likelihood that SBC laws have effect, the margins in Alabama should be higher relative to other states with SBC

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[5]See Appendix E for the results of this regression, including the time dummy variables.

laws. A model to test this is

$$Margin_{it} = \beta_0 + \beta_1 Retwage_{it} + \beta_2 Prval_{it} + \beta_3 Popden_{it} + \beta_4 NSS_{it} + \beta_5 LAW_{it} + \beta_6 AL_{it} + \sum_{t=1}^{T-1} \gamma_{it} W_{it} + \varepsilon_{it} , \quad (4.2)$$

where AL = a dummy variable that takes a value of 1 if the city is in Alabama and zero otherwise.[6]

All other variables are as previously defined. Table 4 shows the regression results for this equation. The coefficient on the variable AL indicates that margins are 2.22 cents higher in Alabama relative to other states with SBC laws. The variable LAW remains positive, but is not statistically significant. Thus, active enforcement, as in the case of Alabama, appears to be an important factor for SBC laws to lead to higher margins.[7]

An additional test of the effect on margins can be made if a particular state's SBC law became effective during the time period of the sample. Missouri and Colorado fit this criteria. A simple model to test for higher margins after the effective date of the law for an individual city is

$$Margin_t = \beta_0 + \beta_1 LAW_t + TIME_t + \varepsilon_t \quad (4.3)$$

where LAW = a dummy variable that takes a value of 1 for the time period after the effective date of the SBC law and is 0 otherwise, and
TIME = a time trend variable to account for inflationary effects.

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[6]Birmingham is the only city in Alabama represented in the sample.

[7]Tennessee and Utah have each had one case since 1985, indicating only a slight amount of enforcement. A dummy variable that includes these states in equation 4.2 is not statistically significant, supporting the notion that active enforcement is a primary determinant of the effect on margins.

Table 4. The Impact of Active Legal Enforcement

Dependent Variable = Margin		
Independent Variables	Estimated Coefficient	*t* - statistics
Retwage	-0.013	-1.036
Prval(,000)	0.043	6.423***
Popden(,000/sq mile)	-0.098	-1.840*
NSS	6.106	5.857***
LAW	0.359	0.743
AL	2.220	2.564**
Adjusted R^2 = .49	Denotes significance at: *** = 1%, ** = 5%, *=10%	
Number of Observations = 3720		

This model is run for each of three cities represented in Missouri and Colorado. In each case, the coefficient β_1 is negative and not statistically significant, indicating that introduction of the laws did not affect the margin.

Equations 4.1 and 4.2, however, do not take into account seasonal demand changes that may vary between cities. To account for this, the quantity variable detailed in Chapter 3 was included. Data was obtained from the Federal Highway Administration's table "Highway Use of Gasoline by States".[8] Since these data are estimates distributed so as to preserve seasonal driving patterns, some error may be involved. Moreover, lags of up to 6 weeks before consumption make these questionable

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[8]Department of Transportation, Table MF-26. The obvious reporting errors in the alternative sources makes their use difficult and authenticity questionable.

proxies for current demand.[9]

If the observed quantities accurately measure demand, quantity and margin should be positively correlated. Recall the quantity/seasonality variable constructed in the previous chapter. Observed weekly quantities, Q, were interpolated from the source listed above. An instrument, yielding price-effect corrected quantities, $\hat{Q}$, was constructed and these variables were then normalized around their mean values. When the price elasticity of demand, η, is set to zero, the normalized Q is equal to $\hat{Q}$. The inclusion of that variable into equation 4.1 yielded a coefficient that was not significantly different from zero, contrary to the hypothesized effect. Experimenting by including the price effect corrected quantity for $\eta = -.1$, increased the coefficient value to 13.35, while for $\eta = -.2$, the coefficient value became 30.77.[10] The variable LAW, however, was not affected by the inclusion of either Q or $\hat{Q}$. Since the results are highly sensitive to small changes in the price elasticity and there appear to be potentially serious errors in the data, we rely on the weekly time dummies to accommodate the seasonal demand patterns.

Another but more complicated model in terms of the error structure, uses the retail price as the dependent variable. In this case, wholesale prices and taxes are included as explanatory variables since these vary over time and across cities. In equation form this is

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[9]Borenstein and Shepard (1993) included a similar quantity measure in their paper. They also note that current demand may affect margins through peak-load pricing or as a result of increased demand elasticity during peak driving months.

[10]Both coefficients for $\hat{Q}$ are statistically significant at the 1 percent level.

$$Retprice_{it} = \beta_0 + \beta_1 Whlprice_{it} + \beta_2 Tax_{it} + \beta_3 Retwage_{it} + \beta_4 Prval_{it} + \beta_5 Popden_{it} + \beta_6 NSS_{it} + \beta_7 LAW_{it} + \sum_{t=1}^{T-1} \gamma_t W_{it} + \varepsilon_{it}, \quad (4.4)$$

where Retprice = the retail price,
Whlprice = the wholesale price, and
Tax = motor fuels taxes.

All other variables, including time dummies, are as previously defined. The regression results are shown below in Table 5. Again, the coefficient on the variable LAW remains positive, but it is not statistically significant. However, we note that the coefficient on the Whlprice variable is only 0.557. This would seem to suggest that wholesale price changes are not fully passed on to the retail level. This issue is addressed in the following section.

Table 5. The Effect of SBC Laws on Retail Price

Dependent Variable = Retail Price		
Independent Variables	Estimated Coefficient	*t* - statistics
Whlprice	0.557	20.800***
Tax	1.073	22.310***
Retwage	-0.011	-0.860
Prval(,000)	0.050	8.488***
Popden(,000/sq mile)	-0.151	-2.815***
NSS	7.852	8.551***
LAW	0.475	1.281
Adjusted R^2 = .51		Denotes significance at: *** = 1%
Number of Observations = 3720		

Measuring Response Differences to
Changes in Wholesale Price

The previous results indicate that retail margins are somewhat affected by the SBC laws. But a binding price floor could also cause retailers to react more quickly to increases in wholesale prices. This argument assumes that retail prices do not adjust instantaneously to changes in wholesale prices and the results reported in Table 5 seem to affirm this. The effect of SBC laws on adjustment processes can be measured by interacting the LAW variable with current and lagged wholesale prices. Conducting this test, however, requires prior knowledge about the lag structure of retail prices.

The analysis of the lag structure began by experimenting with various free form lags on the wholesale price. Equation 4.4 then becomes,

$$Retprice_{it} = \beta_0 + \sum_{j=0}^{n} \alpha_j Whlprice_{i,t-j} + \beta_1 Tax_{it} + \beta_2 Retwage_{it} + \beta_3 Prval_{it} + \beta_4 Popden_{it} + \beta_5 NSS_{it} + \beta_6 LAW_{it} + \sum_{t=1}^{T-1} \gamma_t W_{it} + \varepsilon_{it} \quad . \tag{4.5}$$

A consistent pattern emerges as more lagged terms of the wholesale price are added to this equation. The coefficient on the contemporary wholesale price is consistently between .55 and .60, similar to its value in equation 4.4. The second through fourth weeks are characterized by negative adjustments in retail price. Following this, retail prices begin a slow positive adjustment towards a new equilibrium level.

Long adjustment processes are often modeled by including a lagged dependent

variable as an explanatory variable in equation 4.4. A simple Koyck lag, however, seems inappropriate given the negative adjustment indicated by equation 4.5.[11] A model with a lagged dependent variable that does capture the negative adjustment after the first period is

$$Retprice_{it} = \alpha + \sum_{j=0}^{2} \beta_j Whlprice_{i,t-j} + \beta_3 Retprice_{i,t-1} + \beta_4 Tax_{it} + \beta_5 Retwage_{it} + \beta_6 Prval_{it} + \beta_7 Popden_{it} + \beta_8 NSS_{it} + \beta_9 LAW_{it} + \sum_{t=1}^{T-1} \gamma_t W_{it} + \varepsilon_{it} \quad (4.6)$$

The results of equation 4.6 are given in Table 6. To test the significance of including the one and two period lagged wholesale prices, an F-test was run on the null hypothesis that $\beta_1 = \beta_2 = 0$. This hypothesis is rejected, supporting the time path indicated by equations 4.5 and 4.6 (F=20.00). Further evidence that is consistent with this result is given when considering the following issue.

It has been argued that retail prices respond more quickly to positive changes in wholesale prices than negative. Starting from an initial equilibrium position, a wholesale price decrease supposedly affords a retailer the opportunity for short run profits if the current retail price is maintained. However, under competition the higher prices will not persist. Asymmetry has been attributed to the presence of market power amongst retailers. Shin, however, points to inventory adjustments as one reason for price

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[11]L.M. Koyck, Distributed Lags and Investment Analysis, (Amsterdam: North Holland Publishing Company, 1954).

Table 6. Estimation of the Lag Structure of Prices with a Lagged Dependent Variable

Dependent Variable = $Retprice_t$		
Independent Variables	Estimated Coefficient	t - statistics
$Whlprice_t$	0.567	19.890***
$Whlprice_{t-1}$	-0.603	-14.490***
$Whlprice_{t-2}$	0.132	4.582***
$Retprice_{t-1}$	0.887	113.600***
Tax_t	0.122	11.260***
$Retwage_t$	0.0006	0.356
$Prval_t$ (,000)	0.004	4.383***
$Popden_t$ (,000/sq mile)	-0.014	-1.586
NSS_t	0.676	4.359***
LAW_t	0.142	2.120**
Adjusted R^2 = .88	Denotes significance at: *** = 1%, ** = 5%	
Number of Observations = 3640		

asymmetry in competitive markets.[12] During periods of tight supply, increases in wholesale price may be passed along especially fast. If there is excess supply, however, firms may purchase for future periods as well, thereby slowing the downward movement of retail prices. Moreover, the discussion of gasoline retail markets presented in Chapter 2 suggests that it is highly competitive, thus bringing into question the arguments that price changes are asymmetric for uncompetitive reasons.

Various studies have been done on price asymmetry in the context of the

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[12]David Shin, "Do Product Prices Respond Symmetrically to Changes in Crude Prices," (Washington, D.C.: American Petroleum Institute, Research Study #068, 1992), 4.

petroleum products industry. The results vary, depending on the model and data set used.[13] Bacon, for example, uses a non-linear partial adjustment model and finds only a slight amount of asymmetry.[14] In this model, a quadratic term is included to measure the adjustment process. Changes between wholesale and retail prices were modeled as

$$\Delta NRetpr_{it} = \beta_0(\phi_0 + \phi_1 Whlprice_{i,t-1} - NRetpr_{i,t-1}) + \beta_1(\phi_0 + \phi_1 Whlprice_{i,t-1} - NRetpr_{i,t-1})^2 + \varepsilon_{it} \quad (4.9)$$

where $\Delta NRetpr_{it}$ is the change in retail prices net of taxes. If $\beta_1 = 0$, the model reduces to a linear form and no asymmetry is present. Using Bacon's model we find that asymmetry is present, with positive changes occurring more quickly than negative. The size of the coefficient β_1, however, is extremely small (.007), indicating that the amount of asymmetry is inconsequential.

An alternative estimating procedure is presented by Borenstein, Cameron, and Gilbert (BCG).[15] They study price asymmetry at various levels of the petroleum products industry with a lag adjustment model that incorporates an error-correction term to account for a long run stable relationship between the two price series. If retail and wholesale prices tend to have a fairly constant long run relationship, the error correction term will

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[13]Ibid., 6-11.

[14]Robert W. Bacon, "Rockets and Feathers: The Asymmetric Speed of Adjustment of U.K. Retail Gasoline Prices to Cost Changes," Energy Economics 13, no. 3 (June 1991): 211-218.

[15]Borenstein, Cameron, and Gilbert, (1994).

account for this relationship. BCG model this by including in the regression equation an error correction term of the form :

$$Retprice_{i,t-1}=\phi_0+\phi_1 Whlprice_{i,t-1}+\varepsilon_{i,t-1} \tag{4.10}$$

They then partition the wholesale prices into increasing and decreasing first differences. For our purposes, this can be represented as:

$$\begin{aligned}\Delta Whlprice_{it}^{+} &= Whlprice_{it}-Whlprice_{i,t-1},\ if\ Whlprice_{it}-Whlprice_{i,t-1}>0,\\ &= zero\ otherwise\\ \Delta Whlprice_{it}^{-} &= Whlprice_{it}-Whlprice_{i,t-1},\ if\ Whlprice_{it}-Whlprice_{i,t-1}<0,\\ &= zero\ otherwise\end{aligned} \tag{4.11}$$

BCG find that the positive and negative adjustment processes are statistically different from each other up to 8 weeks after a change in wholesale price, with positive responses occurring more quickly than negative.[16] Following their lead, we include the same error correction term in a slightly different model.[17] The model estimated is shown in equation 4.12 and the results are listed in Table 7.

$$\begin{aligned}\Delta NRetpr_{it}=\alpha_0+\sum_{k=0}^{n}(\beta_k^{+}\Delta Whlprice_{i,t-k}^{+}+\beta_k^{-}\Delta Whlprice_{i,t-k}^{-})\\ +\theta_0 NRetpr_{i,t-1}+\theta_1 Whlprice_{i,t-1}+\theta_2 TIME_{it}+\varepsilon_{it}\end{aligned} \tag{4.12}$$

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[16]Ibid., 26.

[17]Their model also includes lagged positive and negative differences of the dependent variable as explanatory variables. Here, the disturbance term is corrected for autocorrelation.

The error-correction term insures that retail prices fully adjust to wholesale prices according to their long run relationship.[18] Note that dividing θ_1 by θ_0 yields an estimate of the coefficient ϕ_1, shown in equation 4.10. The results, reported in Table 7, yield a ϕ_1 equal to .8. Although less than unity, this constraint results in plausible time paths of adjustment. The time paths using the results presented in Table 7 are given in Figure 10. The results indicate a large first period response, followed by a negative adjustment and then a gradual ascent to a long run equilibrium. This is consistent with the previous results from equations 4.5 and 4.6. A slight amount of asymmetry is indicated using this model, although in the opposite direction than that which supports the premise of market power.[19] An F-test also rejects the hypothesis that the contemporary positive and negative changes are equal ($F = 5.94$).

Another approach to testing for price asymmetries was proposed by Wolfram.[20] As with the procedure by Borenstein, Cameron, and Gilbert, this procedure partitions the data by positive and negative first differences such as:

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[18]Excluding the error correction term yields results that do not indicate full adjustment of retail prices to changes in wholesale prices.

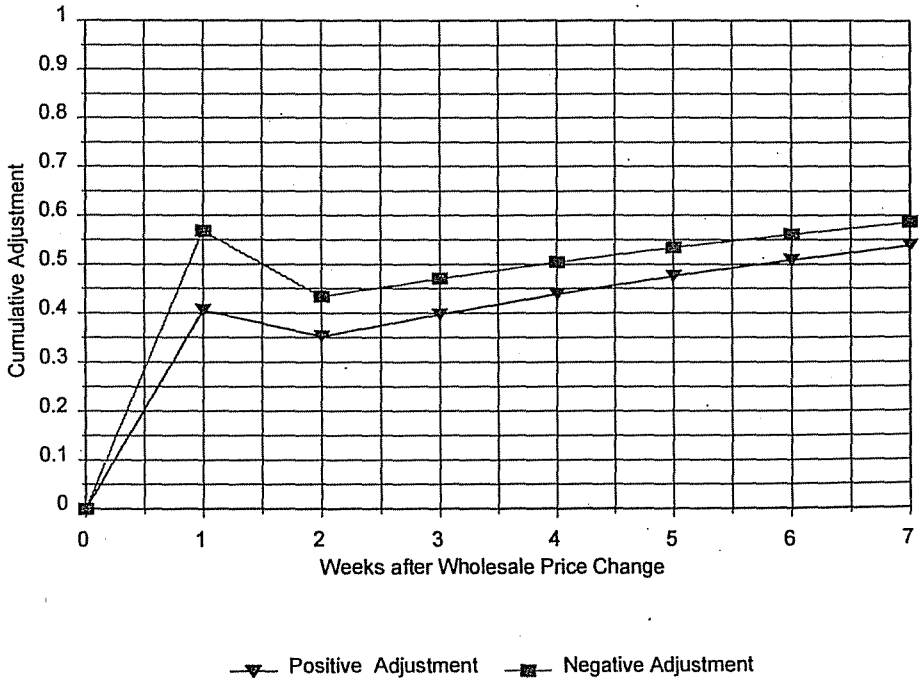
[19]An F-test of the difference between equation 4.12 and a model that does not split wholesale prices into positive and negative differences is statistically significant. This indicates a statistically significant difference between positive and negative changes. Therefore, some asymmetry is present.

[20]Rudolf Wolfram, "Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches - Some Critical Notes," American Journal of Agricultural Economics 53 (1971): 356-59. James P. Houk, "An Approach to Specifying and Estimating Nonreversible Functions," American Journal of Agricultural Economics 59 (Aug., 1977): 570-72, proposes a method of partitioning the independent variable with a slightly different specification than that employed by Wolfram.

Table 7. Test of Asymmetrical Price Responses

Dependent Variable = ΔNRetpr		
Independent Variables	Estimated Coefficient	*t* - statistics
$^{+}\Delta Whlprice_{t}$	0.406	9.286***
$^{+}\Delta Whlprice_{t-1}$	-0.092	-2.138**
$^{-}\Delta Whlprice_{t}$	0.569	14.940***
$^{-}\Delta Whlprice_{t-1}$	-0.159	-4.038**
$Retprice_{t-1}$	-0.099	-14.840***
$Whlprice_{t-1}$	0.080	10.040***
TIME	-0.003	-1.860*
Adjusted R^2 = .18	Denotes significance at: *** = 1%, ** = 5%, * = 10%	
Number of Observations = 3640		

Figure 10. Time Path for the Cumulative Adjustment of Retail Prices to Wholesale Price Changes



$$\begin{matrix} \Delta Whlprice_{it} \geq 0 \\ \Delta Whlprice_{it} \leq 0 \end{matrix} \qquad (4.13)$$

Then, a new vector of prices, WP'_{it}, is formed for the increasing phase. The initial value of this vector is formed by adding the first $\Delta Whlprice_{it} \geq 0$ to the initial value of the vector of observed wholesale prices. Succeeding values of $\Delta Whlprice_{it} \geq 0$ are then summed to the previous values of WP'_{it}. A new vector of prices, WP''_{it}, is formed for the decreasing phase in the same manner using values of $\Delta Whlprice_{it} \leq 0$. The vector of lagged wholesale prices is partitioned following the same procedure. In this case however, the first observation is lost. The initial value of the lagged wholesale prices thus becomes the base value upon which all succeeding positive or negative changes are summed. Applying this procedure for each city yielded mixed results with many of the estimated coefficients being unrealistic. This could be the consequence of using a lagged term that requires the exclusion of the initial observation.

The preceding tests indicate only a slight amount of asymmetry and the direction of the asymmetry is sensitive to the model being used. Thus, the results are not consistent with the hypothesis that the retail gasoline business is non-competitive. Recall that it was argued that retail prices would respond more quickly to positive changes in wholesale price than negative changes and the majority of the adjustment would not occur in the contemporary period. With these issues in mind, we may now proceed with measuring differences in price responsiveness between law and non-law states.

To accomplish this, consider equation 4.12. This model is particularly appropriate since the hypothesized effect will occur for price increases. Interacting the

LAW dummy variable with the current and lagged positive changes of wholesale price allows a measure of any difference between SBC law states and non-SBC law states. The equation estimated is

$$\Delta NRetpr_{it} = \alpha_0 + \sum_{k=0}^{n} [\beta_k^{+}\Delta Whlprice_{i,t-k}^{+} + \beta_k^{-}\Delta Whlprice_{i,t-k}^{-}] + \sum_{k=0}^{n} [(\gamma_k^{+}\Delta Whlprice_{i,t-k}^{+} * LAW_i) + \theta_0 NRetpr_{i,t-1} + \theta_1 Whlprice_{i,t-1} + \theta_2 TIME_{it} + \varepsilon_{it} \quad , \tag{4.14}$$

for $n = 2$. The hypothesis is supported if the coefficients on the interaction terms (γ_k^{+}) are positive. The results of this regression are shown in Table 8. None of the γ_k^{+} coefficients are significantly different from zero.[21]

Conclusion

The above tests, utilizing the retail margin as the dependent variable, indicate that SBC laws do affect the pricing behavior of firms in the retail gasoline business, at least to some extent. It was initially shown that margins were moderately higher in states with SBC laws. The majority of this effect, however, was attributed to active enforcement of the laws. These results are also consistent with the premise that predatory pricing is not a common occurrence in the retail gasoline business.

Regression runs using the retail price as the dependent variable and allowing for a

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[21]These results are not affected if the LAW variable is also interacted with the negative changes.

Table 8. The Differences in Retail Price Response to Increases in Wholesale Prices

Dependent Variable = ΔNRetpr		
Independent Variables	Estimated Coefficient	t - statistics
$^{+}\Delta Whlprice_{t}$	0.400	8.646***
$^{+}\Delta Whlprice_{t-1}$	-0.093	-2.027**
$^{-}\Delta Whlprice_{t}$	0.568	14.920***
$^{-}\Delta Whlprice_{t-1}$	-0.160	-4.051***
$^{+}\Delta Whlprice_{t}$ * LAW	-0.047	0.453
$^{+}\Delta Whlprice_{t-1}$ * LAW	0.007	0.067
$Retprice_{t-1}$	-0.099	-14.830***
$Whlprice_{t-1}$	0.081	10.040***
TIME	-0.003	-1.829*
Adjusted R^2 = .18 Observations = 3640	Significant at: *** = 10%, ** = 5%, * = 1%	

distributive lag process also revealed a statistically significant positive effect of the SBC laws on price. However, it is also clear that the error structure in those models is especially complex. Introducing a more detailed adjustment model allowed for the testing of additional hypotheses. These results, however, do not indicate that retail prices in states with SBC laws respond more quickly to increases in wholesale prices, therefore suggesting that SBC laws are not always binding.

CHAPTER 5

CONCLUSION

The objective of this thesis was to quantify the effects of Sales Below Cost laws in the retail gasoline business. To accomplish this, implications of the laws were inferred from economic theory and a workable definition of a predatory price. Based on the conditions of cost advantage, expected profits, and entry deterrence, the potential for predatory pricing in the retail gasoline business appears unlikely. In comparison with the Areeda and Turner rule, the SBC laws appear to define cost so as to restrict competition and set a binding price floor.

But if the laws are unnecessary and their effect is to restrict, rather than protect, competition, why were they enacted? A plausible answer is that political pressures, initiated by special interest groups, namely independent dealers, have resulted in regulations that protect less efficient firms. This hypothesis would be supported if retail margins in states with SBC laws were higher than states without such laws. Additionally, if the laws are binding, retail gasoline stations in states with SBC laws will increase retail prices more quickly in response to wholesale price increases.

Several preliminary analyses were conducted to obtain a sense of how actively the laws are enforced. Active enforcement would be *prima facie* evidence that SBC laws are binding. The analysis revealed scant evidence of enforcement, except in the state of

Alabama. However, this is merely *prima facie* evidence and the mere threat of penalties may be sufficient to make a SBC law binding. Thus we began to look for direct evidence of a binding price floor. By comparing descriptive statistics, it was revealed that the minimum value of margins were higher in states with SBC laws. And in Montana, retail margins were typically above the minimum markup. These results suggested that the pricing behavior of firms may be affected by these regulations.

While suggestive, further defining and quantifying the effect required empirical tests using time series, cross sectional data. The results indicated that margins are affected by the SBC laws, but the majority of this effect is the result of active enforcement of the law in Alabama. Also, the speed of retail price adjustment in response to increases in wholesale prices was not affected. Although the effect of these laws may be weak, the results support the premise that the industry is not characterized by predatory pricing. Rather than protecting independent dealers from predatory behavior, SBC laws appear to be directed at protecting these same firms from competition.

These results should be understood in the context of several characteristics of the data set. First, the cost data used in the margin equation is aggregate city-wide data and although the data set includes 3720 observations, the variability in these cost measures only occurs across the 40 cities. Second, the nearly impossible task of obtaining the invoice cost of fuel to a typical retailer could result in overestimated margins. Some correction for this problem was offered by the inclusion of the population density variable to account for expected differences in types of ownership based on demographics. Third, measurement of the varying seasonal effect between cities was made difficult by

inadequate data on the quantity of gasoline consumed. A more extensive time series could prove beneficial because seasonal patterns may be identified with more certainty and time series variability could be added to the explanatory variables.

An interesting and additional aspect of this study was the analysis of the lag structure of prices and the hypothesis of asymmetry between positive and negative changes in price. The assumption that the retail gasoline business is relatively competitive imposes several prior expectations about such price behavior. We expect, for example, that retail prices will respond symmetrically to changes in wholesale prices. Since the existing literature argues otherwise, further study in this area is warranted.[1] This would necessitate, however, reliable price data that is preferably measured in time periods that allow reasonable estimates. An additional area of interest relating to the gasoline business is the types of contractual ownership that exist. Although hampered by the accessibility of data, this issue is relevant to recent legislation that, as with Sales Below Cost laws, assumes strategic behavior on the part of large firms.

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[1]For example, Borenstein (1991) argues that price discrimination occurs within the retail gasoline business based on customers willingness switch between retail stations.

REFERENCES CITED

References Cited

Alabama. Motor Fuel Marketing Act. Statutes, Annotated. 1984.

American Petroleum Institute. Policy Analysis Department. "An Overview of Gasoline Prices and Their Determination." Washington D.C.: American Petroleum Institute, 1990.

American Petroleum Institute. State Governmental Relations Department. "State Gasoline Excise Tax Rankings - May 4, 1993." Washington D.C.: American Petroleum Institute, 1993.

Areeda, Phillip, and Donald F. Turner. "Predatory Pricing and Related Practices Under Section 2 of the Sherman Act." Harvard Law Review 88 (1975): 697-733.

Bain, Joe S. Barriers to New Competition. Cambridge: Harvard University Press, 1956.

Barron, John M., Mark A. Lowenstein, and John R. Umbeck, "Predatory Pricing: The Case of the Retail Gasoline Market." Contemporary Policy Issues 3 (Spring 1985): 131-39.

Borenstein, Severin. "Selling Costs and Switching Costs: Explaining Retail Gasoline Margins." The Rand Journal of Economics 22 (Autumn 1991): 354-69.

Borenstein, Severin, A. Colin Cameron, and Richard Gilbert. "Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes." Program on Workable Energy Regulation, University of California Energy Institute, PWP-001R, 1994.

Borenstein, Severin, and Andrea Shepard. "Dynamic Pricing in Retail Gasoline Markets." National Bureau of Economic Research, Research Paper No. 1269, Sept., 1993.

Bork, Robert H. The Antitrust Paradox. New York: Basic Books, Inc., 1978.

Breusch, T.S., and A.R. Pagan. "A Simple Test for Heteroscedasticity and Random Coefficient Variation." Econometrica 47 (1979): 1287 - 1294.

Burns, Malcolm R. "Predatory Pricing and the Acquisition Cost of Competitors." Journal of Political Economy 94, no. 2 (April 1986): 266-296.

Carlton, Dennis W., and Jeffrey M. Perloff. Modern Industrial Organization. New York, N.Y.: Harper Collins College Publishers, 1994.

Colorado. Unfair Practices Act. Revised Statutes, Annotated. 1993.

Dahl, Carol and Thomas Sterner. "Analyzing Gasoline Demand Elasticities: A Survey." Energy Economics (July 1991): 203-210.

Dennison, Mike. "Restriction on Gasoline Prices Widely Criticized." Great Falls Tribune, 25 Sept. 1995, 2(A).

Dougher, Rayola, and Thomas F.Hogarty. "The Impact of State Legislation on the Number of Retail Gasoline Outlets." Washington D.C.: American Petroleum Institute, Research Study 062, 1991.

Easterbrook, Frank H. "Predatory Strategies and Counterstrategies." The University of Chicago Law Review 48, no. 2 (1981): 263 - 337.

Florida. Motor Fuel Marketing Practices Act. Statutes, Annotated. 1985.

Gellerson - Savvides, Evi. "The Effects of State Below Cost Selling Laws on Retail Prices of Motor Gasoline." Washington D.C.: American Petroleum Instititute, Research Study 043, 1987.

Hogarty, Thomas F., and Perry M. Lindstrom. "Empirical Examination of Allegations of Below Cost Retail Selling of Gasoline by Refiners." Washington D.C.: American Petroleum Institute, Research Study 038, 1986.

Houck, James P. "An Approach to Specifying and Estimating Nonreversible Functions." American Journal of Agricultural Economics (Aug. 1977): 570-72.

Kmenta, Jan. Elements of Econometrics: 2nd ed. New York: Macmillan Publishing Company, 1986.

Koyck, L.M. Distributed Lags and Investment Analysis. Amsterdam: North Holland Publishing Company, 1954.

Massachusetts. Unfair Sales Act for the Retail Sale of Motor Fuels. General Statutes, Annotated. 1950.

McGee, John S. "Predatory Pricing Revisited." The Journal of Law and Economics 23, no. 2 (Oct. 1980): 289-330.

Missouri. Missouri Motor Fuel Marketing Act. Code, Annotated. 1993.

Montana. Montana Retail Motor Fuel Marketing Act. Code Annotated. 1991.

Motor Fuel Pricing Problems. prepared by Paul E. Verdon, Staff Researcher. Helena, MT: Montana Legislative Council, 1990.

New Jersey. Unfair Motor Fuels Practice Act. Statutes, Annotated. 1953.

Oil and Gas Journal. (Tulsa, OK) 23 Mar. 1992 - 27 Dec. 1993.

Scherer, F.M. "Predatory Pricing and the Sherman Act: A Comment." Harvard Law Review 89 (1976): 869-890.

Shepard, Andrea. "Contractual Form, Retail Price, and Asset Characteristics in Gasoline Retailing." The Rand Journal of Economics 24 (Spring 1994): 58-77.

Shin, David. "Do Product Prices Respond Symmetrically to Changes in Crude Prices?" Washington D.C.: American Petroleum Institute, Research Study #068, 1992.

Solomon, Caleb. "Independent Gas Stations Cry Foul Over Price Wars." The Wall Street Journal, 1 April 1991, 7(B).

Sorenson, Philip E., Rayola S. Dougher, Lisa A. Hofman, and Thomas. F. Hogarty. "An Economic Analysis of the Distributor-Dealer Wholesale Gasoline Price Inversion of 1990: The Effects of Different Contractual Relations." Washington D.C.: American Petroleum Institute, 1991.

The Road Information Program. 1993 State Highway Funding Methods. Washington, D.C.: The Road Information Program, 1993.

Tennessee. Petroleum Trade Practices Act. Code, Annotated. 1977.

Tennessee. Unfair Sales Law. Code, Annotated. 1937.

U.S. Department of Commerce. Economics and Statistics Administration. County and City Data Book: 1994. Washington D.C.: U.S. Government Printing Office, 1994.

_____. 1992 Census of Retail Trade. Geographic Area Series. Washington D.C.: U.S. Government Printing Office, 1994.

U.S. Department of Energy. Energy Information Administration. Petroleum Marketing Monthly. Washington D.C.: U.S. Government Printing Office, Mar. 1992 - Dec. 1993.

_____. Petroleum Supply Annual 1993. Washington D.C.: U.S. Government Printing Office, 1994.

U.S. Department of Energy. Minimum Markup Laws in Gasoline Marketing: An Economic Analysis and a Legal, Economic and Legislative Review. Washington D.C.: U.S. Government Printing Office, 1985.

U.S. Department of Transportation. Federal Highway Administration. Monthly Motor Fuel Reported by States. Washington D.C.: U.S. Government Printing Office, Mar. 1992 - Dec. 1993.

_____. Highway Statistics. Washington D.C.: U.S. Government Printing Office, 1992, 1993.

Utah. Motor Fuel Marketing Act. Code, Annotated. 1981.

Williamson, Oliver E. "Predatory Pricing: A Strategic and Welfare Analysis." The Yale Law Journal 87, no. 2 (1977): 284 - 340.

Wolffram, Rudolf. "Positivistic Measures of Aggregate Supply Elasticities: Some New Approaches - Some Critical Notes." American Journal of Agricultural Economics 53 (1971): 356-59.

APPENDICES

APPENDIX A

INTERPOLATION OF WEEKLY QUANTITY DATA

Interpolation Method of Weekly Quantity/Seasonality Variable

1) Let:
   a) mvol = the monthly total volume for the current month. This value will become the quantity value for the last day of the current month.
   b) lagmvol = the monthly total volume for the previous month. This value will become the quantity value for the last day of the previous month.

2) Calculate the slope of a line between mvol and lagmvol.

slope = (mvol - lagmvol)/no. of days in current month

3) Multiply slope times the number of days corresponding to the date of the price observation.

4) Add result from (3) to lagmvol to get the weekly quantity for that observation.

APPENDIX B

DESCRIPTIVE STATISTICS

Table 9. Descriptive Statistics of Key Variables (part 1) (3720 observations)

Variable	Mean	St. Dev.	Minimum	Maximum
Whlprice (¢)	61.023	7.260	38.000	81.000
Retprice (¢)	111.870	8.708	85.100	142.500
Margin (¢)	15.829	5.748	-3.000	37.522
Retwg ($)	226.210	24.118	187.790	288.340
Prval ($,000)	84.401	56.950	25.600	298.900
Popden (,000/sq mile)	5.854	4.580	0.746	23.671
NSS	0.050	0.218	0.000	1.000
LAW	0.167	0.373	0.000	1.000
W_t	0.011	0.103	0.000	1.000
AL	0.025	0.156	0.000	1.000
Tax (¢)	35.015	4.990	22.100	49.999
Time	47.000	26.849	1.000	93.000

Table 9. Descriptive Statistics of Key Variables (part 2) (3640 Observations)

Name	Mean	St. Dev.	Minimum	Maximum
(all values are in cents)				
$Nretpr_{it}$	76.984	7.212	51.533	101.150
$\Delta NRetpr_{it}$	-0.034	2.414	-13.643	18.100
$Whlprice_{i,t}$	61.047	7.328	38.000	81.000
$Whlprice_{i,t-1}$	61.234	7.071	38.000	81.000
$Whlprice_{i,t-2}$	61.415	6.805	38.000	81.000
$\Delta Whlprice^{+}_{it}$	0.495	0.873	0.000	11.700
$\Delta Whlprice^{-}_{it}$	-0.682	1.048	-13.800	0.000
$\Delta Whlprice^{+}_{i,t-1}$	0.498	0.873	0.000	11.700
$\Delta Whlprice^{-}_{i,t-1}$	-0.679	1.049	-13.800	0.000
TIME	48.000	26.271	3.000	93.000

APPENDIX C

MOTOR FUELS TAXES BY CITY

Table 10. Motor Fuels Taxes and Computational Formulas as of Dec. 27, 1993 (part 1)

City	ST* (¢)	FT (¢)**	Misc.Per Gallon Tax (¢)	Sales Tax Base (STB) (¢)	State Sales Tax (%)	Local Sales Tax (%)	Sales Tax Formula
Albuqurque	23	18.4	N/A	N/A			
Atlanta	7.5	18.4	N/A	RP-ST	4	1	STB - (STB/1.05)
Baltimore	23.5	18.4	N/A	N/A			
Birmingham	18	18.4	1	N/A			
Boston	21	18.4	N/A	N/A			
Buffalo	22.24	18.4	N/A	RP-8	4.5	4	STB - (STB/1.08)
Cheyenne	9	18.4	N/A	N/A			
Chicago	19	18.4	N/A	RP-ST	6.25	1.75	STB - (STB/1.08)
Cleveland	22	18.4	N/A	N/A			
Dallas	20	18.4	N/A	N/A			
Denver	22	18.4	N/A	N/A			
Des Moines	20	18.4	N/A	N/A			
Detroit	15	18.4	N/A	RP-16	4		STB - (STB/1.04)
Houston	20	18.4	N/A	N/A			
Indianapolis	15	18.4	N/A	RP-ST-FT	5		STB - (STB/1.05)
Kansas City	13.03	18.4	N/A	N/A			
Los Angeles	17	18.4	N/A	RP	7.25	1	STB - (STB/1.0825)
Memphis	20	18.4	N/A	N/A			
Miami	11.8	18.4	10.3	N/A			
Milwaukee	23.2	18.4	N/A	N/A			
Minneapolis	20	18.4	N/A	N/A			
New York	22.24	18.4	N/A	RP-8	4.5	4.25	STB - (STB/1.0825)
New Orleans	20	18.4	N/A	N/A			
Newark	10.5	18.4	4	N/A			

Table 10. Motor Fuels Taxes and Computational Formulas as of Dec. 27, 1993 (part2)

Norfolk	17.5	18.4	N/A	N/A			
Okla. City	17	18.4	N/A	N/A			
Omaha	24.4	18.4	N/A	N/A			
Pheonix	18	18.4	N/A	N/A			
Philadelphia	22.35	18.4	N/A	N/A			
Pittsburgh	22.35	18.4	N/A	N/A			
Portland	24	18.4	N/A	N/A			
Salt Lk. City	19	18.4	N/A	N/A			
San Antonio	20	18.4	N/A	N/A			
San Diego	17	18.4	N/A	RP	7.25	0.5	STB - (STB/1.0775)
San Francisco	17	18.4	N/A	RP	7.25	1.25	STB - (STB/1.085)
Seattle	23	18.4	N/A	N/A			
St. Louis	13.03	18.4	N/A	N/A			
Tulsa	17	18.4	N/A	N/A			
Wash., D.C.	20	18.4	N/A	N/A			
Wichita	18	18.4	N/A	N/A			

ST = State per Gallon Tax
FT = Federal per Gallon Tax
RP = Retail Price
N/A = Not Applicable
* Some state taxes vary during during the sample period.
** Prior to Oct. 1, 1993, the Federal Gasoline Tax was 14.1 cents.
Sources: Federal Highway Administration, Monthly Motor Fuel Reported by States (various dates); The Road Information Program, 1993 State Highway Funding Methods; American Petroleum Institute, "State Gasoline Excise Tax Rankings - May 4, 1993".

APPENDIX D

SALES BELOW COST LAWS BY STATE

Table11. Sales Below Cost Laws by State

State	Sales Below Cost Law	Minimum Markup Provision
Alabama	✓	
Arizona		
California		
Colorado	✓	
District of Columbia		
Florida	✓	
Georgia		
Illinois		
Indiana		
Iowa		
Kansas		
Louisiana		
Maryland		
Massachusetts	✓	✓
Michigan		
Minnesota		
Missouri	✓	
Montana	✓	✓
Nebraska		
New York		
New Mexico		
New Jersey	✓	
Ohio		
Oklahoma		
Oregon		
Pennslyvania		
Tennessee	✓	✓
Texas		
Utah	✓	✓
Virginia		
Washington		
Wisconsin		
Wyoming		

✓ denotes the existence of a Sales Below Cost Law or Minimum Markup Provision

APPENDIX E

REGRESSION RESULTS OF EQUATION 4.1

Table 12. Full Regression Results of Equation 4.1 (part 1)

Dependent Variable = Margin		
Independent Variable	Coefficient Value	*t*-statistic
Retwg	-0.007	-0.545
Prval	0.040	6.053
Popden	-0.113	-2.148
NSS	5.810	5.732
LAW	0.841	1.976
W_1	-12.254	-18.320
W_2	-13.762	-20.680
W_3	-16.262	-24.510
W_4	-15.231	-23.010
W_5	-13.930	-21.080
W_6	-14.337	-21.730
W_7	-15.000	-22.750
W_8	-14.924	-22.650
W_9	-13.175	-20.000
W_{10}	-13.286	-20.170
W_{11}	-12.923	-19.630
W_{12}	-13.016	-19.770
W_{13}	-11.736	-17.830
W_{14}	-10.067	-15.290
W_{15}	-8.356	-12.700
W_{16}	-7.439	-11.300
W_{17}	-5.815	-8.836
W_{18}	-7.333	11.140
W_{19}	-8.138	-12.370
W_{20}	-7.545	-11.460
W_{21}	-7.271	-11.050
W_{22}	-8.768	-13.320
W_{23}	-9.979	-15.160
W_{24}	-11.259	-17.110
W_{25}	-11.190	-17.000
W_{26}	-9.907	-15.050
W_{27}	-7.759	-11.790
W_{28}	-7.641	-11.610
W_{29}	-8.132	-12.360
W_{30}	-8.820	-13.400
W_{31}	-8.642	-13.130
W_{32}	-8.500	-12.920

Table 12. Full Regression Results of Equation 4.1 (part 2)

Independent Variable	Coefficient Value	t-statistic
W_{33}	-7.802	-11.860
W_{34}	-6.677	-10.150
W_{35}	-4.119	-6.259
W_{36}	-4.074	-6.191
W_{37}	-3.488	-5.300
W_{38}	-2.498	-3.796
W_{39}	-2.824	-4.291
W_{40}	-5.375	-8.168
W_{41}	-5.645	-8.577
W_{42}	-5.645	-8.578
W_{43}	-5.598	-8.507
W_{44}	-3.062	-4.653
W_{45}	-3.004	4.566
W_{46}	-2.984	-4.535
W_{47}	-2.986	-4.537
W_{48}	-3.003	4.564
W_{49}	-6.995	-10.630
W_{50}	-7.049	-10.710
W_{51}	-7.086	10.770
W_{52}	-7.121	-10.820
W_{53}	-7.158	-10.880
W_{54}	-11.479	-17.450
W_{55}	-11.509	-17.500
W_{56}	-11.560	-17.580
W_{57}	-12.707	-19.320
W_{58}	-12.751	-19.400
W_{59}	-12.832	-19.520
W_{60}	-12.889	-19.610
W_{61}	-11.145	-16.970
W_{62}	-11.193	-17.040
W_{63}	-11.218	-17.090
W_{64}	-11.234	-17.120
W_{65}	-11.223	-17.120
W_{66}	-6.510	-9.935
W_{67}	-6.489	-9.911
W_{68}	-6.624	-10.130
W_{69}	-6.487	-9.931
W_{70}	-4.485	-6.877

Table 12. Regression Results of Equation 4.1 (part 3)

Independent Variable	Coefficient Value	t-statistic
W_{71}	-4.484	-6.887
W_{72}	-4.482	-6.898
W_{73}	-4.492	-6.930
W_{74}	-4.518	-6.992
W_{75}	-8.393	-13.030
W_{76}	-8.372	-13.060
W_{77}	-8.521	-13.360
W_{78}	-8.529	-13.460
W_{79}	-6.590	10.480
W_{80}	-6.618	-10.620
W_{81}	-10.961	-17.780
W_{82}	-10.978	-18.050
W_{83}	-9.450	-15.800
W_{84}	-9.453	-16.140
W_{85}	-9.475	-16.600
W_{86}	-9.497	-17.190
W_{87}	-4.220	-7.966
W_{88}	-4.225	-8.425
W_{89}	-4.225	-9.075
W_{90}	-4.222	10.080
W_{91}	-0.023	-0.064
W_{92}	-0.021	-0.081
Constant	22.549	8.914
Adjusted $R^2 = .49$		
3720 Observations		