The Empirical Analysis of Predatory Pricing Aspects of Loss Leading*

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Abstract

One of the most common policies to prevent predatory pricing is to regulate loss leading prices through below-cost sales laws. Yet only a handful of research studies have been conducted on the competitive impact of loss leading and laws against it, both theoretically and empirically, yielding conflicting predictions. My research aims to empirically analyze the predatory aspects of loss leading pricing strategies and the effectiveness of below-cost sales (BCS) laws. Specifically, I study the retail gasoline market, leveraging state law changes in Wisconsin as a natural experiment. Analyzing station-week level price data over six years and employing a difference-in-differences approach, the research finds that all firms engage in loss leading pricing about 3.2% of the time when below-cost sales are permitted. However, the BCS law is not effective in preventing loss leading pricing at least in the first couple of years. Unlike the predatory theory predicts, loss leading pricing was primarily driven by small firms, not large firms, and although margins were squeezed for all firms, small firms' margins decreased more than large firms. Lastly, again contrary to conventional predatory pricing narratives, the absence of BCS laws did not significantly affect the total number of gas stations, regardless of the firm size. These findings do not support that loss leading pricing is predatory. This paper contributes to antitrust literature by providing insights into the impact of BCS laws on competition and challenging prevailing notions regarding loss leading pricing strategies.

JEL codes: L4; L5; L81; K2
Key words: loss leading; below-cost sales; minimum markup; predatory pricing

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1 Introduction

Sometimes firms cannot sell products at excessively low prices because government regulations forbid below-cost sales. These laws are imposed in France, Germany, and nearly half of the states of the U.S.[1] For instance, some states currently do not allow retail gas stations to set prices lower than the cost. The purpose of such laws is to ensure healthy competition in the market and protect consumer welfare. These regulations aim to prevent large firms (e.g., chain grocery stores) from engaging in predatory pricing strategies, such as loss leading. If sales below cost are permitted, large firms can lower prices of certain products at a loss, making it difficult for small firms (e.g., mom and pop shops) to compete. This aggressive price discounting on loss leaders can drive small firms out of the market, leading to a more concentrated economy and ultimately harming competition and consumer surplus. For instance, Matt Hauser, former president of the Wisconsin Petroleum Marketers & Convenience Store Association in 2010 said that prohibiting below-cost sales supports independent gas station owners and benefits consumers by preventing concentration of market power.[2] On the other hand, the Federal Trade Commission (FTC) states that courts, including the Supreme Court, finds predatory pricing claims skeptical. [3] In addition, FTC views that predatory pricing is unlikely in a competitive market, such as gasoline retailing. Yet, there is no empirical research on the predatory aspects of loss leading.

My research aims to empirically analyze the predatory aspects of loss leading pricing strategies and the effectiveness of below-cost sales (BCS) laws. I exploit the unique state law changes on below-cost sales of retail gasoline in Wisconsin.[4] In February 2009, the BCS law was repealed, then it was reinstated in September 2010. Data is available on the station-week level price in nearly all stations in Wisconsin and surrounding states over six years and the empirical strategy is to use two-way difference-in-differences approach as well as synthetic difference-in-differences.

[1] The Federal Trade Commissions (2005)

[2] Milwaukee Journal Sentinel)

[3] Federal Trade Commission (FTC)'s Guide to Antitrust Laws

[4] There has not been any other states which changed BCS law since Wisconsin's changes except that Minnesota removed BCS law in the middle of 2023.

There are three major results. The first result shows that when below-cost sales are allowed, firms engage in loss leading prices about 3.2% of the time. However, in contrast to the predatory pricing theory, it is not large firms which engage in loss leading the most. Mainly, small firms facing competition with either large or small firms sell gasoline below cost most frequently and severely. This result contradicts the typical predatory story behind BCS laws. Interestingly, loss leading practice continues even after the BCS law was reinstated. This could be because the enforcement takes time to be a credible threat. At least in a short run (less then 2 years after BCS laws), the BCS laws are not effective in preventing loss leading prices.

The second result shows that the overall retail prices decreased by 2 cents per gallon and the margins are squeezed by 1.6 cents per gallon, which is about 10% of the total margin. Large firms' retail prices and margins are also affected (e.g. 1.3 cents decrease in margin) but not as much as the small firms (e.g. 1.3-2.9 cents decrease in margin). Whereas the predatory pricing theory predicts that the margins of large firms would fall more than the small firms and they can even be negative. Taken with the first result, it appears that loss leading squeezes small firms' margins more than large firms. Again, this result is evidence against the idea that large firms use loss leading to compete severely with small firms. Restricting the sample to isolated markets near highway exits does not change the result.

The last result shows that the total number of gas stations did not change at all for small and large firms without BCS laws and actually decreased slightly for mid-size firms over the course of ten years after BCS laws were reinstated. This pattern is robust to gas stations with or without convenience stores. It is possible that one and a half years of time without BCS law is not long enough to drive out small firms or they had accurately expected the law to be reinstated. Even if this were the case, it still would not provide supporting evidence to the predatory aspect of loss leading.

Despite the importance of BCS laws in antitrust, the predatory aspects of BCS laws is not empirically verified and the impact on competition is still understudied. Recent theoretical studies (Chen and Rey (2012);Johnson (2017);Chen and Rey (2019)) have suggested that loss leading is not necessarily predatory. Even without the predatory intent,

loss leading may still negatively impact consumer welfare. Only a limited amount of empirical research (Skidmore et al. (2005);Brannon (2003);Peltier et al. (2013)) has been conducted on the competitive impact of loss leading and laws prohibiting it, largely due to the lack of convincing identification strategies and absence of establishment-level data in the past.

The uniqueness of this research relies on the granularity of the data at the establishment level. The retail gasoline market is considered very local, meaning one gas station faces a small number of geographically close competitors.[5]. Therefore, depending on the geographic dispersion of gas stations, an aggregated average price may not reflect the local prices. Indeed, applying a difference-in-differences estimator with state-level average prices (which is the empirical strategy used by Peltier et al. (2013); Zimmerman (2012); Skidmore et al. (2005)) shows no retail and wholesale price changes for both events in Wisconsin.[6][7]

This research makes several significant contributions to both antitrust literature and the understanding of loss-leading pricing strategies. Firstly, it sheds light on the often overlooked impact of BCS laws on competition dynamics, particularly in markets where such laws are in effect. By empirically analyzing the economic implications of these laws, the study provides valuable insights into their effectiveness in fostering competition and protecting consumer welfare. This contributes to antitrust literature by addressing a gap in understanding the real-world implications of BCS regulations.

Secondly, this research challenges conventional wisdom regarding loss leading pricing strategies. Contrary to theoretical expectations (even the recent ones), which often depict large firms as the primary executor of loss leading, this study finds that it is primarily small firms that engage in such practices when permitted to by law. This finding not only contradicts prevailing predatory pricing narratives but also underscores the localness of the competitive effect that aggregate data cannot detect. By providing empirical evidence on the prevalence and impact of BCS laws across different firm sizes, this research en-

[5]Eckert (2013) reviews empirical studies on retail gasoline market, including Houde (2012) andHastings (2004)

[6]Anderson and Johnson (1999) used metropolitan area, Brannon (2003) used city-level.

[7]See Table (A) in Appendix A.

hances our understanding of competitive behavior in retail markets.

Lastly, this study offers insights into the effectiveness of BCS laws in preserving market competition. Despite the reinstatement of BCS laws, this research finds no significant changes in the total number of gas stations, indicating that these laws may not be as effective in preventing market concentration as previously assumed. This finding prompts a reevaluation of the efficacy of BCS regulations and highlights the need for further research and potentially alternative policy approaches to ensure robust competition and consumer welfare in affected markets. Overall, this research makes a valuable contribution to both academic literature and policy discussions surrounding antitrust regulation and pricing strategies in retail markets.

2 Literature Review

The standard predatory loss leading theory is suggested by Telser (1966) and Milgrom and Roberts (1982) and then further developed by Benoit (1984) in terms of "deep pockets". The chain-store paradox was first demonstrated by Selten (1978) where chain store may engage in predatory pricing to establish reputation.

Economics literature on loss leading has not reached consensus on the reasons and welfare effect of loss leading. Theories consider many reasons for loss leading prices other than predatory reasons. For instance when there is complementarity between products, loss leading may not be predatory (Ramsey (1927), Bliss (1988)). Also, loss leading could be explained by consumers' imperfect information on prices, heterogeneous transaction/shopping costs, and/or bounded rationality. Loss leading prices may become an equilibrium pricing strategy for firms to economize on advertisement if consumers cannot perfectly observe all prices (Lal and Matutes (1994); Simester (1995); In and Wright (2014); Rhodes (2015)) or subsidize across product categories with different elasticities (Ambrus and Weinstein (2008)).

Economic theories also predict opposite welfare effects of BCS law. Depending on the situation, consumers may be better or worse off from BCS law. Large firms may engage in loss leading pricing as an price-discrimination device given heterogenous consumer

shopping costs, firm efficiencies, and product scopes (Chen and Rey (2019)). Chen and Rey predict under certain conditions that loss leading can reduce consumer surplus (especially the multi-stop shoppers), retail competition, and the number of small firms, even in the absence of predatory intent. Therefore, they argue that BCS laws (or banning loss leading) can be beneficial for consumers. In contrast, Chen and Rey (2012) argue that BCS laws hurt consumer surplus (especially the one-stop shoppers) when firms with similar product scope cross-subsidize products. In addition, Johnson (2017) argues that BCS laws raise overall prices and lead to decrease competition. On the other hand, Byford and King (2021) shows a mediated result – a cap on discounts would result in higher consumer surplus and more independent small retailers than BCS laws or no-BCS laws, using Hotelling and Salop models.

Many economic theory papers look at the competitive effect of BCS laws in relation to suppliers. Here, the welfare effect is mixed. For instance, Allain and Chambolle (2005) and Allain and Chambolle (2011) show that in a monopoly market BCS laws dampen upstream competition, resulting in higher prices. In contrast, von Schlippenbach (2008) argues that BCS laws are welfare enhancing because they reduce the double marginalization problem.

Limited empirical work has been done on BCS laws. Using gasoline retail prices, Anderson and Johnson (1999) (using cross-sectional variation) and Collins et al. (2001) and Biscourp et al. (2013) and (using time-series) showed that BCS increases retail margins. Brannon (2003) used a difference-in-differences approach to confirm that retail markups increased when BCS law was introduced in Wisconsin in 1998 in comparison to Minnesota. On the other hand, Peltier et al. (2013) and Skidmore et al. (2005) used 12 to 13 state law changes and applied difference-in-differences approach to show that BCS lowers retail prices and margins by 0.65-0.66 cents and increases retailers by 0.5 in the long run. Similarly, Zimmerman (2012) and Wang (2015) show that the presence and competition of supermarkets, which sell or offer discounts on gasoline, gasoline retail prices decrease. Zimmerman (2012) argues that BCS laws would limit retail price competition. Wang (2015) rejects the predatory argument of loss leading pricing. Using book retail prices, Lee and Png (2015) show that a loss leading strategy is more likely for large stores.

The closest papers to this research in terms of empirical strategy would be Peltier et al. (2013), Skidmore et al. (2005), and Brannon (2003). However, instead of relying on aggregate data, this paper utilizes establishment-week level price data and avoids any bias created in aggregation measures, more accurately testing for the presence of predatory pricing.

The impact of loss leading is also studied in terms of quality and price dispersion. A non-price implication of loss leading on consumers includes a reduction in quality (or mix of suboptimal products), reducing consumer surplus (Inderst and Obradovits (2022); Gans and King (2006)). Price dispersion on loss leading studies include Barron et al. (2004) and Li et al. (2013).

3 Background

If BCS is allowed, some worry that large firms may engage in predatory pricing, such as loss leading pricing, to reduce competition. This type of argument follows Milgrom and Roberts (1982)'s. Large firms can put pressure on small firms by lowering prices up to the point where small firms cannot match or beat the price. As small firms cannot sustain business anymore and exit the market, then the large firm would become a monopolist and raise the price and recoup losses from below-cost sales.

More recently, though, loss leading prices are not seen as prima facie evidence of predatory pricing. The Federal Trade Commission (FTC) has taken the stance that loss leading prices, especially in gasoline retail industry with a large number of firms, is not necessarily anti-competitive (The Federal Trade Commissions (2005)). Moreover, it has stated that BCS laws can actually be harmful for competition and consumers because the law can reduce vigorous price competition and provide protection to inefficient firms. Therefore, its competition advocacy program discourages states from enacting any BCS law. Even though FTC submitted opposing comments to legislation of BCS laws in South Carolina, North Carolina, and Wisconsin in 1980s, those states all passed or strengthened their respective laws limiting below-cost sales.

The BCS law in Wisconsin imposes a minimum markup to retailers' costs as a function

of wholesale cost, taxes, and freight. In Wisconsin, the Unfair Sales Act has been imposing a minimum markup rule for nearly all retail industries since the 1930s. For instance, retail gas price must be higher than or equal to the maximum of two costs. One cost is measured by the minimum of a 9.18% markup on the sum of actual wholesale or replacement cost, freight, and taxes. The other cost is measured by the average wholesale rack cost, freight, and taxes, plus 6% markup where the average wholesale rack cost is publicly available. The motivation behind such regulation was to prevent predatory pricing that can reduce competition. Some states do not have any such regulations and others regulate only a subset of products (most commonly gasoline and cigarettes). Some states consider below cost pricing a "violation" only if it is intended to harm competition. Unlike these states, the Wisconsin's Unfair Sales Act is applied to general retail products and firms can be fined with low markup (or below cost) pricing even if the intention is not to damage competition.

There had been two major changes to the Wisconsin BCS law since its inception in 1939. First, the BCS law was found unconsitutional and repealed starting from February 2009 (Flying J, Inc. v. J.B. Van Hollen). In addition, the federal court ruled that the state should refrain from enforcing the law. The Wisconsin state attorney general did not appeal this ruling. However, the Wisconsin Petroleum Marketers & Convenience Store Association did appeal. The second event was that the law was reinstated in September 2010 after a successful appeal by the Wisconsin Petroleum Marketers & Convenience Store Association. Therefore, there was a temporary void on the law for about a year and a half, and no reinstatement was planned, although some may have anticipated a reinstatement.

The enforcement of this law, when it has been in force, has been done by competitors reporting on each other. See an example of a complaint in Figure (3) in Appendix A. Competitors are encouraged to sue and collect damages of $2,000 or actual damages (whichever is greater), for each day that the reported violator sells below cost.[8] Since the average wholesale cost is public information, competitors can easily calculate the minimum retail price of any competitor.[9] See Figure (4) for the publicly available cost infor-

[8]Wis. Stat Section 100.30(5m)

[9]Wisconsin Department of Agriculture, Trade and Consumer Protection provides an Excel calculator for statutory legal minimum retail price and it includes a URL where anyone can check the current average

mation in Appendix A. In addition, violators face penalties per incident of $50-2,500.[10]

There is one study which compared the gas price six months before and after a change strengthened the Unfair Sales Act in Wisconsin back in 1998. On August 1, 1998, the damages for violating the Unfair Sales Act increased to either three times the amount of any loss sustained or $2,000 multiplied by each day of violation, plus attorney fees. Brannon (2003) used this change to identify the causal effect of the minimum markup rule on retail gas price. He found that the margin increased by 2-3 cents after the regulation, compared to Duluth in Minnesota.

4 Data

The gas price panel data used for the study is from Oil Price Information Service (OPIS). Retail and wholesale gasoline regular unleaded prices are averaged over a week for each gas station in Wisconsin and the neighboring states of Michigan, Minnesota, Illinois, and Iowa, from 2007 to 2012. Among the neighboring states, Minnesota is the only state which had a similar BCS law on gasoline retail. Retail prices are the pump prices, not accounting for any discounts from personal coupons or credit card discounts. Daily prices from nearly all gas stations (150,000 stations in the U.S.) are collected, amounting to 4-5 million observations each day. Some affiliated gas stations directly report real-time price to OPIS electronically. Other information is collected via fleet card and credit card companies. It also relies on crowd-sourced gasoline price websites, such as GasBuddy, and all are cross-checked regularly. For the rest of the stations, OPIS hires individuals to drive around towns to collect posted pump prices manually. In the end, within every 72-hour period, at least one price is observed at 98% of all stations in the U.S. OPIS provides data to Google and Waze for real time gas prices. Wholesale price information comes directly from tanker rack data. OPIS also provides freight cost and all taxes. Station information includes name of the station, store brand (e.g. Casey's, Kwik Trip, Kum & Go), gas brand (e.g. BP, Marathon, Mobil, Shell), and corporate brand (e.g. ExxonMobil, PSX),

posted wholesale cost by terminal.

[10] Wis. Stat Section 100.30(4)

Table 1: Pre-law change description

	% Store-week binding		% Store-week below cost		Retail price		Margin	
	WI	Control	WI	Control	WI	Control	WI	Control
Small, competitive	55%	61%	0.001%	0.01%	$3.01	$3.03	$0.67	$0.71
Small, fringe	51%	64%	0	0.001%	$3.01	$3.07	$0.67	$0.70
Small, monopoly	48%	51%	0.01%	0.03%	$3.02	$3.01	$0.69	$0.69
Large	58%	61%	0.001%	0.006%	$3.00	$2.99	$0.67	$0.69

Notes: Pre-law change refers to 2007 to January 2009 where the BCS law was in place in Wisconsin. Price and margin are in U.S. dollars. Margin is retail price minus actual wholesale cost+tax+freight. Control: neighboring states Michigan, Illinois, and Iowa. Minnesota is included in this table because it had a similar BCS law. Binding means if the retail price was set such that the minimum markup was lower than 6%.

and address.

In total, there are 18,652 unique gas stations in the sample period. Some gas stations experienced ownership or banner changes, leading to 25,512 observations. Wisconsin has about 3,300 unique gas stations and 4,200 observations.

The data on the total number of gas stations data come from County Business Patterns. I use county-year-employment size level data from 2002 to 2020.

Since the existence of loss leading pricing strategies hinges on the competition between large and small firms (except Chen and Rey (2019)), I divide gas stations into four groups, large and three different types of small firms. First, if the grocery or convenient store attached to a gas station is branded (e.g. 7-Eleven, BP-brand convenient store, Walmart, Kroger), it is classified as "large". I then divide the "small" firms into fringe, competitive, and monopoly. Small monopoly indicates there is no gas station of any kind within a radius (e.g. 0.1, 0.5, 1, 3, 5 mile radiuses). If there is any "large" competitor within a radius (regardless of existence of "small" competitors), the station is considered "small fringe". If there is at least one "small" competitor but no "large" competitor, then the station is classified as "small competitive".

The pre-law change (2007 to January 2009) market is summarized in Table (1). The control is the average of neighboring states except Minnesota.[11] There are three major take aways from this table which cross-sectionally compares Wisconsin and states without any

[11]Minnesota had a BCS law at that time.

BCS law. First, more than half of the time, firms in Wisconsin sold gasoline at a price lower than the required markup of 6%. Second, regardless of the existence of a BCS law, gasoline was almost never sold at a loss. Third, despite having a BCS law in place, Wisconsin's retail prices and margins were lower than those of the surrounding states without BCS laws in the pre-law change period.

5 Empirical Model of Prices and Margins

5.1 Theory of Predatory Pricing and Testable Hypothesis

The BCS law was absent from February 2009 to August 2010 in Wisconsin. I will consider two situations. First, suppose absence of the BCS law for one and a half years was sufficient to drive small firms out of the market. Then, predatory pricing would lead to the following testable conclusions. If a large firm indeed engages in predatory pricing, only local markets which have at least one large firm and small fringe(s) would respond to the absence of BCS law and other kinds of local markets, such as a monopoly or competition among small firms only, would not respond. In the former asymmetric local markets, the large firms would price gasoline below cost but small fringe(s) would not adopt such loss leading strategy because it is not profitable and exit the market. Therefore, we expect to observe 1) loss leading pricing by large, 2) no loss leading pricing by small fringe(s), and 3) less number of small fringe(s) only in asymmetric markets.

Second, one and a half years of that time period may not be long enough to drive small firms out of the market. Suppose that small firms could sustain their business even without the BCS law by engaging in loss leading pricing as well. Then, we expect to see 1) loss leading by large and small fringes and 2)

5.2 Empirical Models

I describe implications of BCS laws on loss leading behavior and margin change and test whether empirical finding is consistent with the standard predatory pricing.

$$
\begin{aligned}
Y_{it} \;=\;& \beta_0 + \beta_1 \cdot WI_i \cdot NoLaw_t + \beta_2 \cdot WI_i \cdot Law_t \\
&+1_{\{s,f\}it}\left(\gamma_0 + \gamma_1 \cdot WI_i \cdot NoLaw_t + \gamma_2 \cdot WI_i \cdot Law_t\right) \\
&+1_{\{s,m\}it}\left(\delta_0 + \delta_1 \cdot WI_i \cdot NoLaw_t + \delta_2 \cdot WI_i \cdot Law_t\right) \\
&+1_{\{\ell\}it}\left(\phi_0 + \phi_1 \cdot WI_i \cdot NoLaw_t + \phi_2 \cdot WI_i \cdot Law_t\right) \\
&+1_{\{border\}i}\left(\psi_0 + \psi_1 \cdot WI_i \cdot NoLaw_t + \psi_2 \cdot WI_i \cdot Law_t\right) + \eta_i + \zeta_t + \varepsilon_{it} \qquad (1)
\end{aligned}
$$

β_1 identifies the effect of absence of law for small competitive gas stations. β_2 represents the effect of the reinstatement of the law for small competitives. Similarly, $\beta + \gamma$s identify the effect of the law (or absence of law) for small fringe, $\beta + \delta$s are for small monopoly, and $\beta + \phi$s are for large gas stations. To define the level of competition, I use a one, three, and five-mile radiuses and count the number of competitors. The results are robust to regardless of the market boundary. The dependent variables are margins in U.S. dollars per gallon (retail price - (actual wholesale cost+tax+freight)) and an indicator of whether firm i sold gasoline below cost at time t. Fixed effects include gas station and week fixed effects. This model takes advantage of the fact that no laws were changed in the neighboring states during this time period. I use weekly gas-station level average retail and wholesale prices in Wisconsin, Minnesota, Michigan, Illinois, and Iowa to estimate the model.

First, I test whether large firms begin to engage in loss leading when it is legally permitted as predicted by the standard predatory pricing theory. Under predatory pricing, large firms will adopt loss leading and more severely than small fringe firms. Small competitive or monopoly firms will not respond. Therefore, rejecting the following hypothesis implies that large firms indeed practice loss leading and more than small fringes:

$$
H_0 : \phi_1 = 0, \phi_1 \leq \gamma_1, \beta_1 = 0, \delta_0 \qquad (2)
$$

where the dependent variable is the indicator of whether firm i sold gasoline below cost at time t.

In addition, more recent theories from Johnson (2017) and Chen and Rey (2019), which find that loss leading may not be predatory, predict that small firms competing with small or large firms may also engage in loss leading pricing in response to loss leading pricing of large competitors. The recent theories would be consistent with data if we reject $\beta_1 = \gamma_1 = 0$ conditional on rejecting $\phi_1 = 0$.

Second, I examine whether predatory-loss leading squeezes small firms' margins. The standard predatory pricing theory suggests that the margins of small firms facing competition with a large firm when loss leading is allowed will be squeezed but still positive while the margins of large firms will become negative. This would lead us to expect negative estimates of γ_1 and ϕ_1, and $|\phi_1| > |\gamma_1|$. Given the dependent variable is a margin, the hypothesis consistent with predatory loss leading behavior is

$$H_0 : \gamma_1 > 0, \phi_1 > 0, |\phi_1| \leq |\gamma_1|. \tag{3}$$

Note that the recent loss leading theories of Johnson (2017) and Chen and Rey (2019) may also predict a similar behavior.

Lastly, I directly test for the presence of a predatory effect of BCS laws. In other words, whether small firms are pushed out of the market when loss leading is allowed. For this, I rely on the number of establishments from County Business Patterns. The number of gas stations are available at the county-year-employment size. Here, the control group is all counties in the U.S. outside of Wisconsin. The time frame is 2002-2020. I consider $NoLaw_y$ be 2009 and 2010 and Law_y be post-2010.

$$N_{cy} = a + b_1 \cdot WI_c \cdot NoLaw_y + b_2 \cdot WI_c \cdot Law_y + v_i + z_t + e_{cy} \tag{4}$$

Fixed effects include county and year fixed effects. If loss leading is predatory, we would reject the following hypothesis:

$$H_0 : b_1 = 0 \tag{5}$$

Specifically, b_1 can be estimated negatively if loss leading indeed causes small firms exit.

6 Estimation results

6.1 Loss leading as a pricing strategy

Table 2: Changes in below-cost sales

	Previous	1-mile		3-mile		5-mile	
	Avg.	No Law	Law Again	No Law	Law Again	No Law	Law Again
Small, competitive	0.018	0.033***	0.033***	0.031***	0.032***	0.031***	0.032***
	(0.133)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Small, monopoly	0.030	0.032***	0.029***	0.032***	0.025***	0.028***	0.018***
	(0.171)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)
Small, fringe	0.020	0.042***	0.043***	0.042***	0.044***	0.040***	0.041***
	(0.139)	(0.004)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Large	0.026	0.029***	0.027***	0.028***	0.026***	0.028***	0.026***
	(0.159)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Overall	0.021	0.031***	0.031***	0.032***	0.031***	0.032***	0.032***
	(0.144)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Station FEs		Y		Y		Y	
Week FEs		Y		Y		Y	
Controls		Y		Y		Y	

Notes: Dependent variable is the indicator of whether firm i sold gasoline below cost at time t. Based on the regression model specified in Equation (1), the table shows the marginal effect of no law and law. Firm types are classified based on the competitors where the market radius is assumed to be 3 miles although the results are almost identical with 1- or 5- mile radiuses. The coefficients in columns No Law test hypothesis (2). Controls include interaction of border indicator and events. Standard errors are clustered at the station level.

Table (6.4) shows the regression results of Equation (1). The table shows the percentage point change in loss leading behavior in the periods before, during, and after the absence of the BCS laws by firm types. For instance, the coefficient 0.032 implies that small monopoly firms engaged in loss leading 3.2% of the time (or weeks) when it was allowed. Competition type (monopoly, competitive, or fringe) is determined by counting number of competitors within 3-mile radius although the results are the same with 1- or 5-mile radiuses. The aggregate effect of no below-cost sales is 3.2%. Column "No Law" shows that that firms engage in loss leading pricing when allowed.

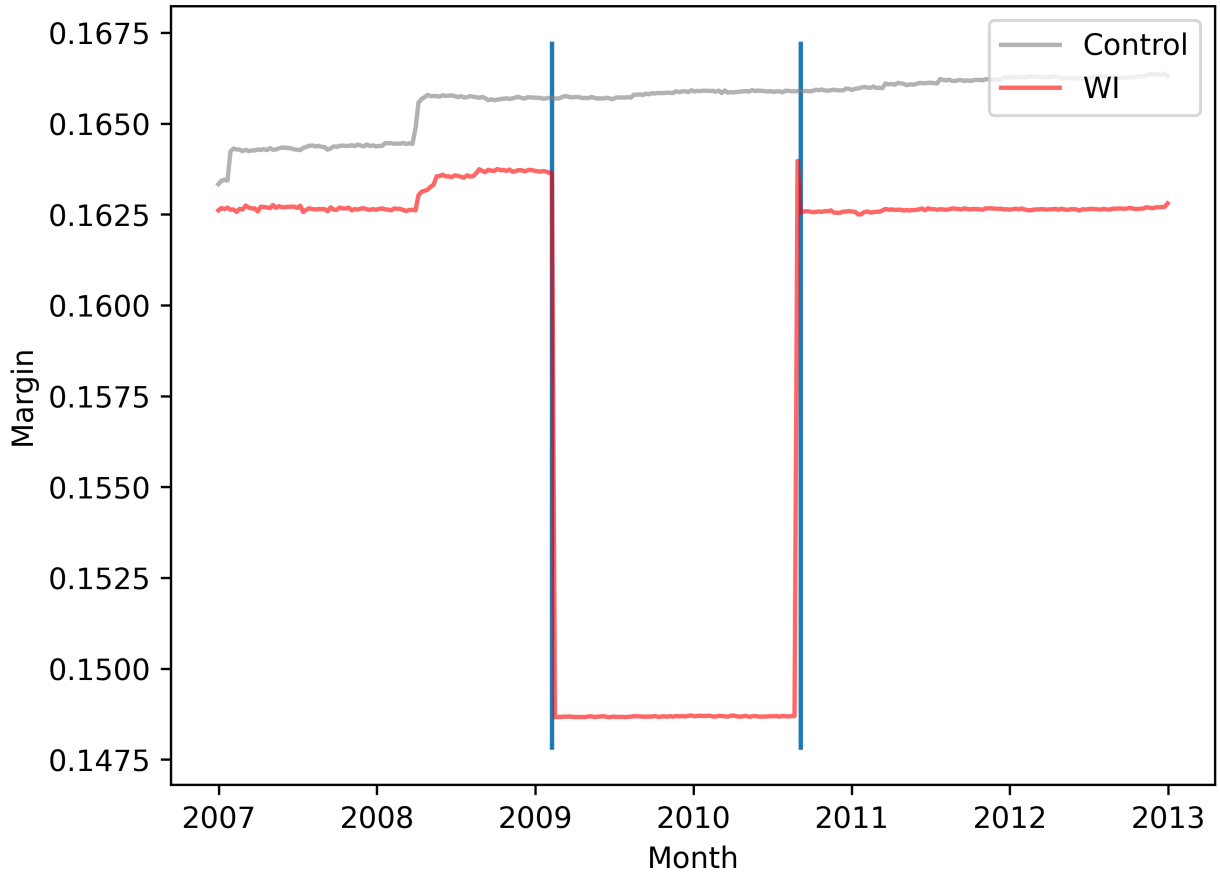
In contrast to predatory pricing theory which predicts loss leading behavior from mainly large firms but not by small firms, I find that both large and small, regardless

of facing competition, engage in loss leading pricing, rejecting the first Hypothesis (2). Small fringes adopt loss leading behavior the most at the rate of 4.2% of the time while small monopoly and competitive and large firms price below cost 3.2% or less of the time. This indicates that the typical predatory story that mainly large firms engage in loss leading given by advocates of BCS laws is not consistent with empirical evidence. On the other hand, the fact that small fringes and competitive firms engage in loss leading pricing in addition to large firms is consistent with the recent theories of non-predatory loss leading behavior by Johnson (2017) and Chen and Rey (2019).

There are two interesting observations to notice. First, a monopolist also engages in loss leading pricing, even when I draw the market boundary as large as 5-mile or as small as 1-mile radius. Second, I find that the loss leading pricing continued even after it was prohibited again in September 2010. It is not because the enforcement mechanism has changed. There were plenty of complaints submitted to Wisconsin DATCP showing competitors selling gasoline below cost as addressed in Section 3. This might imply that when a BCS law is implemented, it can take time for firms to abide by the regulation and that enforcement by competitors is not immediately effective. For instance, violators could avoid paying for damages in the absence of a lawsuit. It is possible that once lawsuits become a credible threat, the BCS law may begin to bind.

These results still hold when the sample period is split such that two separate difference-in-differences are performed for those two events. That is, one difference-in-differences regression is run for pre and "No Law" period and then another regression is run for "No Law" and "Law Again" period. The result with split sample is shown in Appendix Table (A. The columns "No Law" show the effects of going from pre period to "No Law". The columns "Law Again" show the effect of going from "No Law" to "Law Again", in contrast to those columns of the Table 6.4 above show the effect of going from pre period to "Law Again".

Figure 1: Margin changes by firm type



Notes: This graphs the estimated average margins according to Equation (1). Control is the average margin of neighboring states. Blue lines indicate the BCS law changes.

6.2 Margin Squeeze

The next result shows the margin changes by firm type in Table (6.4). The overall margin in Wisconsin decreased by 1.6 cents per gallon when the BCS law was void, equivalent to 9% reduction of margin, and it recovered to its original level after reinstatement of the law (Figure 1). This reduction in margin mainly came from small firms facing competition with another large firm. This result would be consistent with the theoretical prediction that small firms' margins are likely to be squeezed as a result of loss leading on the part of large firms. However, large firms' margins fell less by 8% (1.3 cents) than small fringes which experienced a 19% reduction in margin (2.9 cents), contradicting the predatory loss

Table 3: Margin changes by firm type

	Previous	1-mile		3-mile		5-mile	
	Avg.	No Law	Law Again	No Law	Law Again	No Law	Law Again
Small, competitive	0.173	-0.015***	-0.005**	-0.013***	-0.003	-0.014***	-0.00
	(0.100)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002
Small, monopoly	0.195	-0.018***	0.003	-0.018***	0.005	-0.018***	0.00
	(0.127)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004
Small, fringe	0.174	-0.027***	-0.007*	-0.029***	-0.011***	-0.024***	-0.010**
	(0.102)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002
Large	0.162	-0.014***	0.001	-0.013***	0.002	-0.013***	0.00
	(0.106)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002
Overall	0.171	-0.015***	-0.002***	-0.016***	-0.002***	-0.017***	-0.002**
	(0.104)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
Station FEs			Y		Y		Y
Week FEs			Y		Y		Y
Controls			Y		Y		Y

Notes: Dependent variable is margin in U.S. dollars per gallon (retail price minus sum of wholesale cost, tax, and freight). Based on the regression model specified in Equation (1), the table shows the marginal effect of no law and law. Firm types are classified based on the competitors where the market radius is assumed to be 3 miles although the results are almost identical with 1- or 5- mile radiuses. The coefficients in columns No Law test hypothesis (3). Controls include interaction of border indicator and events. Standard errors are clustered at the establishment level.

leading theory. As before it is interesting to note that the small monopoly firms are also affected by the policy change.

These results are almost identical to those when the sample period is split such that two separate difference-in-differences are performed for those two events. That is, one difference-in-differences regression is run for pre and "No Law" period and then another regression is run for "No Law" and "Law Again" period. The result with split sample is shown in Appendix Table (9. The columns "No Law" show the effects of going from pre period to "No Law". The columns "Law Again" show the effect of going from "No Law" to "Law Again", in contrast to those columns of the Table 6.4 above show the effect of going from pre period to "Law Again".

Table 4: Changes in number of gas stations

BCS law	With convenience store				Without convenience store			
	1-9	10-49	50-99	100+	1-9	10-49	50-99	100+
No Law	0.622	0.293	0.009	-0.014	0.358	-0.151	0.002	0.027*
	(1.086)	(0.436)	(0.043)	(0.018)	(0.572)	(0.173)	(0.049)	(0.015)
Law	0.828	-1.754***	-0.024	-0.025*	1.058	-0.603**	-0.018	0.014
	(1.616)	(0.501)	(0.032)	(0.015)	(0.750)	(0.243)	(0.052)	(0.011)
County FEs	Y				Y			
Year FEs	Y				Y			

Notes: Dependent variable is the number of gas stations in a county-year. The regression model is specified in Equation (6). The coefficients in row No test hypothesis (5). Data source: County Business Patterns. Standard errors are clustered at the establishment level.

6.3 Changes in the number of competitors

The last result shows the changes in number of gas stations. With or without convenience stores, there was not a significant change in the number of small firms when loss leading was allowed. Interestingly, after the law was reinstated, 1.7 mid-size gas stations per county, with size based on the number of employees, exited the market over the course of the next ten years. Therefore, hypothesis (5) for small firms is not rejected, implying that the predatory effect of loss leading is unlikely.[12]

Figure (2) shows the number of gas stations in Wisconsin, in relation to the total number of gas stations in Wisconsin and four neighboring states. Most importantly, the number of small gas stations facing competition with gas stations with large grocery stores slightly increased when loss leading was allowed. This finding contradicts the predatory aspect of loss leading.

Other types of stations remain stable over the course of two changes in BCS laws, except small monopolists. Decreasing number of small monopolists can imply two scenarios. The first scenario is that the small monopolists exited the market after the law was reinstated. The other scenario is that new entrants might have appeared around small monopolists. If the entrants are other small stations, we would expect to see the number

[12]It is possible that one and a half years of time without the BCS law is not long enough to drive out small firms or they may have accurately anticipated the reinstatement of the BCS law within a reasonable time.

of small competitives to grow almost proportionately as the number of small monopolists fall. However, that is not what we see. On the other hand, if the entrants are large grocery stores, we would expect to see the number of large stores to increase proportionately but that is not what we observe.

6.4 Isolated markets – highway exits

Using a radius from a station to define a market creates overlapping markets. Another way to define a local market is to find an isolated market, such as highway exits. I used Open Street Map (2014 version) to extract the GPS coordinates of highway exits (motorway_link) in Wisconsin and the surrounding states. There are about 27,000 unique exits (separately counting each physical exit on each direction), and about 18,500 exits had any gas stations within 6-minute driving distance. I identified the group of gas stations near an exit by two ways. One is using K-means clustering and the other is to simply cutoff at 3-minute driving distance. Google Map typically shows that a gas station is a "quick detour" if the driving distance is within 3 minutes. K-means clustering identified 2,745 gas stations within highway exits and simple cutoff rule found 2,500.

One exit has maximum of 4 or 5 stations, depending on the clustering methods. On average and in median, one exit has 1.2-1.5 station. At the 75% percentile, there are two stations per exit. The average driving duration from an exit to a station within the cluster is 3.7 minutes and driving distance is 2 miles.

The results when restricting the sample to highway exit markets are similar to but slightly smaller than the main results when it comes to the effect of no laws. For instance, using 3-mile radius to classify the firm types, the overall effect of no laws on below-cost sales behavior is a 2.4% decrease, instead of 3.2% using the whole sample. However, the important qualitative results remain the same – below-cost sales are observed mostly often for small fringe, not large firms.

However, the most difference comes from the effect of reinstatement of the laws. Using only highway exits, the effect of reinstated laws is estimated to 0.8% increase in below-cost sales activities compared to the pre-period, instead of 3.1%. In isolated highway markets,

Table 5: Changes in below-cost sales, highway exits only

	Previous	1-mile		3-mile		5-mile	
	Avg.	No Law	Law Again	No Law	Law Again	No Law	Law Again
Small, competitive	0.017	0.029***	0.011**	0.027***	0.010*	0.028***	0.010*
	(0.130)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
Small, monopoly	0.025	0.031***	0.014**	0.036***	0.011	0.046***	0.011
	(0.156)	(0.005)	(0.004)	(0.008)	(0.006)	(0.012)	(0.006)
Small, fringe	0.018	0.029***	0.012***	0.029***	0.013***	0.029***	0.013***
	(0.133)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Large	0.030	0.019***	0.003	0.019***	0.003	0.019***	0.003
	(0.171)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Overall	0.022	0.024***	0.008***	0.024***	0.008***	0.024***	0.008***
	(0.147)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Station FEs			Y		Y		Y
Week FEs			Y		Y		Y
Controls			Y		Y		Y

Notes: Dependent variable is the indicator of whether firm i sold gasoline below cost at time t. Based on the regression model specified in Equation (1), the table shows the marginal effect of no law and law. Firm types are classified based on the competitors where the market radius is assumed to be 3 miles although the results are almost identical with 1- or 5- mile radiuses. The coefficients in columns No Law test hypothesis (2). Controls include interaction of border indicator and events. Standard errors are clustered at the station level.

BCS laws are effective in preventing below-cost sales. This implies that the continuing practice of below-cost sales even after the BCS laws came back is mainly carried out by stations not close to highway exits. Another result to note is that small fringe firms are the only firms that continue the below-cost sales practice after the laws were reinstated.

In isolated highway exit markets, the margin decreased by 2.1 cents per gallon, which is higher than 1.6 when using the entire sample. All firms around the highway exits except small fringes reduced margins more than firms in other markets. Again, important qualitative result remains the same – large firms margins fell the least, contradicting the predatory pricing theory. On the other hand, the margin went back to the same level as in per-period in both full and restricted samples.

Taken together, even within the isolated markets, unlike the predatory pricing theory predicts, large firms are the main players of the below-cost sales practice when allowed and margins of the large firms are reduced the least.

Table 6: Margin changes by firm type, highway exits only

	Previous	1-mile		3-mile		5-mile	
	Avg.	No Law	Law Again	No Law	Law Again	No Law	Law Again
Small, competitive	0.186	-0.027***	-0.006	-0.027***	-0.001	-0.028***	-0.00
	(0.101)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005
Small, monopoly	0.183	-0.028***	0.001	-0.028***	0.003	-0.027***	0.00
	(0.109)	(0.004)	(0.005)	(0.005)	(0.006)	(0.008)	(0.008
Small, fringe	0.178	-0.022***	-0.000	-0.024***	-0.003	-0.024***	-0.00
	(0.102)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003
Large	0.169	-0.017***	0.004	-0.017***	0.004	-0.017***	0.00
	(0.106)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004
Overall	0.176	-0.021***	0.001***	-0.021***	0.001***	-0.021***	0.001**
	(0.104)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
Station FEs		Y		Y		Y	
Week FEs		Y		Y		Y	
Controls		Y		Y		Y	

Notes: Dependent variable is margin in U.S. dollars per gallon (retail price minus sum of wholesale cost, tax, and freight). Based on the regression model specified in Equation (1), the table shows the marginal effect of no law and law. Firm types are classified based on the competitors where the market radius is assumed to be 3 miles although the results are almost identical with 1- or 5- mile radiuses. The coefficients in columns No Law test hypothesis (3). Controls include interaction of border indicator and events. Standard errors are clustered at the establishment level.

7 Discussion and conclusions

In summary, this research has revealed insights into the behavior of firms in response to changes in below-cost sales (BCS) laws and the prevalence of loss-leading pricing strategies in the retail gasoline market. This study finds that small firms, rather than large firms, predominantly engage in loss leading when BCS laws permit, contradicting conventional notions of predatory pricing. Moreover, the absence of BCS laws did not significantly alter the total number of gas stations, suggesting limited effectiveness in preserving market competition. My results generally align with the findings of Wang (2015) which also views loss leading is not necessarily predatory, rather the relevant antitrust question is whether the grocery stores' rewards program creates foreclosure or not.

Looking ahead, there are several avenues for future research to advance our knowledge in this area. One promising direction is to extend the analysis to other products and

industries affected by BCS regulations, such as cigarettes, alcohol, and milk, which are commonly subject to BCS laws. By examining how changes in BCS laws impact market environments across different sectors, researchers can gain a more comprehensive understanding of the effectiveness and implications of such regulatory measures on competition and consumer outcomes. This broader perspective would provide valuable insights for policymakers and stakeholders seeking to promote competition and protect consumer welfare in general markets.

Furthermore, future research could delve deeper into the underlying mechanisms and implications of loss-leading pricing strategies. Recent theoretical developments have challenged the traditional view that loss leading is inherently predatory, yet suggesting that it may still have negative consequences for consumers even in the absence of predatory intent. Utilizing structural models, researchers can empirically assess the impact of BCS laws on consumer welfare by quantifying measures such as compensating variation.

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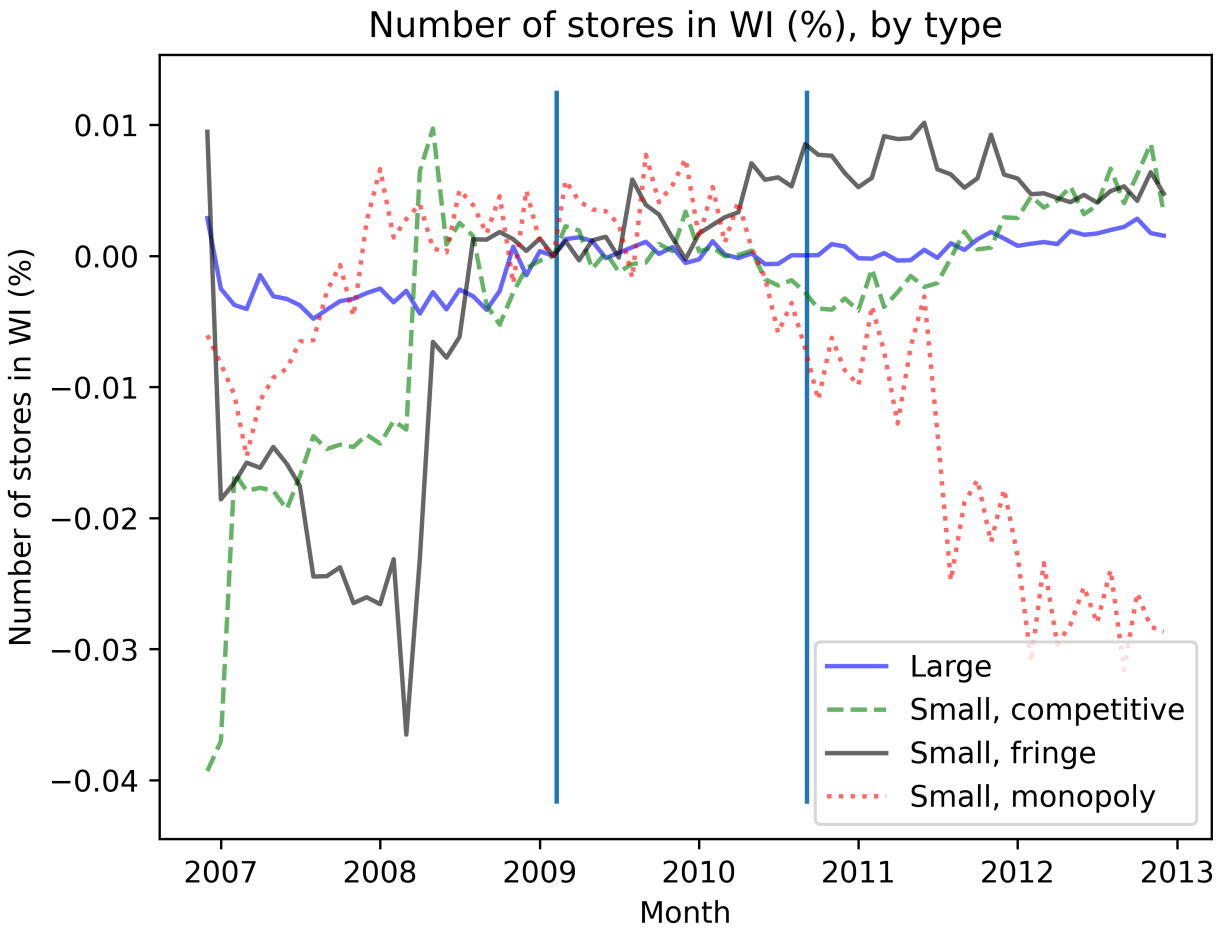
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Figure 2: Number of gas stations by types



Notes: This graphs the ratio of gas stations in Wisconsin within the five states, i.e. number of gas stations in Wisconsin divided by total number of gas stations in Wisconsin and four neighboring states. The ratio is centered at zero at the time of first BCS law change. Black vertical lines indicate the BCS law changes.

A Appendix Exhibits

Table 7: Difference-in-Differences Using State-Level Prices

	No Law	Law again
Retail price	-0.025	-0.03
	(0.024)	(0.024)
Wholesale price	-0.018	-0.025
	(0.021)	(0.022)
State FEs	Y	Y
Year-month FEs	Y	Y
Control	Y	Y
N	1827	1850
R-sq	0.983	0.986

Notes: Regression equation is

$$P_{sy} = c + d_1 \cdot WI_s \cdot NoLaw_y + d_2 \cdot WI_s \cdot Law_y + \kappa_s + \theta_y \nu_{sy} \quad (6)$$

where s is state and y is year. Dependent variable is average prices. Data source: U.S. Energy Information Administration. Control: excise taxes on gasoline. The results are robust to synthetic control method.

Table 8: Changes in below-cost sales, separate sample

	Previous	1-mile		3-mile		5-mile	
	Avg.	No Law	Law Again	No Law	Law Again	No Law	Law Again
Small, competitive	0.018	0.033***	0.002	0.033***	0.001	0.033***	0.001
	(0.133)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Small, monopoly	0.030	0.032***	-0.001	0.032***	-0.006*	0.028***	-0.009**
	(0.171)	(0.002)	(0.002)	(0.003)	(0.002)	(0.005)	(0.003)
Small, fringe	0.020	0.036***	0.003	0.034***	0.005**	0.034***	0.003*
	(0.139)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
Large	0.026	0.029***	-0.001	0.029***	-0.001	0.030***	-0.001
	(0.159)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Overall	0.021	0.031***	0.000***	0.031***	0.001***	0.031***	0.001***
	(0.144)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Station FEs		Y		Y		Y	
Week FEs		Y		Y		Y	
Controls		Y		Y		Y	

Notes: This table replicates Table (6.4) with two separate difference-in-differences regressions, one comparing pre period and no-law period and the other comparing no-law period and law-again period. The Dependent variable is the indicator of whether firm i sold gasoline below cost at time t. Based on the regression model specified in Equation (1), the table shows the marginal effect of no law and law. Firm types are classified based on the competitors where the market radius is assumed to be 3 miles although the results are almost identical with 1- or 5- mile radiuses. The coefficients in columns No Law test hypothesis (2). Controls include interaction of border indicator and events. Standard errors are clustered at the station level.

Figure 3: Complaint Example

01/05/2012 13:17 Powell Petroleum (FAX)8878186 P.002/008

8048

(5)

TR-TP-14 (Rev 7/02)

Wisconsin Department of Agriculture, Trade and Consumer Protection
Trade and Consumer Protection Division

UNFAIR SALES ACT COMPLAINT QUESTIONNAIRE

Mail To: Paul Dingee
DATCP
Trade Practices Section
PO Box 8911
Madison WI 53708-8911

Phone (608) 224-4925
Fax (608) 224-4939

THIS COMPLAINT MUST INCLUDE AN ADVERTISEMENT, RECEIPTED PURCHASE, A COPY OF A COUPON, OR COPIES OF PRICE SURVEYS.

872

YOUR NAME	YOUR BUSINESS NAME			
Ashley Roecker	Shell Travel Mart			
ADDRESS	**CITY**	**STATE**	**ZIP**	**PHONE**
821 Park Ave	Beaver Dam	WI	53916	920-887-8768

873

BUSINESS NAME OF ALLEGED VIOLATOR				
Casey's General Store				COUNTY: Dodge
ADDRESS	**CITY**	**STATE**	**ZIP**	**PHONE**
906 N University Ave	Beaver Dam	WI	53916	~~920~~

PRODUCT	ADVERTISED PRICE	LOWEST AVAILABLE COST	DATES OFFERED
Unleaded	3.23	average rack. - 2.8339	1-5-12
Prem	3.33	" - 3.0091	1-5-12
Diesel	3.79	" -	1-5-12

If Advertised: (Please enclose a copy of advertisement)

(1) Name of Publication	(2) Date of Publication

The information you provide may be used in efforts to resolve the problem and/or to enforce applicable laws and may also be shared with the party complained against. Under Wisconsin's Open Records Law, complaints are available for review on request from a member of the public after agency action is completed.

The information I have given is true, accurate, and complete to the best of my knowledge

SIGNATURE	DATE
Ashley Roecker	1-5-2012

Notes: This is an example of complaints reported by Shell Travel Mart, a competitor of Casey's General Store. The complaint describes the advertised price was below the minimum markup of 9.18% on the average wholesale rack cost+tax+freight on January, 5, 2012.

Figure 4: Public Wholesale Rack Cost Example

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291 DUBUQUE, IA — Date: 1/5/2012 10:28:51 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2ULS	NO2-LA	UNL-87	PRM-91	U87E10	P91E10	ULC10	P91C10
Contract Average	3.1388	----	2.7210	2.8998	2.6855	2.8656	----	----

335 CHICAGO, IL — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2ULS	NO2-LA	UNL-87	PRM-93	87RE10	93RE10	87RELV	92RELV	93RELV	U87E10	P93E10	ULC10	P93C10
Contract Average	2.9816	----	----	----	2.8042	3.0386	----	----	----	----	----	----	----

355 ROCKFORD, IL — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2ULS	NO2-LA	UNL-87	PRM-93	U87E10	P93E10	ULC10	P93C10
Contract Average	2.9925	----	2.8125	3.1609	2.7876	3.0088	2.7793	2.9743

503 DULUTH, MN — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-91	U87E10	P91E10	ULC10	P91C10
Contract Average	----	3.1340	2.7208	2.9441	2.6959	2.8227	2.7005	2.8175

511 MPLS/ST.PAUL, MN — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-91	PRM-92	U87E10	P91E10	P92E10	ULC10	P92C10	P91C10
Contract Average	----	3.1172	2.7162	2.9309	2.9783	2.6669	2.7821	2.8225	2.6746	2.7998	----

513 ROCHESTER, MN — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-91	U87E10	P91E10	ULC10	P91C10
Contract Average	----	3.1187	2.7167	2.9010	2.6727	2.7514	2.7143	2.7743

961 CHIPPEWA FALLS, WI — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-92	U87E10	P92E10	ULC10	P92C10
Contract Average	----	3.0839	2.7739	----	2.7553	2.9550	----	----

963 GREEN BAY, WI — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-93	U87E10	P93E10	ULC10	P93C10
Contract Average	----	3.0007	2.9497	3.1452	2.7810	2.9839	2.7824	2.9420

965 JUNCTION CITY, WI — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-92	PRM-93	U87E10	P92E10	P93E10	ULC10	P93C10	P92C10
Contract Average	----	3.0090	2.8207	----	----	2.7612	2.9218	2.9783	2.7395	----	2.9120

967 MADISON, WI — Date: 1/5/2012 10:28:52 AM

AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-93	U87E10	P93E10	ULC10	P93C10
Contract Average	----	3.0322	2.8339	3.0991	2.7857	2.9706	2.7866	2.9878

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AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-93	87RE10	93RE10	87RELV	93RELV	U87E10	P93E10	ULC10	P93C10
Contract Average	----	2.9932	2.7750	3.1189	2.7829	3.0202	2.7800	3.1400	2.7636	2.9664	2.7684	2.9789

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AXXIS Petroleum Gross Price Report Without Superfund

Supplier	NO2-LS	NO2ULS	UNL-87	PRM-91	U87E10	P91E10	ULC10	P91C10
Contract Average	----	3.1223	2.7152	2.9785	2.6898	2.8387	2.7095	2.8161

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Notes: This is an example of the average wholesale rack cost by terminal close to Wisconsin offered by AAXIS.

Table 9: Margin changes by firm type, separate sample

	Previous	1-mile		3-mile		5-mile	
	Avg.	No Law	Law Again	No Law	Law Again	No Law	Law Again
Small, competitive	0.173	-0.016***	0.010***	-0.015***	0.010***	-0.016***	0.012**
	(0.100)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001
Small, monopoly	0.195	-0.019***	0.021***	-0.019***	0.023***	-0.019***	0.025**
	(0.127)	(0.002)	(0.001)	(0.003)	(0.002)	(0.004)	(0.003
Small, fringe	0.174	-0.026***	0.020***	-0.026***	0.016***	-0.020***	0.013**
	(0.102)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001
Large	0.162	-0.014***	0.015***	-0.014***	0.015***	-0.014***	0.015**
	(0.106)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001
Overall	0.171	-0.016***	0.014***	-0.016***	0.014***	-0.016***	0.014**
	(0.104)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000
Station FEs			Y		Y		Y
Week FEs			Y		Y		Y
Controls			Y		Y		Y

Notes: This table replicates Table (6) with two separate difference-in-differences regressions, one comparing pre period and no-law period and the other comparing no-law period and law-again period. Dependent variable is margin in U.S. dollars per gallon (retail price minus sum of wholesale cost, tax, and freight). Based on the regression model specified in Equation (1), the table shows the marginal effect of no law and law. Firm types are classified based on the competitors where the market radius is assumed to be 3 miles although the results are almost identical with 1- or 5- mile radiuses. The coefficients in columns No Law test hypothesis (3). Controls include interaction of border indicator and events. Standard errors are clustered at the establishment level.