Do state motor fuel sales-below-cost laws lower prices?

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Abstract

In recent years a number of US states have imposed sales-below-cost (SBC) laws directed at motor fuel markets. We use panel data over the 1983–2002 period to evaluate the effects of newly imposed motor fuel SBC laws on retail and wholesale gasoline prices, their mark-up, and the structure of motor fuel markets. A unique feature of our analysis is that we utilize transitions in those states that adopted new SBC legislation to evaluate the effects of the laws. Perhaps surprisingly, we find that gasoline prices are about one cent lower five years after the law is imposed. We also find that total number of gasoline outlets is greater in the presence of the law.
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1. Introduction

In the United States there are numerous federal statutes designed to limit predatory behavior on the part of firms, and in recent years a number of states have also enacted such laws. A notable example is the presence of general sales-below-cost (SBC) laws[1] and, especially, SBC laws in the motor fuel industry. Sixteen states have (or had) SBC motor fuel laws during the 1983–2002 period, and these laws have evolved and changed considerably over this period, with 13 of these 16 states imposing and/or repealing the laws at different times between 1983 and 2002.[2] These laws typically outlaw the selling of motor fuel at retail prices below cost, and are intended to foster competition by preventing predatory pricing.[3] While there are several instructive empirical studies that evaluate the effects of motor fuel SBC laws, the results are somewhat mixed.[4] In this article, we use monthly data over the 1983–2002 period for all 50 states to estimate the impact that gasoline-specific sales-below-cost laws have on retail prices, as well as upon mark-ups, percentage mark-ups, and wholesale prices. A unique feature of our analysis is that we utilize transitions in those states that adopted new SBC laws to evaluate the effects of the laws. Perhaps surprisingly, we find consistent evidence that these laws actually lower average gasoline prices, in part by increasing the number of gasoline outlets. Although critics contend that SBC laws protect inefficient and high-cost producers, our results indicate that gasoline prices are actually lower in the presence of these laws, not higher.

Supporters of gasoline-specific laws typically contend that such laws protect the competitive structure within the retail gasoline market in one of two ways. Proponents argue that SBC laws are thought to foster competition by preventing large vertically integrated firms and high volume firms from posing a predatory threat to smaller and/or independent retailers. In the absence of such laws, it is argued that larger firms could drive out smaller firms by lowering prices below costs, and once the smaller competitors have been purged from the market, the larger retailers would then have a greater ability to push prices above that which would exist in a more competitive environment.[5]

Even in the absence of predatory pricing, proponents also maintain that SBC laws may reduce market concentration either by maintaining the number of competitors in the market

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[1] There were 22 states with some form of general SBC laws in 2002. However, little change in the status of general SBC laws has occurred in recent years; Minnesota is the only state that experienced a change, repealing its law in 1995.

[2] Of the 13 states that adopted new laws, two were immediately challenged in court and were ultimately declared unconstitutional. See Perkins et al. [31] for a detailed discussion of recent developments in SBC legislation across the states. Also, see Dougherty [14] and Fenili and Lane [15] for an assessment of SBC laws.

[3] Due to practical difficulties in assessing actual cost data, gasoline-specific SBC laws sometimes have minimum mark-up provisions, usually set at 6 percent above the wholesale price of gasoline. General SBC laws also employ a minimum mark-up provision, often based upon the inclusion of rents, interest, and other fixed costs in the cost calculation.

[4] Anderson and Johnson [2] provide the most comprehensive study, as well as a review of previous literature. See also Clark and Crane [12].

[5] Church and Ware [11, p. 662] and Pepall et al. [30, p. 338] each contend that predatory actions do occur, that such actions create uncertainty in a potential entrant's mind about an incumbent's behavior, and that this uncertainty can deter entry.

or by reducing market share held by the largest firms (Mueller and Patterson [28]). In both cases, the presence of SBC laws is thought to reduce the price risk to which smaller firms are exposed in making their entry/exit and output decisions. The end result is a more price-competitive market.

Opponents of sales-below-cost laws argue that the laws are more likely to protect inefficient firms from competitive forces, and thus lead to higher prices. This view is grounded on the belief that the elimination of weaker firms would enhance market efficiencies and lead to lower prices over time. In fact, during the 1980s and again more recently the Federal Trade Commission (FTC) urged states not to adopt SBC legislation because FTC officials believed that the laws prevented price discounting, loss leaders, and other competitive pricing strategies in a futile attempt to prohibit what they considered an uncommon practice of predatory pricing. Indeed, the dominant view among many economists is that predatory pricing rarely occurs and is even more rarely successful (Barron et al. [3], Viscusi et al. [41]). Allegations of predatory pricing in the gasoline industry have often been wrong, and mistaken for vigorous competition.[6] Opponents also argue that SBC laws are generally unenforceable, and thus have had little effect (Fenili and Lane [15]). Researchers may also (mistakenly) believe that state SBC legislation is redundant because of federal statutes.[7]

The existing empirical literature has somewhat mixed results, but by and large supports the view that SBC laws are associated with higher gasoline prices and that they fail to preserve the number of retailers in the market (Felini and Lane [15], Anderson and Johnson [2], Calvani [10], Johnson [21], Clark and Crane [12]).[8] For example, in one of the most comprehensive published empirical studies to date, Anderson and Johnson [2] use gasoline price data from 40 cities during the early 1990s, and conclude that gasoline-specific SBC laws have resulted in higher retail margins; Johnson [21] finds a similar result. However, nearly all of this empirical work fails to evaluate the effects of SBC laws over an extended period of time, so that this work has necessarily failed to consider the changes in the status of SBC legislation. Further, most work focuses upon only a small and limited number of cities or states, or compares a single state with an SBC law to one without a law.[9] As a consequence, the results may be overly sensitive to the specific cities or states included. Most studies have also been constrained by data availability, so that only a limited number of control variables have been included in the empirical work and only a limited number of dimensions of SBC impact have been examined.

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[6] As noted by Anderson and Johnson [2], although there are numerous studies regarding federal statutes designed to limit predatory behavior, little attention has been given to state statutes.

[7] Anderson and Johnson [2] argue that the standards for determining a violation of state SBC laws differ substantially from the standard most frequently used by federal courts in predatory pricing cases.

[8] In related work, there is some evidence that general SBC laws preserve market structure (Mueller and Paterson [28], Houston [19]). There is also recent evidence from California that shows that the preservation of a competitive market structure enhances price competition in the gasoline market (Leffler and Pulliam [25], Hastings [18]). There is also a large literature on gasoline demand and pricing (Borenstein et al. [5], Borenstein and Shepherd [6], Slade [34]) and on divorcement (Vita [42]). However, most of this work does not directly address the impact of SBC laws.

[9] For example, Anderson and Johnson [2] examine cities in 30 states, and the cities may not be representative of the entire state (e.g., cities in the Miami metropolitan versus cities in the state of Florida, including rural areas).

In this article we re-examine the impact of gasoline-specific SBC laws. We use monthly panel data from all 50 states over the extended period of 1983 through 2002, in order to examine the longer-run effects of SBC laws and also to examine what happens in states that adopt or repeal SBC laws. We also use average state pricing data, which allows us to avoid any potential bias from a focus on specific cities or metropolitan areas. Finally, we examine the impacts of SBC laws on a wide range of pricing decisions: the retail price of gasoline, the retail margin (or the retail price less the wholesale price), and the percent mark-up (or the retail margin divided by the wholesale price). Our estimation results are quite robust, and consistently indicate that SBC laws actually lower, not raise, gasoline prices. In particular, we find that on average gasoline prices are about one cent lower five years after the SBC law is imposed. We also find that the total number of gasoline outlets is greater in the presence of the law, with most of the increase occurring among establishments with five or more employees.

In the following sections, we present the elements of our approach, including a brief discussion of our analytical framework, our methods and our data. We then present our empirical examination of the effects of SBC legislation on gasoline prices. The final section contains a summary and conclusions.

2. Analytical framework, methods, and data

2.1. Analytical framework

As discussed in the introduction, opponents of SBC laws contend that they protect small and inefficient retailers, and this leads to higher prices. Proponents argue, in contrast, that SBC laws enhance market structure and the number of retailers in the market, which in turn lead to lower prices. It is straightforward to demonstrate how SBC laws may protect small and inefficient retailers and thereby lead to higher prices.[10] However, it is perhaps less obvious how SBC laws can lead to lower prices. One argument is that SBC laws effectively protect gasoline retailers who do not rely on other sources of revenue from larger retailers who sell a broader range of products and who can practice price discrimination (Claycombe [13], Wright [43]). In the absence of SBC laws, these larger and more diverse retailers compete on price (and perhaps use gasoline as a loss leader), driving prices down. Eventually the less powerful retailers are forced out of the market, leading to greater market concentration and ultimately higher gasoline prices. The existence of SBC laws prevents this type of price discrimination behavior, and so leads to more firms and to lower prices.[11]

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[10] See Milgrom and Roberts [27] or Kreps and Wilson [24] for analyses in which predatory pricing may be an optimal strategy for a firm.

[11] We have formalized this argument using a spatial price competition framework similar to that of Greenhut [16] and Greenhut and Greenhut [17]; this theoretical analysis is available upon request. An argument can also be made that SBC laws reduce the price uncertainty faced by some kinds of firms. It can be shown that one effect of this reduced price uncertainty is greater firm output and so lower prices, whether the firm is competitive, oligopolistic, or monopolistic. Under reasonable assumptions about a firm's attitude toward risk, such a reduction in risk will lead eventually to an increase in output (and, by extension, perhaps also to an increase in the willingness of a firm

There is widespread evidence across multiple sectors that an increase (decrease) in market concentration increases (decreases) price (Pinkse et al. [32]), including manufacturing (Allen [1]), banking (Liang [26]), air travel (Stavins [35]), health care (Young et al. [44]), and consumer products (Claycombe [13]). Importantly, increased market concentration has been found to lead to higher energy market prices in general (Borenstein et al. [4], Joskow and Kahn [22]), and specifically within the gasoline market (Borenstein and Shepard [7]).

The relevance of this discussion for the impact of SBC laws is obvious. If, as is commonly argued by proponents of SBC laws (and as is demonstrated later by our estimation results), the law increases the number of firms in a market, then the law also leads to a lower delivered product price.

2.2. Methods

Our basic question is whether SBC laws have altered gasoline prices in states that have adopted them. As shown in Table 1 and Appendix Table A.1, there are 13 states that adopted motor fuel sales-below-cost laws during the 1983–2002 period, with adoptions occurring at different points in time.

By collecting time series data on these states, as well as on the other states, we can use variation across the states in the timing of the adoption of these laws to investigate how the laws affected average prices in states where they have been implemented.[12] We estimate a

Table 1
States with motor fuel SBC statutes, 1983–2002

State	Date of enactment (and termination)
Alabama	May 8, 1984
Arkansas	August 12, 1993 (ruled unconstitutional March 11, 1996)
Colorado	July 1, 1993
Florida	60 days after May 31, 1985, amended 1987, 1989, 1991
Georgia	July 1, 1985 (ruled unconstitutional in 1987)
Maryland	May 2000
Massachusetts	1950
Minnesota	August 2001
Missouri	August 28, 1993
Montana	April 19, 1991 (measure terminated January 1, 1999)
New Jersey	July 1, 1954
North Carolina	September 1, 1986
South Carolina	60 days after June 15, 1993
Tennessee	July 1, 1988
Utah	March 16, 1987
Wisconsin	June 3, 1939, amended 1973, 1987, 1992, 1998

Sources: Johnson [21], Perkins et al. [31], and state statutes.

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to enter or to remain in a market). Consequently, a larger number of retail gasoline establishments and greater output will ultimately lead to reduced retail prices (and other measures of gasoline prices). This analysis is also available upon request.

[12] While Arkansas and Georgia adopted laws, they were immediately challenged in court and were repealed within three years. As such, the laws were arguably never fully enforced or complied with, and so these states

within-group model that exploits the panel nature of our data and controls for fixed state and time effects. We also include a full array of control variables, and we examine multiple dimensions of SBC impact.

The econometric model is as follows. Denote P_{it} as the monthly weighted average end-user price of unleaded gasoline for state i in period t. Then we assume that:

$$P_{it} = D_{it}\alpha + X_{it}\beta + \mu_i + \eta_t + \varepsilon_{it}, \tag{1}$$

where D_{it} represents the status of the law in state i at time t, X_{it} is a vector of demand-side and supply-side characteristics that determine prices, μ_i and η_t are fixed state and monthly time effects, respectively,[13] α and β are coefficient vectors, and ε_{it} is a random error term. We also estimate similar models for M_{it} and PM_{it}, where M_{it} is the average mark-up (or the retail price less the wholesale price) and PM_{it} is the percent mark-up (or (Retail price − Wholesale price)/(Wholesale price)) for unleaded gasoline for state i in period t.

The fixed-effects model is appropriate for our analysis for three reasons. First, much of the variation in prices and mark-ups is between states rather than within states. Although it would be difficult to specify all the institutional, economic, and demographic character-istics that determine the differences across states in prices and mark-ups, we can capture permanent differences between states with state fixed-effects.[14] Similarly, there are a vari-ety of factors that may affect prices and mark-ups over time. We capture those differences with monthly time-effects. A second reason for using the fixed-effects model is that state adoption of an SBC law may be correlated with high motor fuel prices or mark-ups prior to adoption of the law; that is, states with concerns about non-competitive market structure and high prices may be more likely to adopt SBC laws. Suppose, for example, that states that adopt laws had on average higher prices. Then omitting the state effects would yield biased estimates because the estimates would not clearly illustrate the effect that the SBC law had on prices in that state. Third, the fixed-effects model is a within-group estimator that uses the within-state variation to form the parameter estimates. Therefore, our estimate of the effects of SBC laws measures how prices and mark-ups change within the states as legal climates change.[15]

Despite the use of the fixed effects framework, there is a lingering concern that the adop-tion of SBC legislation may be endogenous. Although four states adopted SBC legislation in 1993, a period of unusually low prices, an equal number of states adopted legislation during high price periods, and several states adopted legislation during periods of neither high nor low prices. In recent years, mass retailers such as Wal–Mart have pushed for the repeal of SBC legislation across the states, while organizations such as the Petroleum Mar-keters Association of America have supported the imposition of new legislation and have

are not treated in the analysis as ever having a SBC law. Note, however, that all of our basic conclusions are unaffected if we treat Arkansas and Georgia as having the law. Montana also repealed its law after seven years; Montana is treated as having a SBC law until its repeal in 1999.

[13] One-time indicator variable is omitted to avoid perfect multicollinearity.

[14] State fixed-effects capture any permanent differences across states (e.g., laws banning self-service, divorce-ment, transportation costs) not otherwise captured by other explanatory variables. Similarly, the time-effects capture any variation in prices and mark-ups over time that affects the whole country (e.g., changes in changes in national environmental standards or crude oil prices).

[15] Hsiao [20] presents an excellent discussion of panel data estimation procedures.

fought to protect existing laws. Given that SBC activity does not seem to be spurred by high or low prices, it appears that endogeneity is not a serious concern.

Nevertheless, we examine the possible endogeneity of SBC laws more rigorously using a Hausman specification test, which requires that we identify a variable that is a determinant of SBC laws but that does not directly determine gasoline prices or mark-ups.[16] Importantly, given that we are using a fixed effects framework, we must use an instrument that varies over time. Given these criteria, we use measures of state political control: two dummy variables indicating Democrat and Republican rule, respectively. The Democratic rule variable (*DEM*) is equal to one when the Governor is a Democrat and the Democratic Party has majority control in both the Senate and House, and zero otherwise. Republican rule (*REP*) is equal to one when the Governor is a Republican and the Republican Party has majority control in both the Senate and House, and zero otherwise.[17] We hypothesize that states under Democratic Party leadership are more inclined to impose SBC legislation, whereas states under Republican control are less likely to intervene in the market place.

We must first demonstrate that at least one of the political variables is a valid instrument. Following Shadbegian [33], in the first stage of the Hausman specification test we estimate the following linear probability model:

$$\text{Prob}(SBC\ Law_{it} = 1) = DEM_{it}\mu_1 + REP_{it}\mu_2 + V_{it}\mu_3 + \widehat{S}_i + \widehat{T}_t + \varepsilon_{it} \tag{2}$$

for state i in period t. DEM_{it} is an $n \times 1$ vector that indicates Democratic Party control in the n state-years in our data set, μ_1 measures the effect of this measure on the probability of a SBC law being in place in a particular state-year, and REP_{it} and μ_2 are the Republican control counterparts. V_{it} is an $n \times k$ set of control variables (k is the number is controls), and μ_3 is a $k \times 1$ vector of parameters. $\widehat{S}_i$ represents the state specific effects, $\widehat{T}_t$ is the set of time indicator variables, and ε_{it} is the residual. We find that the estimate of μ_1 is positive and statistically significant;[18] that is, states under Democratic control are more likely to adopt SBC laws. The coefficient on REP is negative as expected, but it is not significant. Thus, *DEM* can be considered a valid instrument, whereas *REP* serves as a weak instrument. We need further to confirm that the political party control is not a statistically significant determinant of retail gasoline prices or mark-ups. In estimates that are not presented but are available from the authors, we find that the political control variables are not significantly correlated with price, mark-ups, or percent mark-ups.

To complete the Hausman specification test, the estimated probability of SBC laws generated from Eq. (2) is included as an explanatory variable in the pricing, mark-up, and percent mark-up equations. If SBC laws are endogenous, then the coefficient on the predicted probability of SBC laws should be significantly different from zero. The Hausman test indicates that the null hypothesis that SBC laws are exogenous cannot be rejected. We therefore proceed with estimating the price and mark-up equations using the fixed-effects procedure without correcting for simultaneity.

Finally, given that our panel consists of 50 states for which we have monthly series over 20 years, it is likely that the errors are serially correlated. A Durbin–Watson test

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[16] See Kennedy [23] for a description of the Hausman specification test.

[17] The omitted category is state-years in which neither the Democrats nor the Republicans have full control.

[18] These (and all other unreported) regression results are available upon request.

indicates that autocorrelation is a concern, and therefore all standard errors are adjusted for autocorrelation.

2.3. Data

The main dependent variables are the inflation adjusted average monthly *Retail price of unleaded gasoline* in state i during period t, measured in cents per gallon, the *Mark-up of unleaded gasoline* calculated as the difference between retail and wholesale prices,[19] and the *% mark-up of unleaded gasoline*; in some models we also estimate the impact on the *Wholesale price of unleaded gasoline*. The retail price is the key dependent variable, but all measures are important in evaluating the effect of SBC laws. We obtained information on retail and wholesale prices for the years 1983–2002 from *The Petroleum Marketing Monthly*, a report published by the US Energy Information Administration. Retail and wholesale prices represent inflation adjusted weighted averages net of all taxes (i.e., net of all federal, state, and local sales and excise taxes) from a scientific sample of more than 3500 companies, and are valid at the 95 percent confidence level.[20]

Our justification for examining the impact of SBC laws on several price measures is straightforward. Because the retail price measures the direct and final impact on consumers, an evaluation of the retail price (as well as of the mark-up and of the percent mark-up) is required to adequately measure the effect of SBC legislation. It is possible that SBC laws have helped to maintain a stronger and larger independent retailing sector, which in turn could reduce the power that integrated refiners have in the marketplace. This loss of power could result in lower wholesale prices (Anderson and Johnson [2]). As a consequence, if an SBC law has helped lower price at the wholesale level, the final retail price will be lower in the SBC state, even though mark-ups are the same, and the use of retail mark-up measures alone to assess the effectiveness of SBC legislation might obscure the true nature of SBC laws. Consequently, a thorough examination of all price and mark-up variables is required to understand fully the effects of SBC laws on gasoline pricing.

Use of these data has two benefits over the use of price data from selected cities over a short period of time. First, since the data are a weighted average of the prices across the entire state, they are a better representation of consumer activity within the state as a whole. Second, analysis using monthly average price data over a number of years is likely to yield a more accurate assessment of the overall, and especially the long-run, impact of the SBC law within each state. Another possible approach to assess SBC laws is to use disaggregated data (i.e., data collected and analyzed at the store level for all states). However, consistent and reliable micro-data over an extended period of time for all states are very difficult to obtain.

We include a number of independent variables to explain the variation in prices and mark-ups across the states and over time. Central to our analysis are two variables that mark the presence and the timing of the adoption of gasoline-specific SBC laws: *SBC law* and the natural logarithm of *Months after SBC law*. *SBC law* is an indicator variable that is equal

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[19] The wholesale price is defined as the price that wholesalers pay refiners for gasoline.

[20] For a more detailed discussion, see http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_marketing_monthly/pmm.html.

to one in all months during which a gasoline-specific law is in effect and zero otherwise.[21] Because newly adopted SBC laws may take some time to alter market structure and prices, we also use the natural logarithm of *Months after SBC law*, which equals 1 plus the number of months since the state implemented the SBC law.[22] This variable is always equal to zero in those state-years in which there was no law. The natural logarithm specification of this variable accounts for the possibility that, once a new equilibrium market structure emerges, any price effects from the law may well diminish. [23]

It should be recognized that three states (Massachusetts, New Jersey, and Wisconsin) have had gasoline specific SBC laws for many years, and that in two states (Arkansas, Georgia) the newly imposed laws were challenged in court and were subsequently eliminated.[24] We have estimated separate models in which we exclude/exclude both sets of states, with no significant impact on our key findings. It should also be recognized that neither *SBC law* nor ln(*Months after SBC law)* captures differences in the nature of the laws or the degree of enforcement across the states. SBC laws commonly specify that fixed costs (e.g., rent, interest on borrowed capital) be included in the cost calculation in evaluating when a firm is selling below cost. In lieu of actual cost data, a number of states have established minimum mark-up provisions (typically around 6 percent of the wholesale price). In some estimates reported later, we examine the effects of different types of SBC laws. While SBC laws are fairly uniform in their requirements, differences across states and their enforcement over time can be substantial.[25] Thus, our variables reflect the average effect of an SBC law, and cannot capture the effects in a particular state.[26] While many states have general antitrust statutes that are similar to federal guidelines, state SBC laws are more constraining in terms of limiting pricing activity.

It is also necessary to control for other possible factors that could individually and/or jointly affect gasoline prices. Following Vita [42], we include a number of demand-side and supply-side factors that determine gasoline prices. These control variables include: *Population*, *Population density*, *Proportion of population over age of 65*, *Real per capita*

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[21] Although several states have amendments to their laws, this variable does not capture that information. We have also estimated models in which we included some information regarding these amendments. Those results are similar to the results presented here, and so are not reported.

[22] To avoid arithmetic error when taking a natural logarithm of zero, we add 1 to each value of *Months after SBC law*. We also note that using *Months after SBC law* without taking its natural logarithm yields estimates that are qualitatively similar to those presented here.

[23] *Months after SBC law* is intended to capture the idea that prices and mark-ups are unlikely to change immediately after the law is imposed, but require time for market structure to adjust. However, once the market reaches a new equilibrium, we expect diminishing impacts in later years.

[24] In principle, our analysis also evaluates what happens to prices when SBC laws are repealed. However, Arkansas and Georgia eliminated their laws within three years of adoption, and it is unlikely that the laws were in effect and credibly enforced long enough to have an impact in the first place. Montana, on the other hand, enforced its law for more than seven years before its repeal on January 1, 1999. For this reason we treat Arkansas and Georgia as never having the law, and, given the length of time Montana enforced the law, we treat Montana as having a SBC law over the period. Our key results are robust to the treating Arkansas and Georgia as having the law, albeit for a very short period.

[25] For example, Wisconsin has amended its SBC law a number of times, most recently in 1998.

[26] The empirical approach is similar to Murray et al. [29], who evaluate the effects of court-ordered education finance reform on education funding across the states.

Table 2
Summary statistics of data from all states, 1983–2002

Variable	Mean	St. dev.
Real retail price of unleaded gasoline (in cents)	82.12	16.03
Mark-up of unleaded gasoline (in cents)	11.52	4.313
% mark-up of unleaded gasoline (in percent)	14.44	5.301
SBC law	0.186	0.389
Months after SBC law	43.63	134.7
Population (in thousands)	5175	5595
Population density	169.9	233.9
Proportion of population over age 65	0.124	0.021
Real per capita income (in dollars)	20,766	6246
Vehicles per capita	0.796	0.119
Drivers per capita	0.684	0.052
Average annual real retail wage (in dollars)	13,985	1742.3
General SBC law	0.431	0.495
Average heating degree days	4679	1642
Real wholesale price of unleaded gasoline (in cents)	70.59	15.71
Reformulated gasoline	0.064	0.246
Total number of gasoline retail establishments (SIC code 554)	2083.05	1866.78
Number of gasoline retail establishments with 1 to 4 employees (SIC code 554)	998.47	935.60
Number of gasoline retail establishments with 5 or more employees (SIC code 554)	1094.58	999.42

See Appendix Tables A.1–A.2 for sources and details.

income, the total number of vehicles per population (*Vehicles per capita*), the total number of licensed drivers in the population (*Drivers per capita*), the average annual inflation adjusted retail wage (*Average annual real retail wage*), a dummy variable equal to one in those state-years in which a general sales-below-cost law exists and zero otherwise (*General SBC law*),[27] the heating degree days in the Census region (*Average heating degree days*), *Real wholesale price of unleaded gasoline*, and a dummy variable that is equal to one in those states that have a city in which use of reformulated gasoline is required by federal law (*Reformulated gasoline*).[28] More detailed definitions and sources of these variables are provided in Appendix Tables A.1–A.2. Table 2 provides summary statistics for all variables.

Vita [42] has shown that gasoline demand is influenced by population and population density. An increased population may lead to increased demand for gasoline and thus an increase in prices. The effect of population density is, however, ambiguous. On the one

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[27] According to a study by Johnson [21], Arkansas, California, Colorado, Idaho, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Montana, North Dakota, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Virginia, Washington, West Virginia, Wisconsin, and Wyoming have or have had general sales-below-cost laws during the period of analysis; only Minnesota and Virginia eliminated the laws during the period of analysis. However, our own search through *Commerce Clearing Trade Regulation Reports* and the Virginia State Statutes failed to confirm Virginia as ever having the law, and so we do not count Virginia as ever having the law. To our knowledge, no other states experienced a change in the status of this law during our period of analysis.

[28] Although our retail and wholesale prices are in monthly terms, many control variables are only available annually. For these variables, we use the annual observation for each of the 12 months within a given year.

hand, more densely populated areas have other transportation modes available, leading to a reduction in demand. Also, increased population density may result in reduced wholesale transport costs. These two factors suggest that we might observe lower prices in more densely populated areas. On the other hand, more densely populated areas experience greater traffic congestion, and thus more fuel consumption per mile traveled, as well as higher rental values. These factors suggest that prices may very well be higher in more densely populated areas. We also include the percentage of population over the age of sixty-five, the number of vehicles and drivers per capita and income per capita to control for changes in gasoline demand. We include the real annual retail wage variable to control for changes in wage costs for gasoline retailers. Although a number of states have general SBC laws, only Minnesota experienced a change in general SBC legislation. Our a priori expectation of the effect of this variable is similar to the gasoline specific SBC variable. Following Borenstein et al. [5] and Vita [42], average heating degree days is included as an exogenous determinant of gasoline production costs.[29] We include the wholesale gasoline price variable in the retail price regressions to control for changes in the most important input cost for retailers. Beginning January 1, 1994 the Clean Air Act Amendments of 1990 required that cleaner burning (and more expensive) reformulated gasoline be sold in the nine worst "ozone nonattainment" areas, and we include the reformulated gasoline dummy to control for this factor.[30]

3. Results

We begin by presenting a model in which we include as covariates in Eq. (1) the series of control variables, state and time indicator variables plus a measure of SBC legislation. We also present a model that examines the potential nonlinear relationship between SBC laws and gasoline prices and mark-ups. We analyze subsets of states and evaluate the degree to which the findings depend on a single state that adopted an SBC law to further test the robustness of our findings. We also examine the effects of different categories of SBC laws (minimum mark-up vs. sales-below-cost). Finally, we provide an examination of why our findings differ from previous research.

Initial findings are shown in Table 3. A consistent result is that retail prices, mark-ups, and percent mark-ups for gasoline fall as new SBC laws are adopted. Columns 1, 3, and 5 show that the coefficients on the SBC law dummy variable are negative and significant, lowering prices, mark-ups, and percent mark-ups by 0.66 cents, 0.65 cents, and 0.6 percent, respectively.

While columns 1, 3, and 5 provide evidence that SBC laws have a depressing effect on prices, they do not account for a possible increase in prices immediately following the

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[29] Transportation and production costs of gasoline are affected by the demand for jointly produced products such as home heating oil, which has a demand that is weather determined. Gasoline is a by-product of the production of home heating oil so that gasoline and home heating oil are complements in production but substitutes in transportation. The expected sign on this variable is indeterminant.

[30] These areas are Baltimore, Chicago, Harford, Houston, Los Angeles, Milwaukee, New York, Philadelphia, and San Diego. Sacramento was added later.

Table 3
Regression results for retail price and mark-up models

Independent variable	Dependent variable					
	Retail price		Mark-up		% mark-up	
SBC law	-0.665^{**}	0.606	-0.645^{**}	0.565	0.006^{**}	0.002
	(-2.186)	(1.009)	(-2.418)	(0.998)	(-2.167)	(0.414)
ln(Months after SBC law)		-0.390^{**}		-0.360^{**}		-0.003
		(-2.401)		(-2.421)		(-1.610)
Wholesale price of unleaded gasoline	0.818^{***}	0.818^{***}				
	(155.5)	(155.5)				
Population	-0.0001	-0.00002	-0.0001	-0.0001	-0.000001	0.000001
	(-0.921)	(-0.180)	(-1.035)	(-0.645)	(-1.116)	(0.854)
Population density	-0.005	-0.006	0.007	0.008	0.00007	-0.00007
	(0.833)	(0.971)	(1.243)	(1.375)	(1.120)	(-1.190)
Proportion of population over age 65	6.581	5.941	-5.069	-5.464	-0.099	-0.101
	(0.563)	(0.510)	(-0.486)	(-0.525)	(-0.901)	(0.920)
Vehicles per capita	-2.073^{*}	-2.303^{**}	-2.213^{*}	-2.429^{**}	-0.022^{**}	-0.024^{**}
	(-1.978)	(-2.126)	(-2.323)	(-2.545)	(-2.215)	(-2.339)
Drivers per capita	2.480	3.364^{*}	3.020^{*}	3.915^{**}	0.020	0.027
	(1.408)	(1.880)	(1.890)	(2.396)	(1.209)	(1.541)
Real per capita income	0.0002^{*}	0.0002^{**}	0.0002^{***}	0.0002^{***}	0.000003^{***}	0.000003^{***}
	(1.977)	(2.109)	(3.261)	(3.379)	(3.254)	(3.348)
Average heating degree days	0.0002	0.0002	0.0002	0.0002	0.00007	0.000001
	(1.280)	(1.220)	(1.257)	(1.175)	(1.120)	(-0.717)
Reformulated gasoline	0.174	0.032	0.117	0.037	0.002	0.001
	(0.503)	(0.093)	(0.389)	(0.012)	(0.658)	(0.390)
Average annual real retail wage	0.0002^{**}	0.0002^{**}	0.0001	0.0001	0.0000009	0.0000009
	(2.109)	(2.138)	(1.076)	(1.090)	(1.318)	(1.339)
General SBC law	-2.552^{***}	-2.355^{***}	-2.020^{***}	-1.872^{***}	-0.015^{**}	-0.014^{**}
	(-3.417)	(-3.169)	(-3.046)	(-2.821)	(-2.089)	(-1.943)
Adjusted R^2	0.898	0.899	0.414	0.415	0.526	0.527

Notes. All models include state and time effects. $n = 11,862$. *t*-statistics in parentheses.
* Significance at the 90% confidence level for a two-tailed test.
** Idem., 95%.
*** Idem., 99%.

imposition of the law and then a decline.[31] We therefore present another set of regressions designed to address the nonlinear relationship that may exist between prices and SBC laws. In columns 2, 4, and 6 we present estimates that include simultaneously in one regression both the *SBC law* and ln(*Months after SBC law*). In these regressions, *SBC law* accounts for the price increase that may occur immediately following imposition of the law, and ln(*Months after SBC law*) accounts for the reduction in prices in later periods. Evidence

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[31] Since the imposition of an SBC law initially cuts off the lower tail of the price distribution, it is not unreasonable to expect price to rise initially. However, over time as SBC laws affect market concentration prices may well decline.

of initial price increases is weak;[32] even so, prices and mark-ups initially rise by about 0.6 cents in the first month following the introduction of the law.[33] However, by the end of the first year prices and mark-ups have returned to pre-legislation environment levels, and, by the end of year five, prices and mark-ups are about a penny less than they would be in the absence of the law.[34]

The coefficients on the control variables are in line with expectations. In the price regressions, a 10 cent increase in wholesale prices leads to an 8.2 cent increase in retail prices.[35] Population characteristics are generally not significant. An increase in the number of vehicles per capita is associated with lower prices, but an increase in the number of drivers per capita is associated with higher prices. Increases in per capita income and retail wages increase prices, whereas heating degree days and reformulated gasoline requirements are not significant. The coefficient on the general sales-below-cost law dummy variable is negative and significant, indicating that gasoline prices are lower in states that have such laws. However, given that only one state experienced a change in general SBC legislation (Minnesota repealed its law in 1995[36]), this result is generated from just one state's experience. The coefficients on the control variables in the mark-up and percent mark-up models are consistent with those in the price regressions.

We also examine the effects of different types of laws on gasoline prices. Here we make the distinction between states with a minimum mark-up law and states that simply indicate that selling below cost is prohibited with no minimum mark-up requirement.[37] A limitation is that only three states that adopted SBC laws over the period of analysis did not specify a minimum mark-up requirement, so that one should interpret the results in Table 4 cautiously.

Regardless of whether states had a minimum mark-up provision or a general rule stating that selling below cost was prohibited, SBC laws have a negative effect on prices. The magnitude of the effect is roughly twice as large in the three states that did not specify a minimum mark-up.

Recall that motor fuel SBC laws may also affect prices at the wholesale level. However, in estimates not reported we find no evidence that SBC laws affect wholesale prices. This

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[32] We conduct a likelihood ratio test to examine whether the nonlinear specification performs better than the linear specification. The result of this test indicates that we cannot reject the null hypotheses that difference between the log-likelihood of the restricted linear model and the log likelihood of the unrestricted nonlinear model is equal to zero.

[33] The net effect in the first month is calculated by summing the coefficient on *SBC law* and ln(2) multiplied by the coefficient on ln(*Months after SBC law*). Effects in later months are calculated in a similar manner.

[34] In regressions not reported, we show that when ln(*Months after SBC law*) is included without the SBC dummy, it is negative and significant in all three regressions.

[35] Inclusion of lagged wholesale prices would capture the remaining increase in retail prices as wholesale prices increase. Inclusion of lagged wholesale prices does not affect the main findings presented here.

[36] Minnesota enacted a gasoline-specific SBC six years after it eliminated its general SBC law.

[37] The following states have or have had minimum mark-up provisions: Alabama, Colorado, Florida, Maine, Massachusetts, Minnesota, Montana (repealed in 1999), New Jersey, North Carolina, South Carolina, Tennessee Utah, and Wisconsin. The following states have sales-below-cost laws with no minimum mark-up requirement: Maryland, North Carolina, and South Carolina.

Table 4
Regression results for SBC states with minimum mark-up requirement vs. no minimum mark-up requirement

Independent variable	Dependent variable					
	Retail price of unleaded gasoline		Mark-up of unleaded gasoline		% mark-up of unleaded gasoline	
SBC law with minimum mark-up	−0.377 (−1.073)		−0.434 (−1.405)		−0.006* (−1.747)	
ln(Months after SBC law with minimum mark-up)		−0.212** (−2.290)		−0.212** (−2.291)		−0.002** (−2.135)
SBC law with no minimum mark-up	−1.432** (−2.540)		−1.203** (−2.435)		−0.007 (−1.387)	
ln(Months after SBC law with no minimum mark-up)		0.382** (−2.525)		−0.380** (−2.507)		−0.004** (−2.373)

Notes. All models include state and time effects, and the following control variables: Real wholesale price of unleaded gasoline (in the case of the retail price equation), Population, Population density, Proportion of population over age 65, Vehicles per capita, Drivers per capita, Real per capita income, Average heating degree days, Reformulated gasoline, Average annual real retail wage, and General SBC law. $n = 11,862$. *t*-statistics in parentheses.

* Significance at the 90% confidence level for a two-tailed test.

** Idem., 95%.

result confirms that the effect on retail prices must come through the retail-wholesale price margin.

3.1. Other robustness tests[38]

3.1.1. A subset of "neighbor" states

Although our findings are robust to a variety of estimation procedures and inclusion (or exclusion) of control variables, there still may be a concern that we have omitted some variable that is correlated with the imposition of SBC laws, and it may be that the omission of this information biases the estimated effects of the SBC laws. We further test the robustness of our findings by using a subset of states that are more similar to one another, and in doing so reduce concerns about potential omitted variables.

We begin by selecting five states that adopted the SBC law during the middle of the 1983–1999 period: Colorado-1993, Missouri-1993, South Carolina-1993, Tennessee-1988, and Utah-1987. These five states have a substantial number of observations prior to and after adoption. For each of these states, we select two neighboring states that lie within the same PADD (Petroleum Administration for Defense Districts).[39] Focusing on the long-run

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[38] All unreported results are available upon request.

[39] In most cases we were able to select a neighboring state within the same PADD. However, because we wanted to avoid comparing states that adopted gasoline specific SBC legislation with states that already had general SBC laws, in some cases we used nearby states that did not lie within the same PADD. Colorado's neighboring states are Arizona and Nevada; Missouri's neighboring states are Illinois, Kansas, and Iowa; South Carolina's neighboring states are Delaware and Georgia; Tennessee's neighboring states are Illinois, Indiana, and Ohio; and Utah's neighboring states are Arizona and Nevada.

effects of SBC laws, we run another set of regressions similar to those presented in Table 3. These regressions again show that the presence of SBC laws lower prices.[40]

3.1.2. Systematic omission of states adopting SBC laws

To further assess whether our findings are driven by a single state, we estimate a series of regressions that systematically omit states that adopted a SBC law over the period of analysis. Our results are again unchanged.

3.1.3. Comparison with past studies

Why do our results differ from other studies? There are two primary differences between our analyses and previous research. First, we use time series cross-sectional data over an extended period, which enables us to capture transitions in the status of SBC legislation in our analysis. Second, we use statewide pricing data, which include prices from urban as well as rural areas, whereas most of the previous research has used data from urban areas exclusively. Due to the nature of our data, we have chosen to use the fixed effects method of analysis, which utilizes the within-state variation to form the parameter estimates. However, much of the price variation is across states. Table 5 presents our findings when we use the across-state variation as well as the within-state variation to form the parameter estimates.

These results again show a highly significant negative effect of SBC laws on prices. The coefficient on *SBC law* shows that prices are 0.86 cents lower as a result of the law, and the coefficient on ln*(Months after SBC law)* shows that 5 years following the introduction of the law prices are about 0.5 cents lower. The mark-up is also significantly correlated with SBC laws, but percent mark-up is not significant in these regressions.

The most comprehensive published study to date is that by Anderson and Johnson [2] who use weekly data from March 1992 through December 1993 for 40 cities to evaluate the effects of SBC laws on gasoline prices. The relatively short period of analysis makes it impossible for them to evaluate transitions in the status of the law. Thus, their analysis

Table 5
Regression results for expanded retail price and mark-up models with no fixed effects

Independent variable	Dependent variables		
	Retail price of unleaded gasoline	Mark-up of unleaded gasoline	% mark-up of unleaded gasoline
SBC law	0.860*** (−3.150)	−0.510** (−2.245)	−0.002 (−0.922)
ln(Months after SBC law)	−0.115* (−1.913)	−0.114* (−1.913)	0.0004 (0.879)

See note in Table 4. $n = 11{,}862$. *t*-statistics in parentheses.
* Significance at the 90% confidence level for a two-tailed test.
** Idem., 95%.
*** Idem., 99%.

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[40] If we estimate any of the previous models using the subset of states, the results indicate that prices fall as a result of SBC legislation.

primarily uses the cross sectional variation to form the parameter estimate on SBC legislation. They also use data exclusively from urban areas. Anderson and Johnson [2] estimate that gasoline specific SBC laws increase the retail margin by 1.61 cents per gallon. For comparison, we estimate a model in which we use data over the 1992–1993 period for the 30 states in which the 40 cities that Anderson and Johnson [2] studied are located.[41] These regressions show that SBC laws are not significantly correlated with prices, mark-ups, or percent mark-ups.

While we are unable to draw any definitive conclusion regarding the differences between the two studies, we believe that there are three possible reasons for the differences. First, we utilize within-state variation to form the parameter estimates whereas Anderson and Johnson [2] rely primarily on the cross state variation to form the parameter estimates. Second, we use twenty more states in our analysis, a number of which adopted SBC legislation after 1993. Third, we use statewide data on gasoline prices that include pricing data for both urban and rural areas, while Anderson and Johnson [2] use pricing data for urban areas only. The urban-rural issue is of key importance here because prices in smaller cities may be most affected by a reduction in market concentration. Specifically, market concentration is likely to be affected most in rural areas where the elimination of just one retail outlet can significantly alter the competitive environment.[42]

A more recent report by Clark and Crane [12] uses pricing data from the lower 48 states over the 1994–2001 period to evaluate the effects of gasoline specific SBC laws. In contrast to our work, they conclude that SBC laws increase prices. The key difference between their study and ours is the period of analysis. We use a longer timeframe (1983–2002) so as to observe changes in SBC legislation, whereas Clark and Crane [12] use a time period (1994–2001) in which just two states experience a change in SBC legislation. Our study also utilizes the within-state variation to form the parameter estimates, whereas they rely more on the cross-state variation to form the parameter estimates. Clark and Crane are aware of and acknowledge the benefits of using the longer timeframe to capture the transitions in SBC legislation, but elect to use the shortened period because,

"The wholesale price series that extends prior to 1994 is a weighted average of the prices for the various supply channels with weights unknown. Discussions with EIA (Energy Information Administration) energy market analysts indicated that this weighting problem was a potentially serious limitation for those wishing do conduct empirical analysis."

They contend that the pre-1994 wholesale price data are problematic and therefore use the "rack price" as a measure of wholesale prices in their study.[43] To examine whether

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[41] This model is similar to the regression in column 1 of Table 3 except that it omits the state fixed effects.

[42] In estimates not reported, we test this notion by including an interaction variable (SBC law ∗ % urban population) in our regressions. Although the interaction term is not significant, the estimated coefficient suggests that SBC laws reduce prices in rural states more so than in urban states.

[43] We contacted the EIA directly to discuss the issue with three EIA analysts, Mike Burdette, Joanne Shore, and Paula Weir, who have given us permission to use their names. From these discussions we have learned that prior to 1994 the EIA did not collect dealer tank wagon, rack, and bulk sales prices separately. Rather,

the choice of wholesale price data was the source of difference between the two studies, we estimated another model using the Clark and Crane [12] time period (as well as their specification), but retaining our price data. Using their time period and specification and our data, we also find that SBC laws are correlated with higher prices. Thus the difference in findings appears not to be due to choice of wholesale price data, but rather choice of time period. We believe that the longer period, a period during which we observe a significant number of changes in SBC legislation, is far more likely to yield unbiased estimates.

3.2. The effects of gasoline specific SBC laws on market structure

We now turn to a direct examination of the relationship between gasoline specific SBC laws and market structure. Proponents of SBC laws argue that one route through which SBC laws reduce prices is by fostering competition in both the wholesale and retail markets. We test this hypothesis using annual data for years 1983–1997 from *County Business Patterns* on the total number of establishments, the number of establishments with one to four employees, and the number of establishments with five or more employees for SIC Code 554 (gasoline stations).[44] Over the period of analysis, 48 percent of all retail stations had fewer than 4 employees, and more than 80 percent of all establishments had fewer than nine employees. We hypothesize that gasoline specific SBC laws serve to protect and enhance the total number of firms in the state. In addition, by running separate regressions on the number of small establishments (1 to 4 employees) and medium to large establishments (more than 5 employees), we are able to examine which type of firm benefits most from SBC legislation. The work by Mueller and Patterson [28] suggests that the smallest firms will not benefit from the law as much as medium sized and larger operations. Table 6 presents the regression results for the natural logarithm of total establishments, small establishments, and medium to large establishments.

We estimate two regressions, one with *SBC law* and one with the natural logarithm of *Months after SBC law*. Each regression also contains the state and year dummy variables and the full set of control variables that may determine market structure.

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wholesale price information was collected from wholesalers by asking for the average wholesale price and total sales volume. Thus, pre-1994 wholesale prices are considered by EIA as properly weighted, even though the weights are unknown. All three analysts also indicated that there was no inconsistency of which they were aware in the pre- versus post-1994 average wholesale price data, and that no information is available that demonstrates a bias in the average wholesale price. Further, it is unlikely that any discrepancies in wholesales prices caused by the reporting method introduce a bias in and of themselves. In fact, the EIA analysts indicated that bias could potentially be introduced in using one particular wholesale price measure such as the rack price used by Clark and Crane [12] because those prices may not be representative of the entire wholesale population. Furthermore, some states rely more on dealer tank wagon sales (California for example), whereas states such as Texas and Louisiana have more bulk sales. Using one particular wholesale price could lead to an under- or over-estimate of actual wholesale prices in states such as California where the dealer tank wagon price is more common, and in Texas and Louisiana where bulk sales is more dominant. Based on these discussions, we believe that using average wholesale prices as opposed to one particular type of wholesale price (rack, dealer tank wagon, or bulk) is more representative of actual prices. We are grateful to Mr Burdette, Ms Shore, and Ms Weir for their help.

[44] Due to changes in the industry classification system that took effect in 1998, we are not able to extend our analysis beyond 1997.

Table 6
Regression results for relationship between market structure and SBC laws (*t*-statistics in parentheses)

Dependent variable	Independent variable		Adj. R^2
	SBC law	ln(Months after SBC law)	
ln(Total number of establishments)	0.020[*] (1.847)		0.998
		0.011[**] (2.821)	0.998
ln(Establishments with 1 to 4 employees)	0.011 (0.504)		0.994
		0.007 (0.981)	0.994
ln(Establishments with 5 or more employees)	0.039[**] (2.026)		0.992
		0.018[***] (2.689)	0.992

See note in Table 4. $n = 747$.
[*] Significance at the 90% confidence level for a two-tailed test.
[**] Idem., 95%.
[***] Idem., 99%.

The coefficients on *SBC law* and ln(*Months after SBC law*) are statistically significant in both the total establishment and the medium or large establishment regressions. These results indicate that SBC laws serve to preserve the total number of establishments over time. They also suggest that SBC laws protect medium sized and larger businesses, but that smaller establishments are unaffected. The coefficient on *SBC law* shows that the number of total and medium and large establishments is about 2 and 4 percent greater as a result of the law, respectively. The coefficient on ln(*Months after SBC law*) indicates that after five years, states have 4.5 and 7.4 percent more total and medium to large retail establishments than they would absent the law, respectively. It should be remembered that other factors have led to net decreases in the number of outlets across the nation (Johnson [21]). Still, gasoline-specific SBC laws have on average served to impede the decline.

To further test the notion that SBC laws affect prices via market structure, we again re-estimated the price, mark-up, and percent mark-up regressions, this time including the number of establishments with 1 to 4 employees and the number of establishments with 5 or more employees as additional explanatory variables.[45] The coefficient on the SBC dummy variable was roughly 30 percent smaller in regressions that include the establishment variables. Although the coefficient on the SBC dummy variable maintained its statistical significance, the standard error of the estimate became larger. Thus, even with this crude measure of market structure, we obtain evidence showing that the route by which SBC laws reduce price is through fostering the competitive environment.

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[45] These estimates can only be generated using data for the 1983–1997 period because our establishment data run only through 1997.

4. Conclusions

In this article we use panel data over the 1983–2002 period to evaluate the effects of newly imposed motor fuel SBC laws on retail and wholesale prices; we also examine the SBC impact on market structure. Unlike most previous work, a notable aspect of our analysis is the extended time period for our panel data, which allows us to utilize transitions in the status of SBC laws in order to evaluate the immediate and the long run effects on motor fuel markets.

In contrast to previous work, our analysis shows that on average gasoline prices are about a cent lower five years after the law is imposed. We also find that the total number of gasoline outlets is greater in the presence of the law, and that the increase is primarily among establishments with five or more employees. Retail gasoline establishments with one to four employees gained little from the newly imposed SBC laws. These results are robust to a number of alternative specifications: to the use of different price measures as the dependent variable, to the inclusion of alternative sets of explanatory variables, to the estimation of nonlinear effects, to the focus on specific subsets of the states, and to the exclusion of different states.

We believe that our empirical results provide evidence that sales-below-cost laws have played an important—and beneficial—role in gasoline markets in states that have adopted them. These findings may well seem surprising. After all, the stated purpose of the SBC laws is to outlaw practices often thought to lead to the sale of "cheap" gasoline, but in fact our estimation results show that the laws have the opposite impact: gasoline prices are actually lower in the presence of these laws, not higher. These findings have important implications for states considering adopting (or repealing) such legislation.

Appendix Table A.1
Statutes, names, and adoption (repeal) dates of motor fuel specific SBC legislation

State	Citation	AKA	Effective	Notes
Alabama	Ala. Code §8-22-1 et seq.	Motor Fuel Marketing Act	May 8, 1984	
Arkansas	Ark. Acts 380, §1-18.		August 12, 1993	Ruled unconstitutional on March 11, 1996
Colorado	Colo. Rev. Stat. §6-2-101 et seq.	Unfair Practices Act	July 1, 1993	Motor Fuel at §6-2-105
Florida	Fla. Stat. §526.301 et seq.	Motor Fuel Marketing Practices Act	60 days after May 31, 1985	

Appendix Table A.1 (*Continued*)

State	Citation	AKA	Effective	Notes
Georgia	Geo. Code §10-1-250 et seq.	Below Cost Sales Act	July 1, 1985	Ruled unconstitutional on February 16, 1987
Maryland	Md. Rev. Stat. §10-304.1 et seq.	Sale of motor fuel prohibited	May 2000	
Massachusetts	Mass. Ch. 94 §295A-W et seq.		1950	
Minnesota	Minn. Rev. Stat. §325D.71 et seq.	Unlawful gasoline sales	August 2001	
Missouri	Mo. Rev. Stat. §416.600 et seq.	Missouri Motor Fuel Marketing Act	August 28, 1993	
Montana	Mont. Code Ann §30-14-801 et seq.	Retail Motor Fuel Marketing	April 19, 1991	Repealed January 1, 1999
New Jersey	N.J. Rev. Stat. §56:6-17 et seq.	An act to regulate the retail sale of motor fuels	July 1, 1954	
North Carolina	N.C. Gen. Stat. §75-80 et seq.	Motor Fuel Marketing Act	September 1, 1986	Ratified July 11, 1986
South Carolina	S.C. Code Ann. §39-5-325 et seq.	SC Unfair Trade Practices Act (part of)	60 days after June 15, 1993	This is a part of a larger act.
Tennessee	Tenn. Code Ann §47-25-601 et seq.	Petroleum Trade Practices Act	July 1, 1988	
Utah	Utah Code Ann. §13-16-1 et seq.	Motor Fuel Marketing Act	March 16, 1987	
Wisconsin	Wis. Code Ann. §100.30 et seq.	Unfair Sales Act	June 3, 1939	Amended 1973, 1987, 1992, 1998

Sources: Perkins et al. [31], and a review of state statutes. We thank the Wisconsin Attorney General's Office for assistance.

Appendix Table A.2
Variable definitions and sources

Variable	Details	Source
Average annual inflation adjusted wage per service station employee (SIC 5541)	Gasoline service station, average annual inflation adjusted wage per service station employee in the state	http://stats.bls.gov/sahome.html [36]
Drivers per capita	Total number of driver licenses divided by state population	Federal Highway Administration, *Highway Statistics*, 1980–2002 [40]
GDP deflator	Gross domestic implicit price deflator	http://www.bea.doc.gov/bea/dn/nipaweb/AllTables.asp [8]
Heating degree days	Heating degree days by census division (where "heating degree-days" are deviations from the mean daily temperature below 65F)	http://www.eia.doe.gov/emeu/aer/overview.html [39]
SBC law	Indicator variable, equal to 1 if a state has a SBC law and 0 otherwise	Anderson and Johnson [2], Perkins et al. [31], and state statutes
Per capita income	Inflation adjusted per capita income	http://www.bea.doc.gov/bea/regional/data.htm [9]

Appendix Table A.2 (*Continued*)

Variable	Details	Source
Population	Total state population	http://www.census.gov/ population/www/estimates/ statepop.html [37]
Population density	Total state population divided by state land area in square miles	http://www.census.gov/ population/www/estimates/ statepop.html [37]
Proportion of drivers between the ages of 20 and 44	Number of drivers between ages of 20 and 44 divided by total number of drivers in the state	Federal Highway Administration, *Highway Statistics*, 1980–2002 [40]
Proportion of population over age 65	Proportion of population over 65 within the state	http://www.census.gov/ population/www/estimates/ statepop.html [37]
Reformulated gas	Indicator variable equal to 1 if a state has a city in which the clean air act amendment required use of cleaner burning reformulated gasoline	Vita [42]
Retail price of unleaded gasoline	Average monthly inflation adjusted price of unleaded gasoline sales to end-users net of all taxes (where "sales to end-users" are sales made directly to the ultimate consumer, including bulk customers such as agriculture, industry, and utilities, as well as residential and commercial customers)	Energy Information Administration, *Petroleum Marketing Monthly*, 1984–2002 [39]
General SBC law	Indicator Variable, equal to 1 if a state has a General Sales-Below-Cost Law and 0 Otherwise	Anderson and Johnson [2]
State gasoline tax	State gasoline tax in inflation adjusted cents per gallon	Federal Highway Administration, *Highway Statistics*, 1980–2002 [40]
Vehicles per population	Total number of vehicles divided by state population	Federal Highway Administration, *Highway Statistics*, 1980–2002 [40]
Wholesale price of unleaded gasoline	Average monthly inflation adjusted price of unleaded gasoline sales for resale net of all taxes (where "sales for resale" are those made to purchasers who are other than ultimate consumers)	Energy Information Administration, *Petroleum Marketing Monthly*, 1984–2002 [39]
Months after SBC law	Cumulative index of the number of months after the implementation of the SBC law	
Total number of gasoline retail establishments (SIC code 554)	Data based on an annual survey completed by the Bureau of the Census [37]	*County Business Patterns* for years 1983–1997 [38]
Number of gasoline retail establishments with 1 to 4 employees (SIC code 554)	Data based on an annual survey completed by the Bureau of the Census [37]	*County Business Patterns* for years 1983–1997 [38]
Number of gasoline retail establishments with 5 or more employees (SIC code 554)	Data based on an annual survey completed by the Bureau of the Census [37]	*County Business Patterns* for years 1983–1997 [38]

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