$2.00 GAS! STUDYING THE EFFECTS OF A GAS TAX MORATORIUM *

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December 2006

There are surprisingly few estimates of the effects of sales taxes on retail prices, especially at the firm level. We consider the temporary suspension, and subsequent reinstatement, of the gasoline sales tax in Illinois and Indiana following a price spike in 2000. Earlier laws set the timing of the reinstatements, providing plausibly exogenous changes in the tax rates. Using a unique dataset of daily, gas station-level data, 70% of the tax suspension is passed on to consumers in the form of lower prices, while 80-100% of the tax reinstatements are passed on to consumers. Some evidence suggests that these short-run pass-through estimates are smaller near the state borders, with the tax reinstatements associated with relatively higher prices up to an hour's drive into neighboring states.

JEL: H22, H73; Keywords: Tax Incidence, Gasoline, Spatial Competition

* We would like to thank Severin Borenstein, Gordon Hanson, Craig McIntosh, Jim Poterba, Andrew Samwick, Tom Stoker, Joel Slemrod and two referees, as well as seminar participants at the University of California, San Diego, the NBER Public Economics Program Meeting, and the University of California Energy Institute for useful comments. Evan Chan provided excellent research assistance. Generous support from MIT Center for Energy and Environmental Policy Research is gratefully acknowledged.
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1. Introduction

Gasoline prices are particularly visible, and when they spike there are often calls to reduce or eliminate gas taxes (Berryman, 2005; Sanger, 2006). State and federal taxes add forty cents to the average gallon of gasoline in the United States, resulting in over $8 billion in tax receipts each year (EIA, 2005). For a tax moratorium to reduce prices it is necessary to understand what proportion of taxes are paid by consumers in the short run. In addition, tax suspensions may lead to lower prices in neighboring states as geographic markets may not end at the state border.

Standard tax incidence theory suggests that the fraction of a tax passed on to consumers in a competitive market depends on the elasticities of supply and demand. For example, the tax would be fully passed on to consumers if the industry exhibited constant marginal costs, while less than ‘full shifting’ is expected in markets with increasing marginal costs. In markets that are less competitive, strategic behavior results in pass-through rates that can be greater or less than one-hundred percent.[1]

Despite the attention paid to the theory of tax incidence, surprisingly little empirical work has estimated the effect of sales taxes on prices, especially at the firm level (Poterba, 1996). This paper studies a moratorium on gasoline sales taxes in Illinois and Indiana following a price spike in the spring of 2000, when prices eclipsed the $2.00 per gallon mark. While relatively low by current standards, this proved to be a politically unattractive price during an election year. Effects of these tax changes on retail prices and cross-border competition are estimated using a unique data set of daily prices at the gas-station level. These data are linked with census and geographic data—including

[1] Kotlikoff and Summers (1987) and Fullerton and Metcalf (2002) offer detailed reviews.

driving distance to the state border—and prices are compared to neighboring states before and after the tax changes.

Given that the reforms were known to be temporary, the estimates necessarily relate to short-run effects of tax changes and likely do not reflect long-run responses. Nevertheless, short-run conditions drive price volatility in this closely watched market. The results also provide an estimate of the geographic size of the gasoline market (with its well-posted prices and mobile consumers) by considering price effects into neighboring states. Last, the estimates provide an evaluation of the tax suspension policy.

The tax moratoria in Illinois and Indiana offer three main advantages for studying the response of prices to changes in tax rates. First, the reinstatements offer plausibly exogenous changes in the tax rate, as the timing of the reinstatements are set in earlier laws. Second, the repeal and subsequent reinstatements allow estimates of the pass-through rate for both decreases and increases in the tax. Similar estimates would suggest that the price changes are tied to the tax rate policies. The comparisons also provide a test for asymmetry in the response to changes in stations' marginal costs, as the speed of adjustment has been found to be slower in response to downward cost shocks than to cost increases (Borenstein, Cameron and Gilbert, 1997). Third, gasoline is a homogeneous product where quality differences across space are minimized when studying the pass-through rate of sales taxes across retailers. The key differentiation in the market would appear to be location, a subject we consider in detail below.

The results suggest that 70% of the tax reduction is passed on to consumers in the form of lower prices, while prices increase by 80-100% of the tax when it is reinstated.

Combined with recent estimates that suggest the short-run demand elasticity is close to zero, this lack of 'full shifting' of the tax when it is suspended suggests that the supply response may be fairly inelastic in the short run as well. In terms of distance to the border, the tax increase in Indiana is associated with higher prices up to an hour away from its border, though the evidence is mixed for the Illinois reinstatement.

The structure of the paper is as follows. Section two briefly provides background on the reasons for the tax repeals and how they were conducted, a review of the related literature, and an analytical framework to place the current results in context. Section three describes the gas station-level data and presents mean comparisons of ZIP code characteristics across the comparison groups. Section four presents the empirical model and results, and section five concludes.

2. Background and Related Literature

2.1 Background

In the spring of 2000, gasoline prices rose sharply in the Midwest. Figure I shows the average daily price of regular unleaded gasoline in Chicago, the rest of Illinois, Indiana, Kentucky, and the other states that are neighbors to Illinois and Indiana (Wisconsin, Iowa, Missouri, Ohio and Michigan, see map in the Appendix). On June 19, average prices spiked to a high of $2.11 per gallon in Chicago, and $1.78 in Indiana. While such prices would be welcome today, at the time they were politically unattractive. In fact, at least five investigations were conducted to determine the cause of the price spike, including one by the Federal Trade Commission (Conrad, Howard, and Noggle, 2000; Shore, 2000; Martin, 2001; FTC, 2001; US Senate, 2002). The main cause was short supplies of refined gasoline in anticipation of a change in the reformulation required of refineries, along with unexpectedly high demand (FTC, 2001).[2]

On June 20, 2000—the day after prices had peaked—the governor of Indiana, Frank O'Bannon, used the power granted under a 1981 statute to declare an energy emergency, allowing him to suspend the 5% sales tax on gasoline for 60 days, with a possible extension for another 60 days. He announced that the suspension would begin on July 1st. He later extended the suspension three times: on August 22nd changing the end date to September 15th, on September 13th extending the suspension until September 30th, and on September 28th allowing the suspension to run its 120 day course, ending on October 29th.[3] This was an election year in Indiana, and the governor was criticized for continuing the sales tax suspension in August and September when prices had already fallen (Figure I). The short-lived nature of the price spike, the political justification for the extensions, and the 120-day cutoff set by the 1981 law suggest that the tax reinstatement was not tied to market conditions.

In Illinois, the legislature responded by passing a bill on June 28th suspending its 5% sales tax on gasoline, set to begin on July 1st as well. The moratorium in Illinois was set to end six months later on January 1, 2001. Of the neighboring states, only Michigan had a sales tax to consider suspending, and while there was talk of a suspension it did not

[2] The Illinois investigation found that prices fell following the tax suspension, though the investigation did not attempt to disentangle the effect of the tax suspension with the falling wholesale prices at the time (Conrad, Howard, and Noggle, 2000).
[3] On October 25th, the governor made known that the sales tax would be ending and pre-payment of the following month's sales tax was to begin. The clear jump in prices occurs at the 120 day mark (see below), as was noted in the press following the election (*The Indianapolis Star,* November 8, 2000). Price differences between Indiana and neighboring states did not change on September 1st, 15th, 30th, nor October 25th.

occur. State and federal excise taxes were not affected, as they are tied to highway funding.[4]

In terms of the logistics of the taxes, the sales tax is remitted by the retailers when they prepay an estimated amount of the tax each month. Meanwhile, the excise tax is paid to the distributor as a separate line item on the wholesale invoice. For both types of taxes, a unique feature of gasoline markets is that the posted price includes the tax. A question that arises is whether consumers will know that the tax change has occurred, especially if less competitive gasoline markets result in strategic coordination among retailers to capture the benefits of the tax change. Krishna and Slemrod (2003) note that including the tax in the posted price may disguise it, and there was concern at the time that the tax change may not be observed. In fact, the Illinois law required gasoline retailers to post a notice that the gasoline tax had been suspended, and the governor of Illinois, George Ryan, noted: "There is no guarantee in a free-market economy that prices will go down, but I believe that the political and public pressure applied by the roll back of the sales tax will help force prices down." (Ryan, 2000).

Further, Chetty, Looney, and Kroft (2006) report recent experimental evidence that suggests consumers respond less to changes in an additional tax than they do to changes in the posted price. This would imply that more of an additional tax may be passed on to consumers than one that is included in the posted price, as in the case of gasoline markets, all else equal.

[4] In a market with close substitutes in quality, such as grades of gasoline, a change in an excise (per-gallon) tax would change the relative price of each grade and could affect the interpretation of subsequent price changes (Barzel, 1976; Sobel and Garrett, 1997). This paper considers a change in the *ad valorem* sales tax, which would leave relative prices unchanged.

In addition, when calculating the sales tax, station owners in Illinois apply the tax rate on top of the federal excise tax (a form of double taxation), but are allowed to deduct the 19-cent state excise tax from the tax base. Station owners in Indiana are allowed to deduct both the 15-cent state excise tax and the 18.4-cent federal excise tax. That is, the tax applies to roughly 90% of the posted price in Illinois and 80% of the posted price in Indiana given their retail prices at the time.

2.2 Related Literature

Poterba (1996) reviews the early empirical literature on sales tax incidence and argues that there has been relatively little empirical work on the incidence of sales taxes.[5] Further, the evidence has been mixed with regard to incomplete, full, and over shifting of taxes on retail prices. Poterba (1996) analyzed city-specific clothing price indices for eight cities during 1947-77 and fourteen cities during 1925-39. Retail prices rose by approximately the amount of the sales tax for the post-war period but only by two-thirds during the Depression years. Besley and Rosen (1999) used quarterly data for 12 commodities (such as bananas, bread, milk and Big Macs) in 155 cities during 1982-90. While the pass-through rates for some commodities are estimated to be close to 100%, their results also suggest that several commodities have pass-through rates of well over 100%. Kenkel (2005) studied establishment-level prices and found similar over-shifting in the market for alcoholic beverages in Alaska.

This paper adds to this literature by studying a commodity that receives considerable policy attention: regular unleaded gasoline. Previous work on gasoline taxation employed monthly panels of prices at the state level. Chouinard and Perloff

[5] Early studies include Brown (1939), Due (1942) and Bishop (1968).

(2002, 2004) used a monthly panel of the 48 US contiguous states and the District of Columbia between 1989 and 1997 to estimate a reduced-form model of gasoline prices. Among other results, they find that tax variations and market power (measured by mergers) contribute substantially to geographic price differentials. They also find that 50% of federal excise tax is passed on to consumers, 75% of state *ad valorem* taxes like those studied here are passed on to consumers, and nearly all of the state excise taxes are passed on to consumers. Meanwhile, wholesale prices appear unaffected by changes in state tax rates.

Alm, Sennoga, and Skidmore (forthcoming) consider a similar panel and find that excise taxes are fully passed on to consumers within the first month of a tax change. In addition, they test whether prices respond differently to excise tax increases and decreases and do not find an asymmetry in the response.

One concern with the use of all tax changes and state x month panel data is that the timing of the tax change may reflect market conditions that can confound the pass-through analysis. For example, a tax increase may be particularly unlikely at a time of increasing oil and gasoline prices. This would tend to underestimate the effects of a tax increase on the increase in retail price. This paper considers a plausibly exogenous change in the tax rate and uses station-level data to explore whether the pass-through rate varies across markets described by their distance to the state border and their levels of brand concentration.

Previous evidence also suggests that consumers should not be willing to travel very far to save on gasoline, despite anecdotal accounts of price shopping. Manuszak and Moul (2005) use local tax differences to study the static trade-off between price and traveling. Using data from "Chicagoland" (Chicago, Cook County, Will County and Northwest Indiana) in July 2001, they find that a typical consumer must save $0.55 per trip to the station in order to travel to only one additional mile. This suggests that traveling for cheaper gas prices is not cost effective. Nevertheless, the market size is likely reflected by commuting patterns, as commuters observe prices along their routes.

2.3 Analytical Framework

Our analytical framework follows the Chouinard and Perloff reduced-form specification. The demand function for gasoline is given by $Q = D(p, X)$, where p denotes the gas price and X represents exogenous demand shifters. On the supply side, the reduced-form marginal cost function is $MC(t, W)$, where t is the tax parameter and W represents cost shifters, such as the wholesale price. Profit maximization implies that the marginal cost of a firm equals its marginal revenue. Therefore, we have $p = f(t, X, W, Z)$, where Z consists of the variables that capture the market power of the firms, which in turn results in price being different from firms' marginal revenue.[6]

Predictions of the model depend on the level of competition in the market. In a perfectly competitive market, theory suggests that the fraction of the tax passed on to consumers will be related to the elasticity of supply and demand according to the pass-through formula: $\eta/(\eta - \varepsilon)$, where η is the elasticity of supply and ε is the elasticity of demand. The short-run elasticity of demand has been well studied for gasoline, with a standard estimate on the order of -0.2 and recent estimates suggesting that it is much

[6] Some evidence suggests that local gasoline markets do not exhibit patterns consistent with perfect competition due to the spatially-differentiated nature of the market (Verlinda, 2004) and the potential for tacit collusion with easily monitored prices (Borenstein and Shepard, 1996).

lower—on the order of -0.05 (Hughes, Knittel, and Sperling, 2006). Nearly full shifting of the tax would be expected unless the supply response is also very inelastic.

While competitive markets are associated with pass through rates that are less than or equal to 100%, in markets that are not perfectly competitive the pass-through rate could be either below or above 100% (Katz and Rosen (1985), Stern (1987), Hamilton (1999)).[7] The analysis will consider whether the pass-through rate varies across markets that appear more or less competitive based on measures of brand concentration and the presence of independent retailers.

The wholesale price will also be considered to test whether the tax change affects this upstream market. Given the inelasticity of demand at the retail level, the quantity of wholesale gasoline should be relatively unaffected by the tax change. If wholesale markets are competitive, then the wholesale price should reflect the marginal cost of producing that level of quantity and should be unaffected as well. If wholesale markets are less competitive, then a tax may be "passed back" to the wholesalers. That is, a tax suspension should increase the willingness to pay for wholesale gasoline, while a tax increase should decrease the retailer's willingness to pay, and these changes may be reflected in the wholesale price in less competitive markets.

As noted in the introduction, the results presented below necessarily relate to short-run effects, as the policy was temporary. One advantage of the temporary nature of

[7] One way to consider the elasticites directly would be to consider price and quantity data. Quantity data are not available at the station level, however. Further, short-run elasticity of demand estimates range from -0.05 to -0.25, implying quantity changes of 0.25% to 1.25% in the case of full shifting of a 5% sales tax. When the Department of Energy's Energy Information Administration state x month data on gasoline volumes sold were considered, quantity changes in IL/IN relative to neighboring states (analogous to the price comparisons below) were: +1.2% between June and July, -3.5% between October and November, and -2.0% between December and January. Variation in the month-to-month differences suggests that these were not extraordinary. For IL/IN compared to neighboring states from 1983-2006, the 5-95% range of one-month quantity differences is -4.8% to 4.6%.

the suspension is that it allows a study of the extent of the geographic market for gasoline taking the location of the stations as given. The temporary tax changes are not likely to change the location decisions of the station owners. The empirical analysis will estimate how far into neighboring states the effect of the tax changes on prices extend. This will provide some evidence on the appropriateness of using neighboring states as comparison groups, as well.[8]

3. Data Description

The analysis uses a unique dataset of daily gasoline prices at the station level. These prices are collected by Wright Express Financial Services, a leading provider of payment processing and financial services to commercial and government car, van and truck fleets in the United States. Its Oil Price Information Service (OPIS) uses the credit card receipts to extract retail gasoline prices for up to 120,000 gasoline stations each day.[9] These data are then used in newsletters tracking the industry and sold to firms including the American Automobile Association. Prices for regular unleaded gasoline will be the focus of the analysis below.

OPIS data also include a measure of each station's wholesale price. This is a rack price—the price at the terminal—from the nearest refinery that produces the formulation of gasoline used by the station. Branded gasoline, such as Shell or Mobil, is sold through

[8] There are some studies that consider cross-border competition in other industries. For example, Coats (1995) studies the effects of state cigarette taxes in the US and finds that about fourth-fifths of the sales response to state cigarette taxes is due to cross-border sales. Sumner (1981) and Ashenfelter and Sullivan (1987) also use cross-state differentials in cigarette excise taxes to study the extent of market power in the industry. Further, there is a literature on the effects of states' fiscal policies on other states. See, for example, Case, Hines, and Rosen (1993).
[9] Further information on the methodology is available at http://opisnet.com/methodology.asp, as well as www.senate.gov/~gov_affairs/ 042902gasreport/appendix1.pdf.

distributors called “jobbers”, and the OPIS records the terminal price from each of these distributors as well as the standard rack price charged to unbranded stations. This measure will differ from the station’s actual wholesale price in that it does not include volume discounts or delivery charges. The percentage change in the wholesale price over time should reflect changes in the wholesale price, however.[10]

Figure I showed that the price spike was particularly severe in Chicago, and noticeably less so in Kentucky. For greater comparability, the main analysis will exclude the Chicago-Naperville-Joliet, IL, IN, WI Metropolitan Statistical Area (MSA), as well as Kentucky, though the results are similar when these areas are included. Stations in Illinois, Indiana, and five neighboring states: Michigan, Ohio, Missouri, Iowa, and Wisconsin are compared, where roughly 6,000 stations are surveyed each day. The data has some missing days, however, especially on weekends and holidays. For example, there are no observations during July 1- July 3 or October 28-30, and there are few observations on January 1. The main analysis will focus on prices just before and after the tax changes as allowed by the data, using two days before and after to increase the number of stations observed. For the July tax repeal, June 27 and 28 are compared to July 5 and July 6; October 26 and 27 are compared to October 31 and November 1 for the Indiana reinstatement; and relatively fewer observations for December 29 and 30 are compared to January 2 and 3 for the Illinois reinstatement. Specifications that consider longer time frames are also considered.

[10] Volume discounts are common for branded gasoline at the wholesale level. Estimates with and without controls for wholesale price are discussed below. In addition, roughly 6% of stations are independent (unbranded) stations in the sample, though none of the stations just before New Year’s in Illinois were independent. Nevertheless, the pattern of results for July and October are similar when estimates are calculated using only these independent stations where there is less concern over the quality of the wholesale price information.

In addition, the street address of each station is available. US Census of Population data at the ZIP code level in 2000 are used to compare the groups and to control for neighborhood characteristics such as the age, race, and educational composition, median household income, population, and commuting behavior. The US Gazetteer ZIP Code file from the US Census was collected, which includes the area of the ZIP code in square miles. In addition, the 2000 US Census ZIP Code Business Patterns database records the number of gasoline stations in each ZIP code, which will be used as measure of local market competition.

The address information also allows an estimate of the distance from the station to the state border. To calculate this distance, ZIP codes that comprise the state borders were identified using ZIP code maps. Then, for stations in Illinois/Indiana, the driving distance (in minutes) from each ZIP code to the nearest neighboring-state ZIP code was calculated using software from Mapquest™. This data source has the advantage of calculating distances as consumers would travel from one area to the next, as opposed to distances calculated along a straight line. For stations in the neighboring states, the distance from each station to the nearest Illinois or Indiana ZIP code was also calculated. Stations near the Illinois/Indiana border will be compared to those farther from the border to test the effect of the tax changes into neighboring states.

One potential limitation of the OPIS pricing data is that it may oversample stations used by consumers who travel extensively. The coverage appears fairly complete in the Midwest, however. When comparing stations in the pricing survey and those in the Census data, the median ZIP code had three quarters of the stations surveyed.[11] Further, the surveyed stations include many unbranded gasoline stations, and over a third of the stations surveyed are in ZIP codes with no interstate, suggesting that the coverage is not limited to the most frequently-traveled areas.

Table I describes the prices and variables used as controls and demonstrates that the comparison groups are similar. The sample considered is for the July tax repeals. One difference is in terms of average gas prices: retail prices were ten cents *cheaper* in Indiana/Illinois, partly because the Chicago MSA is excluded here. Wholesale prices, meanwhile, were four cents cheaper per gallon. Federal and state excise taxes make up much of the difference between wholesale and retail prices.[12]

In terms of ZIP code characteristics, the differences are statistically significant given the large number of observations, but the neighborhoods appear fairly similar. For example, the Illinois/Indiana ZIP codes have median household incomes of $42,000 versus $43,000 in the neighboring states. The commuting patterns were computed for all workers in each ZIP code, and stations in both comparison groups are located in ZIP codes with an average of 82% of workers who drive to work alone. Meanwhile, commute times are nearly identical. The population is somewhat smaller in the Illinois/Indiana ZIP codes (19,000 versus 21,000). When stations in the Chicago MSA were included, the Illinois/Indiana ZIP codes tended to have much higher gasoline prices, were more urban, higher income, younger, and more likely to have residents using public

[11] To explore the types of ZIP codes that have better coverage in the OPIS sample, the ZIP code count of the number of stations in the sample was regressed on the observable characteristics in Table I. The main result is that more populous ZIP codes are associated with more stations surveyed, even after controlling for the number of stations according to the Census. Results are not sensitive to different coverage levels.

[12] According to OPIS, stations are estimated to earn margins of less than five cents per gallon, with the remaining costs including distribution from terminals to stations, franchise fees, rents, wages, utilities, supplies, equipment maintenance, environmental fees, licenses, permitting fees, credit card fees, insurance, depreciation, and advertising.

transportation. By excluding Chicago, the main results consider groups of stations whose average ZIP code characteristics are comparable.

4. Empirical Model and Results

All results in the paper are presented with respect to three time periods: the summer of 2000 when stations in Illinois/Indiana are compared to neighboring states; the fall of 2000 when Indiana is compared to its neighboring states including Illinois; and the winter of 2000/2001 when Illinois is compared to its neighboring states including Indiana. As noted in section two, the sales tax does not apply to certain excise taxes, and full shifting of the tax changes would result in a 4.5% change in prices in Illinois and a 4.0% change in prices in Indiana.[13]

4.1 Main Results

The main results are shown in Figure II, where the difference in average log retail prices between Illinois/Indiana and neighboring states is plotted against time. The solid lines represent local linear regressions separately estimated before and after the tax changes. The size of the discontinuity at the time of the tax change is a difference-in-difference estimate of the effect of the tax change on retail prices. Note that these models do not control for station characteristics, which will be incorporated below.

Figure IIA reports the results for the summer of 2000. One feature is the downward trend in the difference in gas prices prior to the moratorium, as the prices were

[13] The calculation varies slightly with the retail price level. Average retail prices just prior to the tax changes in Illinois were 1.78 in July and 1.38 in January. For Indiana, the averages were 1.69 in July and 1.51 in October.

falling faster in IL/IN prior to the tax change—a criticism of the policy (Martin, 2001). If this trend were to continue, and if the difference-in-difference strategy did not adequately control for pre-existing price trends, the effect of the tax suspension on prices would be overstated. The trend in the cross-state price difference does appear to level off in the week prior to the tax change, however, and the difference-in-difference estimate implied by the local linear regressions is a reduction in retail prices of 2.7 log points, or approximately 2.7%, following the suspension of the sales tax.

Figure IIB reports the price differentials between Indiana and its neighbors around the time of the October 29th reinstatement. The average differences are constant before and after the tax changes, but there is a relative price jump of 4% in Indiana right at the time of the reform. The lack of a difference in price trends prior to the tax change suggests that the sunset provision provides a plausibly exogenous change in the tax rate. The price differences are noisier later in November, reflecting some dates with fewer observations and a temporary increase in the price in Illinois.

Figure IIC shows that the data are noisier around the New Year, reflecting the smaller sample sizes at that time and the presence of pricing cycles found in Indiana (Noel, 2006). The local linear regression estimates suggest that retail prices rose by 2.8% in Illinois relative to its neighbors at the time of the reinstatement.[14]

While the end dates were not chosen to reflect concerns about market conditions, the announced end date may affect purchasing habits prior to the tax increase. Relatively

[14] Results are shown with a bandwidth of 7 days. Results are slightly smaller with a bandwidth of 14 days, with difference-in-difference estimates of -1.8%, 4.1%, and 2.0% for the three time periods. Further, the data points are provided for all of the dates when data were available, even when there were few observations in one or both comparison groups. The main results below restrict the sample to dates with adequate samples as discussed above. The qualitative results are not driven by the particular dates considered (Doyle and Samphantharak, 2006).

higher demand just after a tax suspension, and just prior to the planned tax increase, would tend to dampen the estimated effects of the tax change on prices. The raw data suggest that prices do not follow this pattern in July or October, and the slight rise in prices prior to the reinstatement in January is not found when wholesale prices are controlled. This suggests that the comparison of prices before and after the reform provide a useful estimate of the short-run effect of the tax change on retail prices.

These raw comparisons do not take into account differences between Illinois/Indiana and neighboring states. To test the effect of the tax changes on retail prices controlling for these factors, the following model is estimated for station *s* selling brand *b* at time *t*:

$$
\begin{aligned}
(1) \quad \ln(\text{Retail Price}_{sbt}) = {} & \beta_0 + \beta_1 1(\text{IL or IN})_s + \beta_2 \text{Post Reform}_t \\
& + \beta_3 1(\text{IL or IN})_s {*}\text{Post Reform}_t \\
& + \beta_4 \ln(\text{Wholesale Price})_s + \beta_5 X_s + \delta_b + \varepsilon_{sbt}
\end{aligned}
$$

where **1**(Illinois or Indiana) is an indicator that the station is in Illinois or Indiana for the July time period, Indiana for the October comparison, and Illinois for the January comparison; Post Reform is an indicator that the gas price is observed after the tax change; and X is a vector of controls described in Table I. Standard errors are clustered by state to reflect the variation in state policy.

Brand fixed effects are also included, as decisions regarding the wholesale price and other decisions at the brand level may affect the reaction of prices to the change in taxes. One issue is that brands primarily in one state will be nearly collinear with the indicator for Illinois or Indiana. As a result, the indicators for major brands that make up at least five percent of the station observations in both the treatment and comparison groups are included. These major-brand stations account for 60% of the observations. Results are nearly the same when brand fixed effects for all stations are included while restricting the data to those brands observed in both comparison groups, but including the indicators for only the major brands allows the use of all the stations.

Table II reports the results of models with and without controls. Again, the estimates are broken into three time periods: just before and after July 1, October 29, and January 1. The samples are over 20,000 station-dates in July and October, though the sample is smaller at the New Year given the lack of data around the holiday season. Results tend to be the most stable for the October time period, when no major driving holiday affects demand and sample collection.

Column (1) reports a model with no control variables, and shows that retail prices fell by roughly 3.5% around the time of the tax change in July, increased by 3.9% in October and 2.7% in January. Column (2) includes the wholesale price measure, which serves to control for differential changes in the costs of the stations at the time of the reform. The potential effect of the tax changes on the wholesale price itself is discussed below. After including this control, the estimates decrease to 2.9% in July, remain about the same in October at 4.0%, and increase in January to 3.6%.

Demand conditions can vary with demographics such as income levels and commuting patterns (Schmalensee and Stoker, 1999). To test whether the response to the tax changes are affected by demand conditions, the control variables listed in Table I were included in the model, along with the brand indicators. Column (3) shows that the results are essentially unchanged. This confirms the conclusion of Table I that the Illinois and Indiana neighborhoods considered are similar to those in the neighboring states, as well as the ability of the difference-in-difference estimate to control for time invariant differences across the comparison groups.

Of the control variables, the signs of the associations are generally as expected.[15] For example, wholesale prices, neighborhood income levels, and the fraction of workers who carpool are all positively associated with retail prices.[16] Meanwhile, the fraction of workers with long commutes is negatively associated with retail prices in July and January, possibly as they expand the number of competitors. Last, the brand fixed effects suggest that brands earn a premium, with BP and Citgo prices tending to be 2% higher than unbranded stations, and Mobil and Shell tending to be 3% higher. This is consistent to the results from hedonic frameworks in Hastings (2004).

When the models were estimated separately for the tax repeals in Illinois and Indiana, prices in Illinois were found to decline by 3.1% compared to its neighbors, while prices were found to drop by 2.7% in Indiana compared to its neighbors. Both estimates represent a 68% pass-through rate (taking into account the different treatment of state and federal excise taxes) and these differences are statistically significantly different from full pass through.[17] When the taxes are reinstated, prices are fully shifted upwards in Indiana (100% pass through) and 82% of the tax increase is passed on to consumers in Illinois. These results are generally consistent with the estimated 75% pass-through rate for gasoline sales taxes found by Chouinard and Perloff (2004).

[15] Full results are reported in Doyle and Samphantharak (2006), along with more detailed descriptions of comparisons across market types, time periods, and the other robustness and specification checks discussed below.
[16] Previous work suggests that retail prices may take time to respond to changes in wholesale prices. Estimates were robust to the treatment of the wholesale price, including the use of lagged wholesale price and both current and lagged wholesale prices. The coefficient on current wholesale price is also robust to the inclusion of lagged wholesale prices.
[17] Full pass through would imply a 4.5% reduction in Illinois and a 4.0% reduction in Indiana. 0.689=0.031/0.045 for Illinois and 0.675=0.027/0.040 in Indiana.

To compare the results with changes in station costs, we considered the relationship between the retail and the wholesale price measure using data from all of the states considered here from April 1, 2000 to March 31, 2001. The result was slightly smaller: a 5% increase in a station's wholesale price is associated with a 3% increase in its retail price, and this estimate was stable to the inclusion of control variables and station fixed effects.

Two features of the results are their asymmetry and the potential for a lack of full shifting of the tax changes onto retail prices, especially when the tax is suspended. In terms of asymmetry, equality of response to the repeal and reinstatements of the tax cannot be statistically rejected, though the point estimates do suggest that less of the tax decrease is passed on to consumers compared to the tax increases. This could reflect strategic behavior among stations to capture more of the tax reduction. It could also be consistent with competitive markets, where firms were close to capacity constraints at the time of the tax suspension. Recall that the source of the price spike was attributed to limited supplies of a new formulation of gasoline. This may result in a smaller pass-through rate at that time.

The potential for a lack of 'full shifting' of the tax onto consumers is consistent with less competitive markets or competitive markets with inelastic supply. As noted in the background section, the elasticity of demand is thought to range from -0.05 to -0.25. A pass-through rate of 70% implies that the supply elasticity would range from 0.1 to 0.6, while 80% would imply a supply elasticity ranging from 0.2 to 1. The October increase is consistent with full-shifting of a tax increase, however, in which case the inelastic demand may swamp any supply effects.

4.2 Wholesale Prices

The previous discussion restricted attention to the retail gasoline market and controlled for wholesale prices in an attempt to compare stations with similar marginal costs. Of course, the wholesale market may have been affected by the retail tax change. As noted in the background section, competitive wholesale markets should result in little change in the wholesale price following the tax changes, while less competitive wholesale markets may lead to higher wholesale prices in July and lower wholesale prices in October and January.

To test whether the retail tax change affects wholesale prices, column (4) of Table II presents models similar to those above, but with log wholesale price as the dependent variable. The results are mixed, however, with the sign of the estimates suggesting that wholesale prices fell in each of the periods with a (statistically insignificant) 0.7% decline in Illinois/Indiana at the time of the tax decrease, a 0.5% decrease at the time of the tax increase in Indiana and a 1.4% decrease at the time of the tax increase in Illinois. The change in October is fairly small and columns (1) and (2) show that the inclusion of the wholesale price does not affect the main results in October. This result is consistent with prior estimates that the tax incidence does not pass back to wholesalers in the market for gasoline (Chouinard and Perloff, 2004). The January results, meanwhile, suggest that the wholesale markets may not be competitive and that the 82% pass-through may be an upper bound.

To consider the effect on the estimated pass-through rate, consider allowing the wholesale price to vary with the retail tax rate in the analytical framework in section 2: $p = f(t, X, W(t), Z)$. Then $dp/dt = df/dt + df/dW \cdot dW/dt$. The second term is negative, as the effects on the wholesale market would tend to mitigate the effect of a tax change on retail prices. If most of the variation in wholesale prices stemmed from responses to the tax change, controlling for the wholesale price in the above models would tend to overstate the pass-through rate. In January, the pass-through could be as low as 64%.[18]

4.3 Competition across Borders

One question that arises when using neighboring states as a comparison group is whether or not they were affected by the reforms in Illinois and Indiana. The effect of the tax change on border competition can also yield insights into cross-border tax incidence and the extent of the geographic market for gasoline. If the border stations and consumers along the border (including drivers commuting across the border) respond to the tax change, we would expect smaller effects of the tax changes near the border. For example, when the tax is suspended, stations in the treated states may be under less pressure from the cross-border competitors to pass along the tax savings, and the stations just across the border may be under pressure to match any temporary price declines.

Figure III depicts how the price changes, and difference-in-difference estimates, vary with distance from the state border. The horizontal axes in each of the panels are five-minute intervals from the Illinois/Indiana border (0-5 minutes, 5-10 minutes, and so on). For stations in Illinois or Indiana, this is the traveling time to the nearest border (including Kentucky), while for the neighboring states this is the distance to the nearest tax reform state. Stations over an hour and a half from the border, for example, are

[18] As noted above, a 1% increase in the wholesale price is associated with a 0.6% increase in the retail price for these states from April 2000 – March 2001. The estimated change in the wholesale price in January was 1.4%, suggesting that the estimated pass through of 3.7% out of the effective 4.5% sales tax increase in Illinois may be overstated by as much as 1.4*0.6=0.8 percentage points, representing a pass through of (0.037-0.008)/0.045=64%. This is similar to the estimate in column (1) that did not include the wholesale price as a control.

stations within an oval-shaped region in the center of the treated states. Note that, for the July comparison, Illinois and Indiana are treated as one treated region, so the Illinois-Indiana border is omitted from the calculation. Some cells had few observations, so the analysis was restricted to cells with at least 10 stations in each of the comparison groups. This results in few observations far from the border, especially in January.

The lines in Figure III represent local linear regressions of the price changes at the time of the reforms in the state(s) that received the tax change(s), the neighboring states, and the difference between the two to form a difference in difference estimator for each five minute interval.[19]

Consider Figure IIIA, which reports the results for the tax suspensions in July. The bottom line shows that the retail price fell 8.5% (approximately 14 cents) in Illinois and Indiana following the tax suspension, regardless of distance to the border. Meanwhile, retail prices fell 5.5% in the neighboring states for stations whose distance from Illinois or Indiana was greater than an hour away. Contrary to what we expected, relative price declines appear to be smaller near the border—closer to 4.5%. This leads to a difference-in-difference estimate that varies from -4% at the border to -2% farther from the border. The shape in levels is the same, with estimated difference-in-difference estimates ranging from -7 cents to -5 cents per gallon.

For the reinstatements, the raw comparisons do reveal smaller difference-in-difference estimates closer to the border. Figure IIIB shows that in October, the price increase in Indiana is not related to distance to the border (with a slightly smaller increase at the border). In neighboring states, prices declined by approximately 2% an hour away

[19] The estimates use a bandwidth of twenty minutes representing four five-minute cells.

from the border, fading to zero for stations close to the border. The estimated difference-in-difference therefore increases from 0.5% at the border to an estimated 2.6% an hour from the border. The decline at the very end of Figure IIB may be partly due to few observations that far from the Indiana border.

Last, Figure IIIC reports the results for January, where the price increase at the time of the tax reinstatement in Illinois is relatively smaller near the border (1.3%) compared to an hour from the border (4.1%). The difference does decline far from the border (2.8%), though these estimates employ much smaller cell sizes.

One caveat is that areas far from the state border may differ from border areas in ways that can affect the response to the reforms. It appears that these areas are fairly similar in the Midwest, however, with no consistent patterns of differences across the three time periods. When stations less than an hour from the border are compared to stations more than an hour from the border, the only control variable that was consistently found to be statistically significantly different was the fraction of workers with a commute of over an hour. This fraction was lower for ZIP code areas less than an hour from the border in July (4.5% vs. 5.1%) and October (4.4% vs. 5.3%), though the fraction was higher in January when Illinois reinstated its tax (4.7% vs. 4.1%).[20]

To control for observable characteristics and consider larger cell sizes, a model with the same specification as before is augmented with indicators for station distance to the border defined by thirty minute intervals: less than 30 minutes away from the treated

[20] In terms of ZIP code median income, stations near the border had slightly higher incomes in July and January (44.3 vs. 42.2 thousand dollars in July; 44.8 vs. 22.7 in January) and slightly lower in October when Indiana reinstated its sales tax and Illinois is in the comparison group (41.9 vs. 43.6 thousand dollars). Recall that these analyses exclude the Chicago area, where observable characteristics are much different from the rest of the ZIP codes.

state border, between 30 and 60 minutes, between 60 and 90 minutes, and more than 90 minutes away. In particular, the two- and three-way interactions between each of the distance categories, **1**(Illinois or Indiana), and Post Reform are included. For station s at date *t* selling brand *b*, the following model is estimated:

$$
\begin{aligned}
(2)\quad \ln(\text{Retail Price}_{sbt}) = {} & \beta_0 + \beta_1 1(\text{IL or IN})_s + \beta_2 \text{Post Reform}_t \\
& + \beta_3 1(\text{IL or IN})_s * \text{Post Reform}_t \\
& + \beta_4 \text{D}_\text{s} + \beta_5 \text{D}_\text{s} * 1(\text{IL or IN})_s \\
& + \beta_6 \text{D}_\text{s} * 1(\text{IL or IN})_s * \text{Post Reform}_t \\
& + \beta_7 \text{X}_\text{s} + \delta_b + \varepsilon_{sbt}
\end{aligned}
$$

where D is a vector representing indicators for each 30-minute distance category, and X represents the controls, including the wholesale price measure.

Columns (1), (3) and (5) of Table III report the results for the three-way interaction coefficients, with less than thirty minutes from the border as the excluded category. The third row reports the difference-in-difference estimate for this group of stations nearest to the IL/IN borders: -3.5% in July, 3.2% in October, and 2.8% in January. The effect is slightly larger at thirty to sixty minutes away where summing the coefficient on IL/IN*Post and IL/IN*Post*1(>=30minutes and <60minutes) reveals a larger difference-in-difference estimate (in absolute value) of -4.2%. The effect at 60-90 minutes is similar to the stations closest to the border (-3.6%), and is smaller at stations farther from the border (-2.4%). None of these differences across distance categories are statistically significant, however.

In October, the effect found in the raw data is present when controlling for observable characteristics: a difference-in-difference estimate of 3.2% at the border, remaining flat at 3.3% between thirty minutes and one hour from the border, but increasing to 4.3% over an hour away from the border. These differences are statistically significantly different from one another.

In January, the shape of the effect found in the raw data is again evident in the model with controls, with smaller treatment effects at the border, large treatment effects sixty to ninety minutes from the border, and smaller effects for stations far from the border. Again, the January results should be taken with some caution given the relatively smaller sample sizes.

Another way to consider the border competition is to compare stations that are just across the border from one another. To estimate these effects, stations in Illinois/Indiana that are not in a border ZIP code were excluded, as well as stations outside Illinois/Indiana that are more than thirty minutes from the border. To compare the estimates to the main results, the Chicago MSA is also excluded. Then, an indicator for the "treated-state ZIP code" was created, which is the ZIP code for a station in Illinois/Indiana, and the nearest Illinois/Indiana ZIP code for stations outside of Illinois/Indiana. Columns (2), (4), and (6) of Table III present estimates of models similar to those presented in Table II, but with treated-state ZIP code fixed effects. The estimates are again larger in July (-5.6%), but smaller in October (3.1%) and January (1.3%). While the evidence is again somewhat mixed in terms of the larger effects for July and smaller effects for October and January, the reinstatements suggest smaller difference-in-difference estimates for stations that compete along the border compared to stations farther from the border.

A third approach estimated a model similar to (1), but restricted to stations within the seven MSAs that overlap state borders, including Chicago, St. Louis, and Cincinnati.

MSAs are defined by commuting patterns and may reflect the area where gasoline stations compete. When stations within the Chicago-Naperville-Joliet, IL-IN-WI, MSA were considered, the estimates were -2.7% in July; 0% in October—consistent with press reports that Gary, Indiana stations matched the Illinois stations' prices following the tax reinstatement at the end of October; and a 2.7% price increase in Illinois compared to the Wisconsin and Indiana stations following the tax increase in January. For the remaining cities, MSA fixed effects were incorporated to compare stations within the same city but in different tax jurisdictions. Te results were mixed, with a larger difference-in-difference estimate in July (-3.6%), slightly larger in October (4.2%), but smaller in January (1.5%).

Overall, the difference-in-difference results suggest somewhat smaller results when analyzed close to the border, especially for the reinstatements. While some of the evidence is mixed, the results are generally consistent with the effect of the tax extending across state borders. In particular, the October results appear to be more stable given the relatively larger sample size in October, and the lack of a major driving holiday that may affect the results. These estimates suggest a 3.2% increase at the border and a 4.3% increase farther from the border: a pass-through rate of approximately 80-100%.

4.4 Competitive Environment

Another way the pass-through rates can differ is when the market conditions differ. The temporary nature of the moratorium implies that it should not affect the structure of the market. To the extent that entry barriers are low, each market may be competitive, whereas zoning regulations may result in high barriers in some locations. As noted in section two, previous work on market structure has suggested that the spatial differentiation in this industry can lead to less competitive markets. Previous work has highlighted the effect of brand concentration and the presence of independent gasoline stations—those unaffiliated with a refiner or oil company—in determining the competitiveness of a local market (Hastings 2004; Van Meerbeeck, 2003; Sen, 2005).

To consider how the results may vary across markets with different levels of brand concentration, brands in the OPIS price data were considered for the month of June to capture all of the sampled stations just prior to the reforms. The share of stations within each ZIP code or MSA was calculated for each brand. These shares were then squared and summed to create a Herfindahl-Hirschman Index (HHI) using station shares rather than market shares, as quantity data are not available.

The effect of the tax on retail prices was then compared for stations that belonged to different HHI quartiles. For example, in July the bottom quartile of MSAs averaged an HHI of 711 (with an average three-brand concentration ratio (CR3) of 37%), the second quartile averaged 1458 (CR3=58%), the third quartile averaged 1733 (CR3=64%) and the top quartile averaged 2470 (CR3=74%). At the ZIP code level, the HHIs in the four quartiles averaged 615, 1957, 3010, and 7005 (average CR3 = 28%, 67%, 82%, and 98%), respectively. The top-quartile includes mostly one brand (likely one-station) ZIP codes in the OPIS data. This may reflect differences in the neighborhoods, and models identical to equation (2) were estimated with full controls, but with a vector of HHI quartiles rather than a vector of distance categories.

Table IV reports the results for the three-way interaction coefficients, with the excluded category being the bottom HHI quartile. Panel A focuses on the ZIP code level, and the first row reports the difference-in-difference estimate for the least concentrated

ZIP code areas. The results are remarkably similar across the 3 time frames: -2.6% in July, 2.6% in October, and 2.4% in January. For July, the results are roughly flat with regard to HHI levels, though October and January both show 2 percentage point increases in prices relative to the least concentrated ZIP codes—a 4.6% price increase in all. That is, ZIP code areas that differ markedly in their brand concentrations had similar pass-through rates, except for the least concentrated ZIP codes where the increase in price was found to be smaller. To the extent that the cost structure is similar across these markets, it appears that greater brand concentration is associated with larger pass through rates, especially for tax increases.

The MSA-level results are more mixed. Panel B shows no consistent pattern across cities with different levels of brand concentration in July. A pattern similar to that found at the ZIP code level was found for October, and a sharp increase in the price was found for the most concentrated MSAs in January. Again, the January results are typically noisier given fewer observations considered, especially with the sample broken into subgroups. Still, the least concentrated MSAs do appear to have smaller price increases at the time of the tax reinstatements, mirroring the ZIP code results to some degree.

In a related approach, we used the brand name to determine if a station was independent—not owned or affiliated with an oil company.[21] The main results were generally robust across markets that differed in their independent gasoline station composition. In July, the Illinois/Indiana stations located in a ZIP code with an independent gasoline station saw prices decline by 3.4% at the time of the tax change

[21] When we controlled for whether the station was independent, there was no effect on the main coefficients of interest. Independent status was associated with 1.4% lower prices (s.e.=0.7%).

compared to neighboring states, while stations in ZIP codes with no independent station saw relative price declines of 2.7% (controlling for ZIP code characteristics, such as population). The comparable changes in the October reinstatement were 3.3% and 4.2% (a smaller increase in price with independent stations), and 4.6% and 3.3% for the January reinstatement (a larger increase in price with independent stations).[22]

4.5 Specification & Robustness Checks

The previous results suggest that the effects of the tax changes on retail prices are robust across increases and decreases in the tax rate, across different types of ZIP codes, and across space with some evidence of smaller effects at the border and in the least concentrated markets. A number of robustness and specification checks suggest that these results do stem from the change in tax policy.

The first specification check considers the treatment of time. The main results estimate a discontinuity at the time of the tax change, similar to an event study. This was justified in part by the lack of pre-existing trends in the price differences shown in Figure II. One way to be more flexible regarding timeframes is to consider data ten days before and after the reforms, with indicators for each day to trace out the effect over time. When this model was estimated, the differences appear stable before and after the reforms, especially within one week of the reforms (Doyle and Samphantharak, 2006). The drop in July appeared to take two days, while the increases were seen in the first day. Interestingly, no change in price is found just prior to the tax changes, which may have

[22] An alternative specification considered the number of stations in an area. A doubling of the stations in an MSA is associated with a 0.5 percentage point smaller effect on prices in July, a 0.4 percentage point larger effect on prices in October, and virtually no effect was found in January. Doubling the number of stations at the ZIP code level also revealed a smaller effect on prices in July (by 0.4 percentage points), and larger effects in October (0.3 percentage points) and January (0.7 percentage points).

been expected given the potential for intertemporal substitution. These results suggest that the analysis just before and after the tax changes captures the effects on retail prices.[23]

The main results also are robust to a battery of robustness checks including: (1) models that use ZIP code population weights as a proxy for transactions in an area; (2) models that incorporate station fixed effects; (3) spatial regressions with standard errors estimated using a two-dimensional spatial autocorrelation structure set out in Conley (1999), which suggested that the standard errors reported here are conservative; and (4) regressions including Chicago MSA and Kentucky.

Three placebo tests were estimated where a relative change in price would suggest that the results here are not driven by the tax changes : (1) a comparison of price changes around Memorial Day to check weather our results in July and January are driven by changes brought about by travel holidays; (2) a comparison around September 1st, September 15th, and September 30th, the dates the Indiana reform was set to expire prior to the governor's extensions; and (3) a comparison on the same dates as the main analysis, but along the Pennsylvania-New York border. No price changes were found in these placebo tests.

Last, demand conditions may affect the response to the tax changes as well. To test for these differences, ZIP codes were broken into two groups according to the median household income: higher income consumers may be less elastic, and the pass through

[23] Models using data from one month before and after the tax changes were also considered, with quadratic trends allowed to vary across comparison groups before and after the tax changes added to the controls. The result in July is fairly similar, a 3.3% decline at the time of the tax change. A smaller increase is found in October (3.2%), while the change is slightly larger in January (4.2%).

may be larger as a result. The average income level in the bottom half of ZIP codes is roughly $34,000, while the average ZIP code in the top half has an income level of $51,000. The results provide mild evidence that the pass-through increases with income level, with the effect of the reform on prices relatively flat with respect to income in July, and 0.5 percentage points larger in the wealthier ZIP codes in October and January. Taken together, the results appear similar across different types of neighborhoods.

5. Conclusion

When gasoline prices spike, governments are under some pressure to respond to the volatility by cutting taxes. Illinois estimates that the state lost $157 million in tax revenue (Noggle, 2005), while Indiana estimates a loss of $46 million (Nass, 2000). One question is how much of a reduction in retail prices did the tax suspension buy? Further, despite a great deal of attention paid to the theory of tax incidence, surprisingly few empirical studies of the pass-through rates of sales taxes have been conducted, especially at the firm level. Using a unique dataset of gasoline station prices, and a plausibly exogenous change in tax rates, the Indiana/Illinois reforms provide a way to estimate the short-run effects of a tax change on gasoline prices and border competition

The estimates here suggest that 70% of the reduction in the sales tax was passed on to consumers, while 80-100% of the tax reinstatement was passed on to consumers. These short-run pass-through rates are consistent with the previous work using aggregate state-level data (Chouinard and Perloff, 2002; Alm, Sennoga and Skidmore, forthcoming). While our results directly measure effects for states only in the Midwest, the setting where a short-lived price spike during an election year led to the tax suspension, and the reinstatements were determined by earlier laws rather than market conditions, result in a particularly compelling way to study the effects of tax changes on retail prices.

The estimates provide some evidence for less-than-full shifting of the tax, especially when the tax is reduced and in the least concentrated local markets when the tax is increased. Given that short-run demand elasticities are known to be quite small, any less-than-full shifting of tax changes onto consumers suggests that the short-run supply response is inelastic as well. The results are also suggestive of smaller price differences near the border, with higher prices up to an hour's drive into neighboring states at the time of the tax reinstatements.

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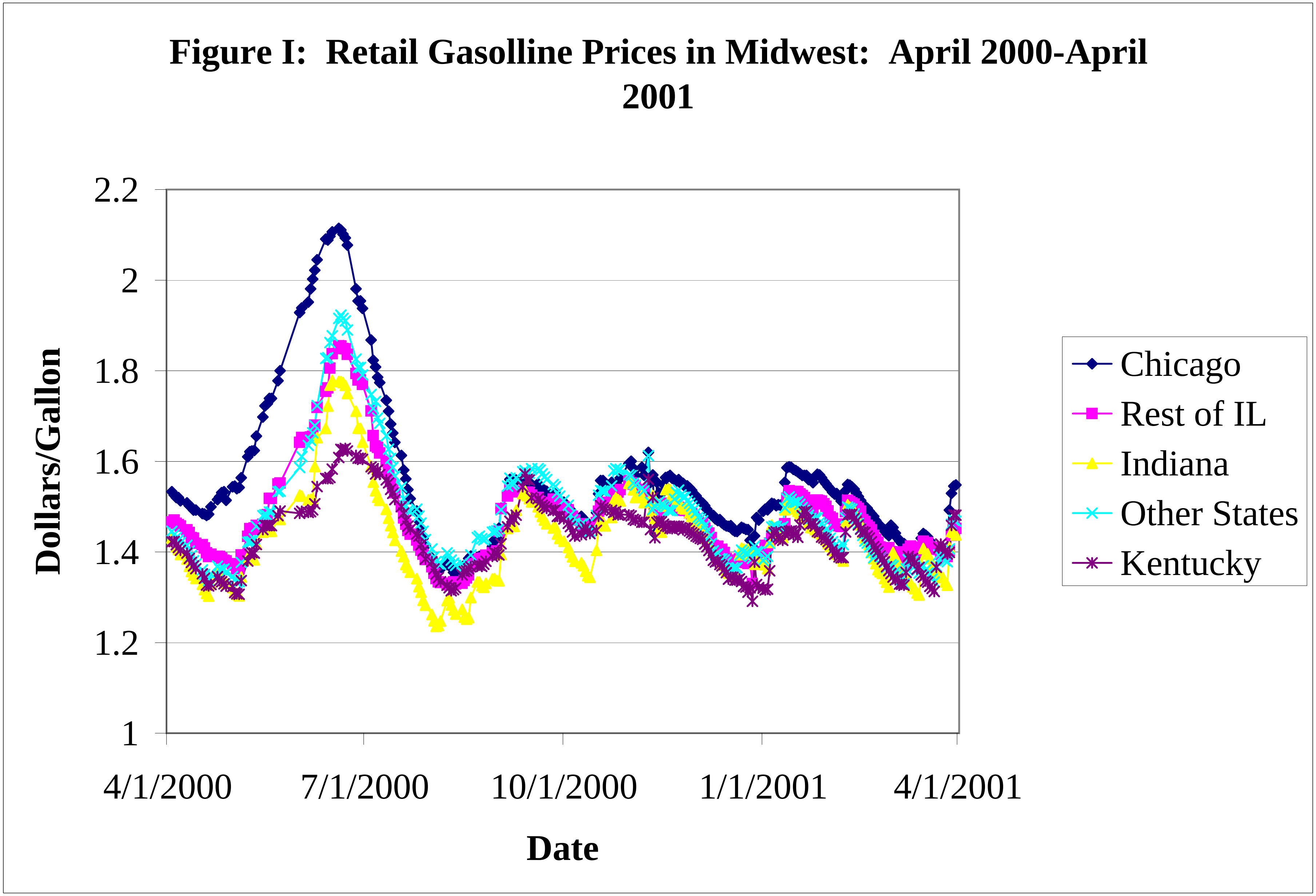


Figure I: Retail Gasolline Prices in Midwest: April 2000-April 2001
2.2
2
1.8
1.6
1.4
1.2
1
Dollars/Gallon
4/1/2000
7/1/2000
10/1/2000
1/1/2001
4/1/2001
Date
Chicago
Rest of IL
Indiana
Other States
Kentucky

Figure IIA: Summer 2000 Difference in Log Gas Prices
IL/IN vs. Neighboring States: MI, OH, MO, IA, WI

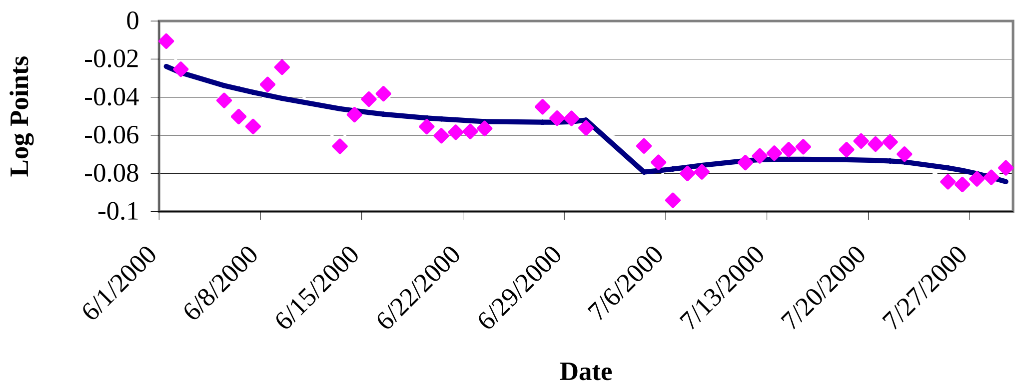


Figure IIB: Fall 2000 Difference in Log Gas Prices
IN vs. Neighboring States: MI, OH, IL

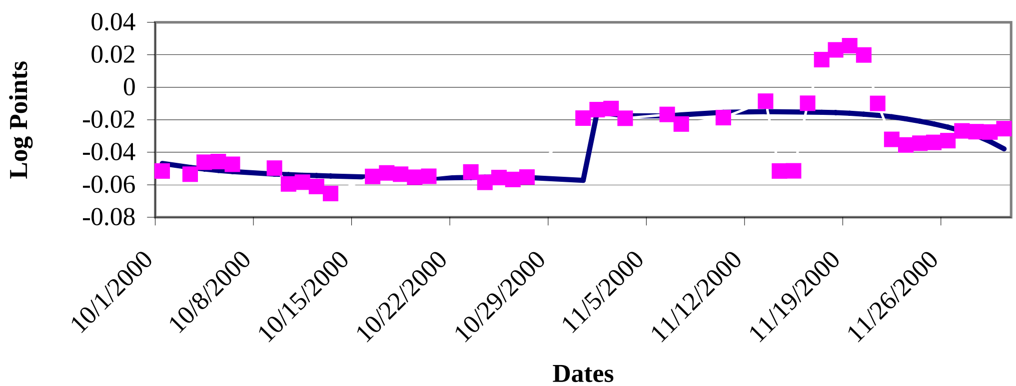
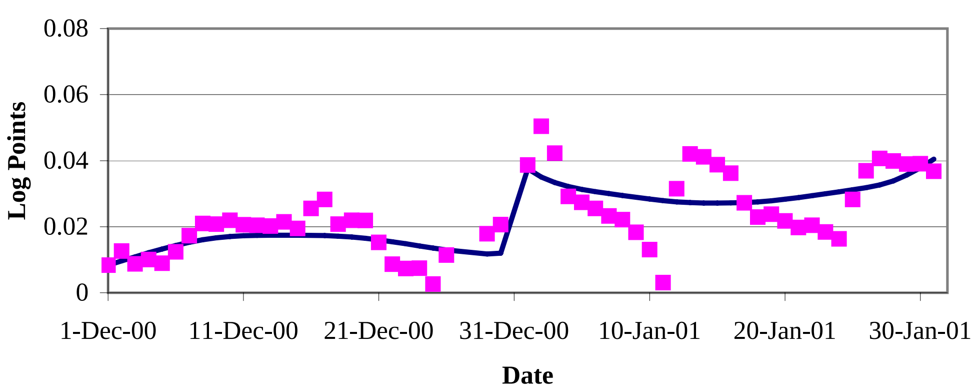


Figure IIC: Winter 2000/2001 Difference in Log Gas Prices
IL vs. Neighboring States: MO, IA, WI, IN



Local linear regressions of the difference in log(price) against time. Bandwidth=7 days.

Figure IIIA: Change in Log Retail Price: July

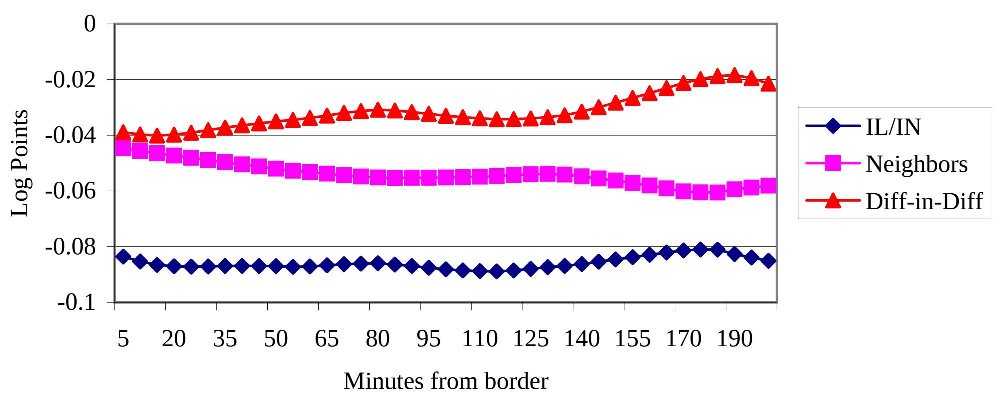


Figure IIIB: Change in Log Retail Price: October

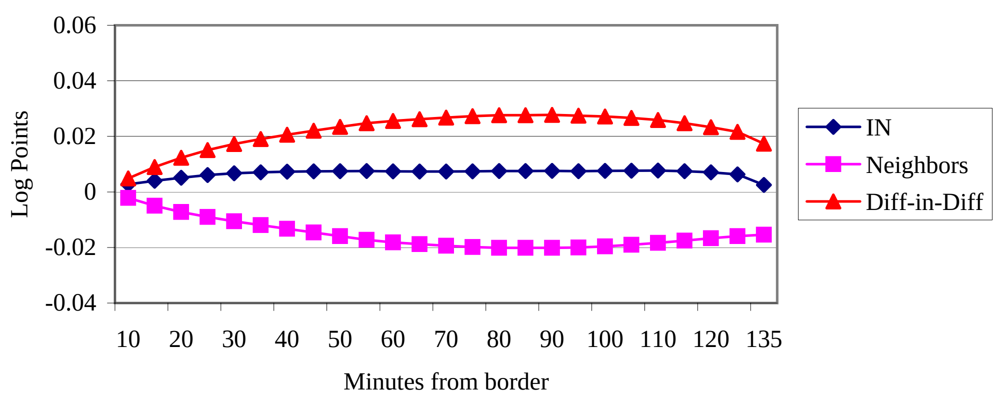
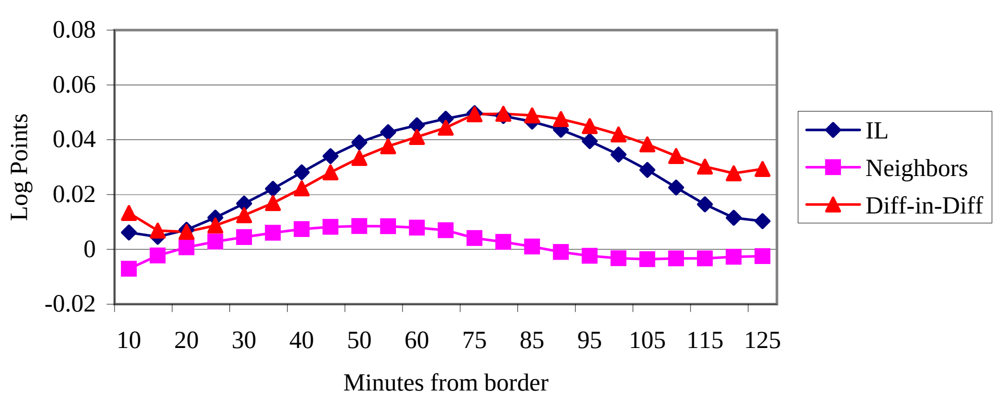
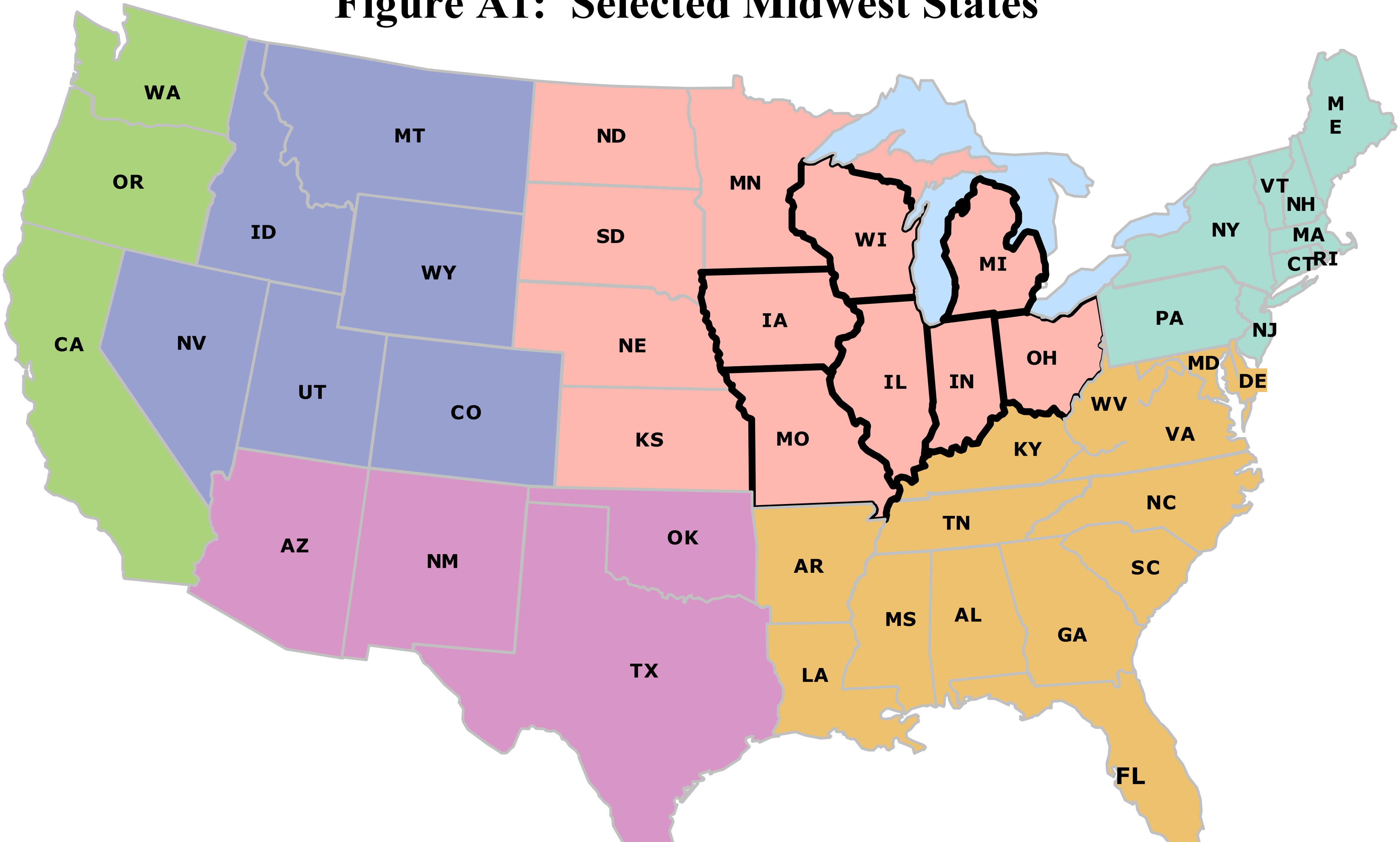


Figure IIIC: Change in Log Retail Price: January



Local linear regressions of the change in log(price) at the time of the tax reforms against time. Bandwidth=20minutes.

Figure A1: Selected Midwest States



Table(s)

Table I: Selected Summary Statistics: July 2000

		Illinois & Indiana		Neighboring States	
Variable		Mean	Std. Dev.	Mean	Std. Dev.
Prices	retail price	1.67	0.12	1.78	0.14
	log(retail price)	0.51	0.07	0.57	0.08
	wholesale price	1.08	0.06	1.12	0.08
	log(wholesale price)	0.07	0.05	0.11	0.07
	federal & state excise tax	0.35	0.02	0.39	0.03
ZIP Code Characteristics	population	19221	13312	21121	15005
	area (square miles)	73.78	61.08	69.80	76.16
	gas stations	9.76	7.04	9.75	7.21
	income	41515	9776	43027	12431
Race	white	0.89	0.12	0.87	0.18
	black	0.05	0.10	0.07	0.16
	Hispanic	0.03	0.03	0.02	0.04
Age	age 0-18	0.27	0.03	0.26	0.04
	age 19-34	0.21	0.06	0.21	0.06
	age 35-64	0.38	0.04	0.39	0.04
	age 65+	0.14	0.04	0.14	0.04
Education	less than high school	0.18	0.07	0.16	0.07
	high school	0.37	0.08	0.35	0.09
	some college	0.27	0.04	0.28	0.05
	college	0.19	0.11	0.21	0.12
Commuting	drive alone	0.82	0.05	0.82	0.07
	car pool	0.11	0.03	0.10	0.04
	public transport	0.01	0.01	0.01	0.03
	other transport	0.03	0.03	0.03	0.03
	work at home	0.03	0.01	0.03	0.02
	0-10 minutes	0.23	0.09	0.22	0.10
	10-20 minutes	0.33	0.10	0.32	0.10
	20-30 minutes	0.19	0.08	0.20	0.07
	30-45 minutes	0.15	0.07	0.16	0.07
	45-60 minutes	0.05	0.03	0.05	0.04
	60+ minutes	0.05	0.02	0.05	0.03

Neighboring states: MI, OH, MO, IA, WI. Prices observed June 27, June 28, July 5, & July 6
5945 Illinois observations; 23488 Neighboring State observations.

Table II: Regression Results

A: July Tax Repeal

Dependent Variable:	Log(Retail Price)			Log(Wholesale Price)
	(1)	(2)	(3)	(4)
Illinois or Indiana	-0.048	-0.013	-0.014	-0.035
	(0.038)	(0.025)	(0.021)	(0.017)
Post July 1	-0.052	0.029	0.025	-0.088
	(0.007)	(0.013)	(0.015)	(0.006)
(IL or IN)*Post July 1	-0.035	-0.029	-0.029	-0.007
	(0.007)	(0.008)	(0.008)	(0.006)
Observations	29675	29675	29433	29433
R-Squared	0.23	0.60	0.64	0.57
Mean of Dep. Var.	0.560	0.560	0.560	0.560

B: October Tax Reinstatement

Dependent Variable:	Log(Retail Price)			Log(Wholesale Price)
	(1)	(2)	(3)	(4)
Indiana	-0.056	-0.052	-0.053	-0.015
	(0.009)	(0.007)	(0.007)	(0.001)
Post Oct. 29	-0.014	-0.008	-0.009	-0.021
	(0.006)	(0.006)	(0.006)	(0.001)
IN*Post Oct. 29	0.039	0.040	0.040	-0.005
	(0.006)	(0.007)	(0.006)	(0.002)
Observations	22092	22092	21884	21884
R-Squared	0.16	0.18	0.26	0.41
Mean of Dep. Var.	0.457	0.457	0.456	0.456

C: January Tax Reinstatement

Dependent Variable:	Log(Retail Price)			Log(Wholesale Price)
	(1)	(2)	(3)	(4)
Illinois	0.019	-0.001	-0.005	0.029
	(0.035)	(0.024)	(0.021)	(0.007)
Post Jan. 1	-0.000	-0.038	-0.020	0.051
	(0.004)	(0.004)	(0.004)	(0.002)
IL*Post Jan. 1	0.027	0.036	0.037	-0.014
	(0.004)	(0.004)	(0.004)	(0.003)
Observations	7090	7090	7071	7071
R-Squared	0.04	0.24	0.39	0.41
Mean of Dep. Var.	0.303	0.303	0.303	0.303
Controls:				
Wholesale Price	No	Yes	Yes	-
ZIP Codes Characteristics	No	No	Yes	Yes

Panel A: Prices observed June 27, June 28, July 5, July 6; Panel B: Prices observed Oct. 26, Oct. 27, Oct. 31, Nov. 1
Panel C: Prices observed Dec. 29, Dec. 30, Jan. 2, Jan. 3. Standard errors are reported, clustered at the state level.

Table III: Distance to Border

Dependent Variable: Log(Retail Price)

	July Repeal		October Reinstatement		January Reinstatement	
	(1)	(2)	(3)	(4)	(5)	(6)
Illinois or Indiana	0.015	0.009	-0.067	-0.043	0.015	0.023
	(0.030)	(0.016)	(0.006)	(0.005)	(0.027)	(0.010)
Post Tax Change	0.025	-0.023	0.004	-0.007	-0.018	0.012
	(0.019)	(0.009)	(0.008)	(0.007)	(0.004)	(0.003)
IL/IN*Post	-0.035	-0.056	0.032	0.031	0.028	0.013
	(0.012)	(0.013)	(0.009)	(0.008)	(0.006)	(0.003)
IL/IN*Post*1(>=30min & <60min)	-0.007	-	0.001	-	0.009	-
	(0.006)		(0.003)		(0.004)	
IL/IN*Post*1(>=60min & <90min)	-0.001	-	0.012	-	0.053	-
	(0.007)		(0.002)		(0.009)	
IL/IN*Post*1(>=90min)	0.011	-	0.011	-	-0.012	-
	(0.010)		(0.003)		(0.004)	
IL/IN ZIP Code Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	29433	1858	21884	1047	7071	692
R-Squared	0.66	0.80	0.28	0.61	0.42	0.63
Mean of Dep. Var.	0.560	0.506	0.456	0.449	0.303	0.267

Columns (1) & (2): Treated states: IL & IN; Neighboring states: MI, OH, MO, IA, WI & Prices observed June 27, June 28, July 5, July 6
Columns (3) & (4): Treated state: IN; Neighboring states: MI, OH, IL & Prices observed Oct. 26, Oct. 27, Oct. 31, Nov. 1
Columns (5) & (6): Treated state: IL; Neighboring states: MO, IA, WI, IN & Prices observed Dec. 29, Dec. 30, Jan. 2, Jan. 3.
Columns (2) (4) & (6) include stations in IL/IN border ZIP codes, as well as stations within a 30 minute drive from IL/IN.
All models include full controls. Standard errors are reported, clustered at the state level.

Table IV: Pass through & Brand Concentration Across MSAs or ZIP Codes

	A. ZIP code Level			B. MSA Level		
Dependent Variable: Log(Retail Price)						
	(1) July Repeal	(2) Oct. Reinstatement	(3) Jan. Reinstatement	(4) July Repeal	(5) Oct. Reinstatement	(6) Jan. Reinstatement
IL/IN*Post	-0.026	0.026	0.024	-0.028	0.015	0.038
	(0.005)	(0.010)	(0.012)	(0.005)	(0.011)	(0.011)
IL/IN*Post*Brand HHI Second Quartile	-0.002	0.019	0.015	0.018	0.030	0.006
	(0.004)	(0.006)	(0.008)	(0.007)	(0.010)	(0.011)
IL/IN*Post*Brand HHI Third Quartile	-0.001	0.024	0.021	-0.009	0.034	-0.011
	(0.008)	(0.009)	(0.015)	(0.006)	(0.010)	(0.015)
IL/IN*Post*Brand HHI Top Quartile	-0.007	0.016	0.018	-0.004	0.027	0.060
	(0.005)	(0.006)	(0.019)	(0.010)	(0.010)	(0.025)
Observations	29433	21884	7071	25324	19797	6665
R-Squared	0.64	0.29	0.41	0.67	0.28	0.50
Mean of Dep. Var.	0.560	0.456	0.303	0.558	0.455	0.302

Panel B: Data are restricted to stations within an MSA.
Brand Herfindahl-Hirschman Index (HHI) is the sum-of-squared brand shares in the OPIS pricing data.
Columns (1) & (4): Treated states: IL & IN; Neighboring states: MI, OH, MO, IA, WI & Prices observed June 27, June 28, July 5, July 6
Columns (2) & (5): Treated state: IN; Neighboring states: MI, OH, IL & Prices observed Oct. 26, Oct. 27, Oct. 31, Nov. 1
Columns (3) & (6): Treated state: IL; Neighboring states: MO, IA, WI, IN & Prices observed Dec. 29, Dec. 30, Jan. 2, Jan. 3.
All models include full controls including main effects and two-way interactions. Standard errors are reported, clustered at the state level.