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UNIVERSITY of PENNSYLVANIA
Budget Model

Effects of a State Gasoline Tax Holiday

Summary: We provide causal evidence that recent suspensions of state gasoline taxes in three states were mostly passed onto consumers at some point during the tax holiday in the form of lower gas prices: Maryland (72 percent of tax savings passed onto consumers), Georgia (58 percent to 65 percent) and Connecticut (71 percent to 87 percent). However, these price reductions were often not sustained during the entire holiday.

Introduction

Gasoline taxes in the United States include a federal excise tax of 18.4 cents per gallon as well as state excise taxes and other taxes and fees at state and local level. Legislation to suspend state gasoline taxes has been proposed and passed in a few states to combat rising gasoline prices.

Three states, Maryland, Georgia, and Connecticut have enacted gasoline tax holidays. Twenty more states are considering various measures to provide gasoline tax relief after gasoline prices hit record highs in recent weeks.

Maryland suspended its state tax of 36.1 cents per gallon on gasoline and 36.85 cents per gallon on diesel from March 18 to April 16 this year.[1] Georgia lifted its state fuel taxes for 10 weeks from March 18 until May 31 including a tax of 29.1 cents per gallon on gasoline and a tax of 32.6 cents per gallon on diesel. Finally, Connecticut suspended its state tax on gasoline of 25 cents per gallon from April 1 to June 30.

In addition, two states, New York, and Florida, have passed legislations that will suspend their gasoline tax later in the year. New York's gasoline tax holiday will take effect on June 1 through the end of the year and suspend 16 cents per gallon of the state's sales and excise taxes on gasoline (16.75 cents per gallon in MCTD region). Florida will lift its 25.3 cents per gallon state gasoline tax from October 1 to October 31.

Many other states including Michigan, Illinois, Florida, Chicago, Missouri and California are also considering a state gasoline tax holiday along with other measures to address rising gasoline prices. These include keeping state gasoline tax constant or lowering it despite inflation, distributing gasoline cards and public-transport vouchers as well as providing a gasoline tax rebate.

Figure 1 shows the gasoline prices in Maryland, Georgia, Connecticut and an average of the rest of the states from October 1, 2021, to May 16, 2022. Retail gasoline prices stayed relatively stable until February this year and then saw a significant increase in March. The gasoline prices started to decline in many states in mid-March including Maryland, Georgia, Connecticut and then climbed back up in late April.

Figure 1: Gasoline prices in Maryland, Georgia, Connecticut and the rest of the country

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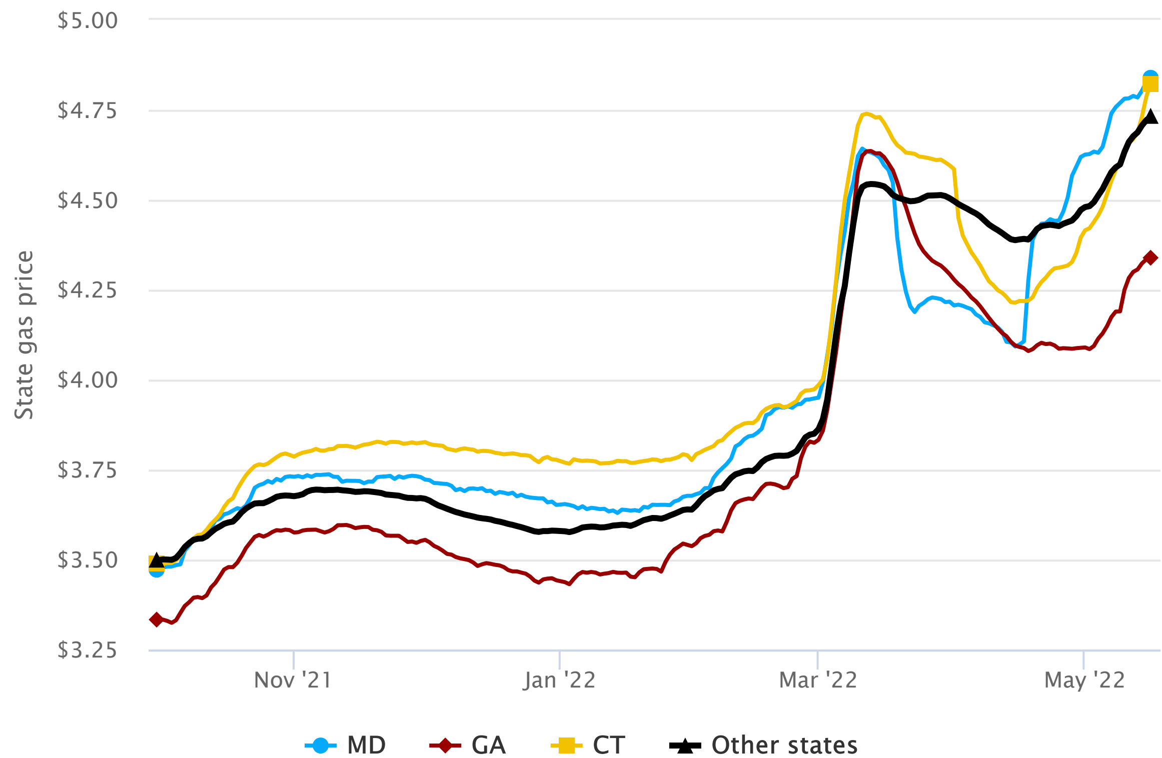

Many factors affect the retail prices of gasoline, including the cost of crude oil, refining and distribution costs and profits as well as taxes. As a result, we cannot know whether the decrease in gasoline prices is primarily caused by a gasoline tax holiday by simply looking at the change in prices over time. We can control the confounding factors if they are observed. However, other identification strategies—considered below—are needed to account for unobservable confounding factors.

Who captures the benefit of a tax cut?

An excise tax like a gas tax is imposed on producers and creates a wedge between the prices that consumers pay and the prices that producers receive. It is a well-established principle in economics that the actual "incidence" of a tax reduction (i.e., who actually benefits) is independent of whether the statutory tax is charged to consumers or to suppliers.

In the case of gas tax holiday, suppliers can capture part of the economic benefit of the tax reduction if pump prices do not fall by the full amount of the suspended tax. That could happen if the "demand elasticity" (consumer flexibility) for gasoline is quite low, giving suppliers more opportunity to capture the benefits of the tax cut.

Estimating the *causal* impact of a gas tax holiday requires careful attention to details. We consider two approaches to identification: the difference-in-differences approach (DID) and synthetic control methods.

Difference-in-differences estimates

DID requires several assumptions for identification, the most important of which is that the treatment and control groups have "parallel trends" in outcome in the absence of the intervention. Parallel trends means that the average gasoline prices in Maryland, Georgia and Connecticut (the treatment group) would have followed the same trend as those in other states (the control group) in the absence of the tax holiday.

To satisfy that requirement, we need to include states in the control group that are similar to Maryland, Georgia and Connecticut before the enactment of the gasoline tax holiday. These control states then provide us with a projection of what the gasoline prices would have been in Maryland, Georgia and Connecticut if the state gasoline tax was not suspended. The difference between the actual and counterfactual gasoline prices is the causal effect of the gasoline tax holiday on gasoline prices.

We use neighboring states to Maryland (Pennsylvania, Delaware, Virginia, West Virginia), Georgia (Tennessee, South Carolina, Florida, Alabama) and Connecticut (Massachusetts, Rhode Island, New York) as their respective control group. Figure 2 shows the gasoline prices in Maryland, Georgia, Connecticut each compared to an average of their control group.

Figure 2: Gasoline prices in selected state and its neighboring states

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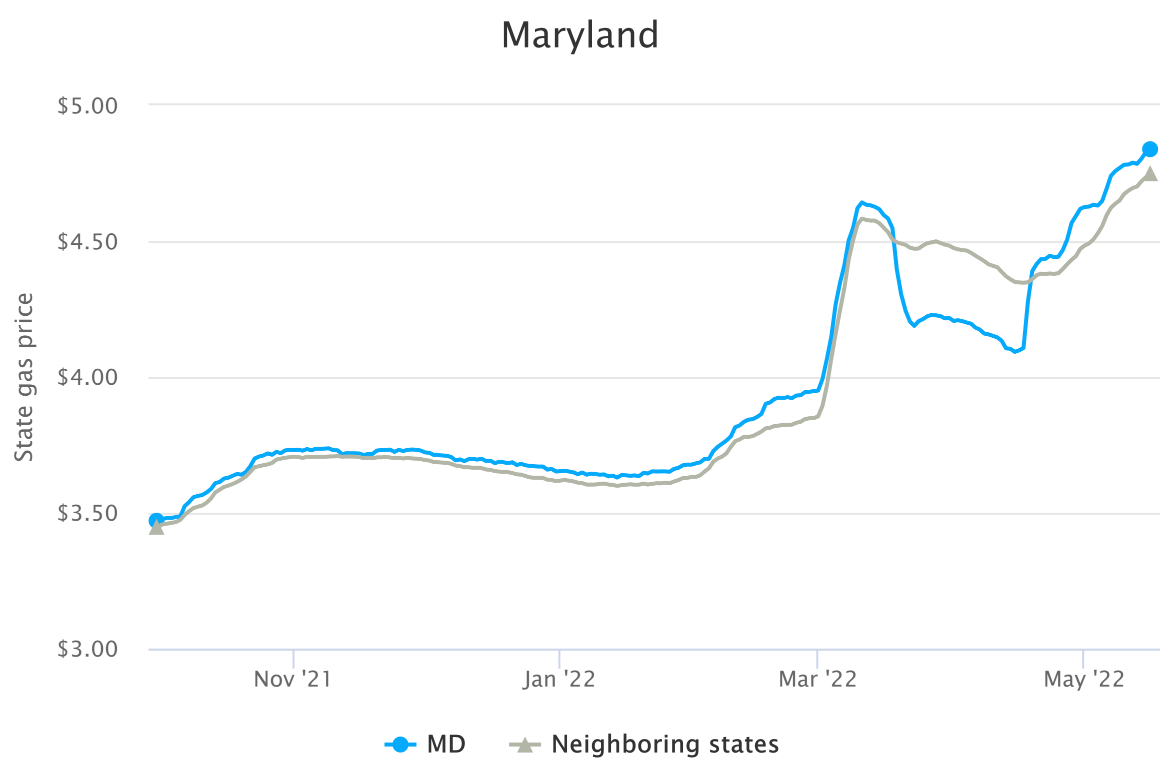
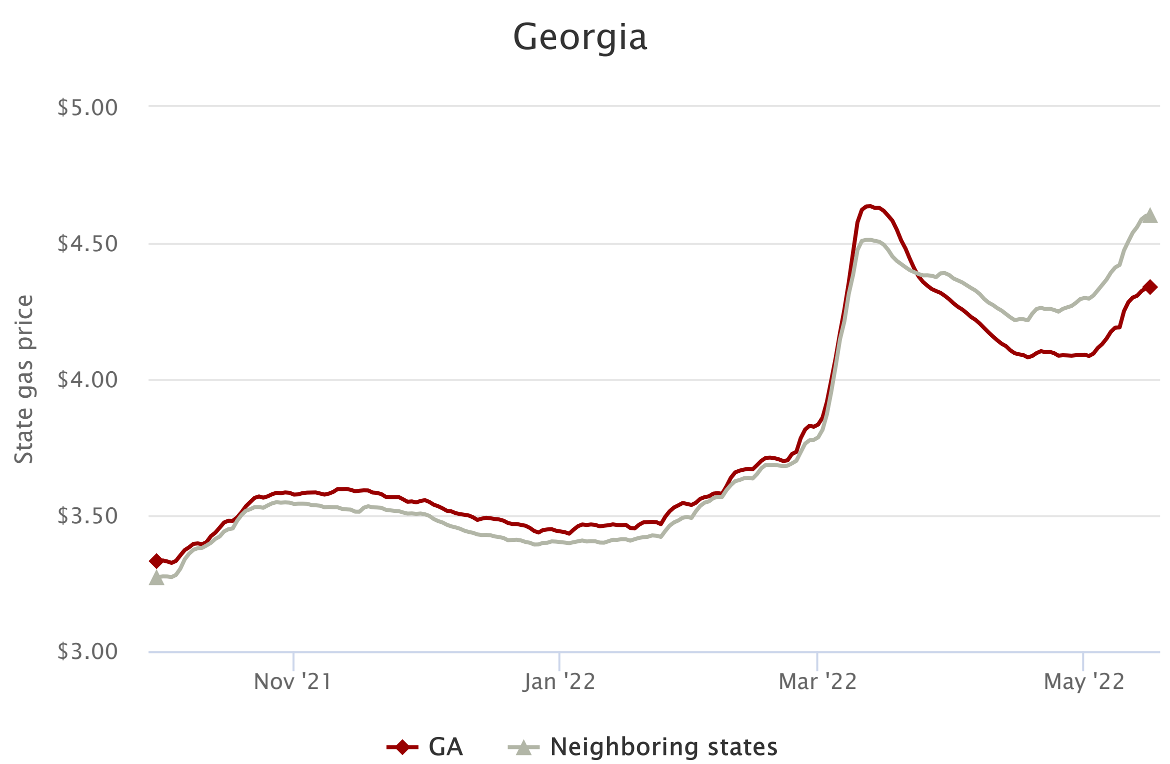
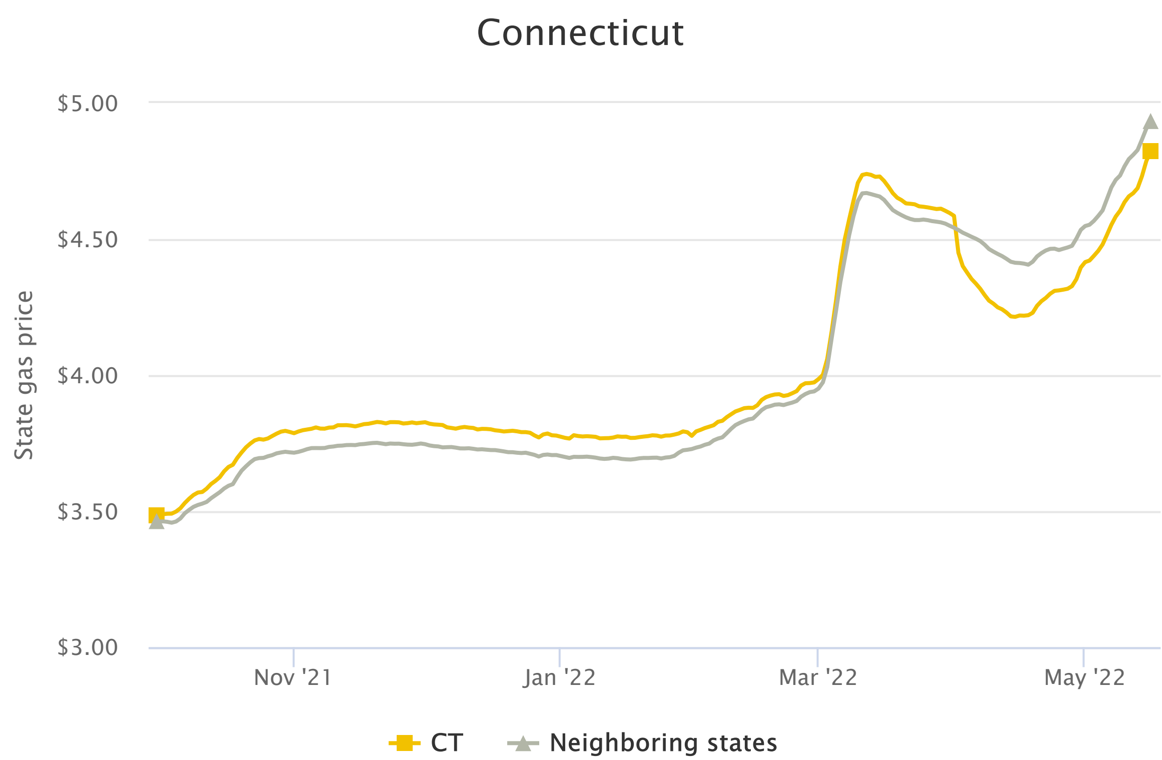
- 2a: Maryland
- 2b: Georgia
- 2c: Connecticut







It is always difficult to verify the common trends assumption by a subjective visual examination of the gasoline prices in the treatment and control states over time. To provide a statistical test of whether the price trends are comparable in the two groups pre-treatment as well as to estimate the dynamic effects of the gasoline tax holiday post-treatment to see if they grow or fade as time passes, we use the following estimating equation:

$$P_{st} = \gamma_s + \lambda_t + \sum_{\tau=0}^{m} \delta_{-\tau} D_{s,t-\tau} + \sum_{\tau=1}^{q} \delta_{+\tau} D_{s,t+\tau} + \epsilon_{st},$$

where P_{st} is the average gasoline price in state s at time t, γ_s is the time-invariant state fixed effect, λ_t is the time fixed effect that is common across states, $D_{st} = 1$ if state s has suspended its gasoline tax at time t. This specification allows an estimate of the posttreatment effects, $\delta_{-\tau}$, that is, the effect of the gasoline tax holiday on gasoline prices τ periods after its enactment. It also allows an estimate of the anticipatory effects, $\delta_{+\tau}$, that is, the effect of the gasoline tax holiday on gasoline prices τ before its enactment. Given that serial correlation at the state level may lead to downward bias in standard errors, we use Huber-White standard errors clustered at the state level which are robust to correlated errors in a state.

Figure 3 plots the regression coefficients, δ, with 95 percent confidence intervals on the treatment leads and lags. We find that before the state gasoline tax holiday, the difference in the gasoline price dynamics between Maryland, Georgia, Connecticut and their neighboring states is not statistically significant at the 5 percent level. There seemed to be some positive anticipatory effect in Georgia and Connecticut, that is, gasoline prices rose shortly before the gasoline holiday went into effect, but this effect could not be precisely estimated to be conclusive.

Maryland

After the gasoline tax holiday was enacted on March 18, Maryland saw a decline in gasoline prices that is statistically significant at the 5 percent level from March 19 until April 18. The decline also grew in magnitude from 12 cents the next day to a little below 30 cents from March 22 to April 16. After the gasoline tax holiday expired on April 17, gasoline prices in Maryland became higher than what they would have been if the gasoline tax holiday never occurred, although the difference was not statistically significant at the 5 percent significance level.

Georgia

The price decline in Georgia, on the other hand, was more gradual and grew from 7 cents on March 24 to around 30 cents on May 16.

Connecticut

Gasoline prices also declined immediately after the gasoline tax holiday went into effect in Connecticut and grew from 11 cents on April 2 to 23 cents on April 15. However, the decline shrank slowly after that to about 14 cents on May 16, even though the gasoline tax holiday would still be in place for another month and a half.

Figure 3: Dynamic effects of state gasoline tax holiday on gasoline prices in selected state

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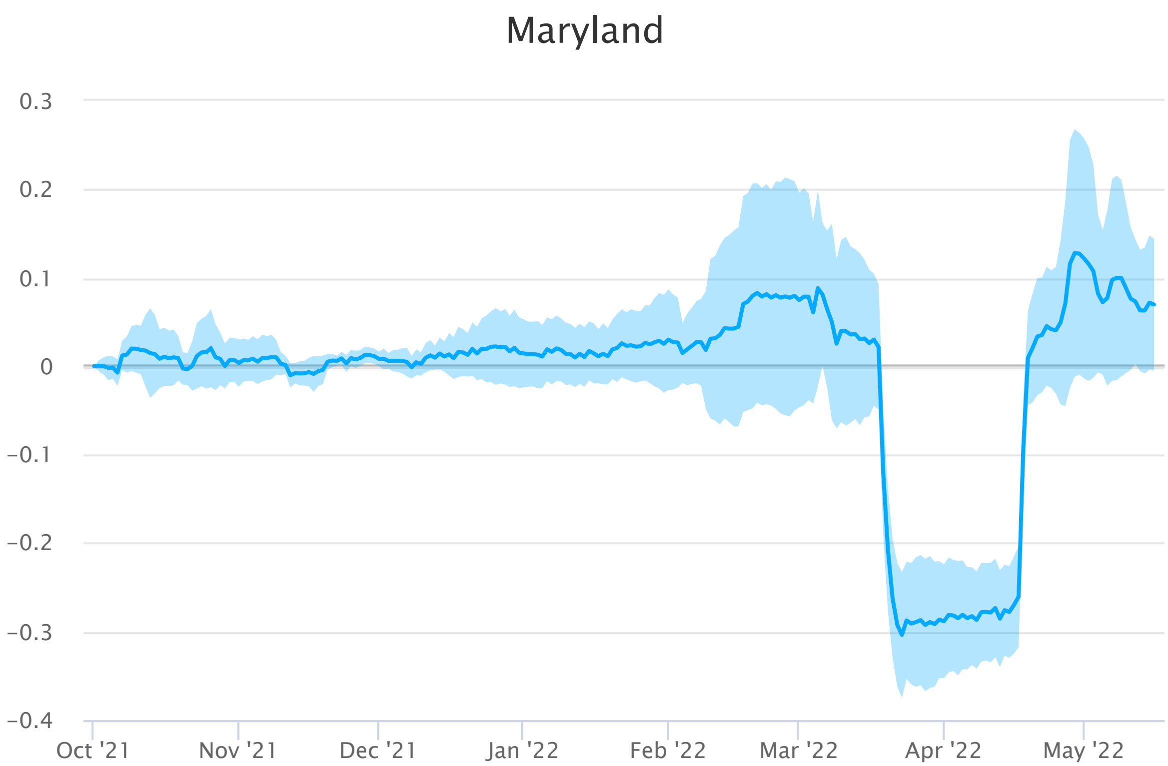
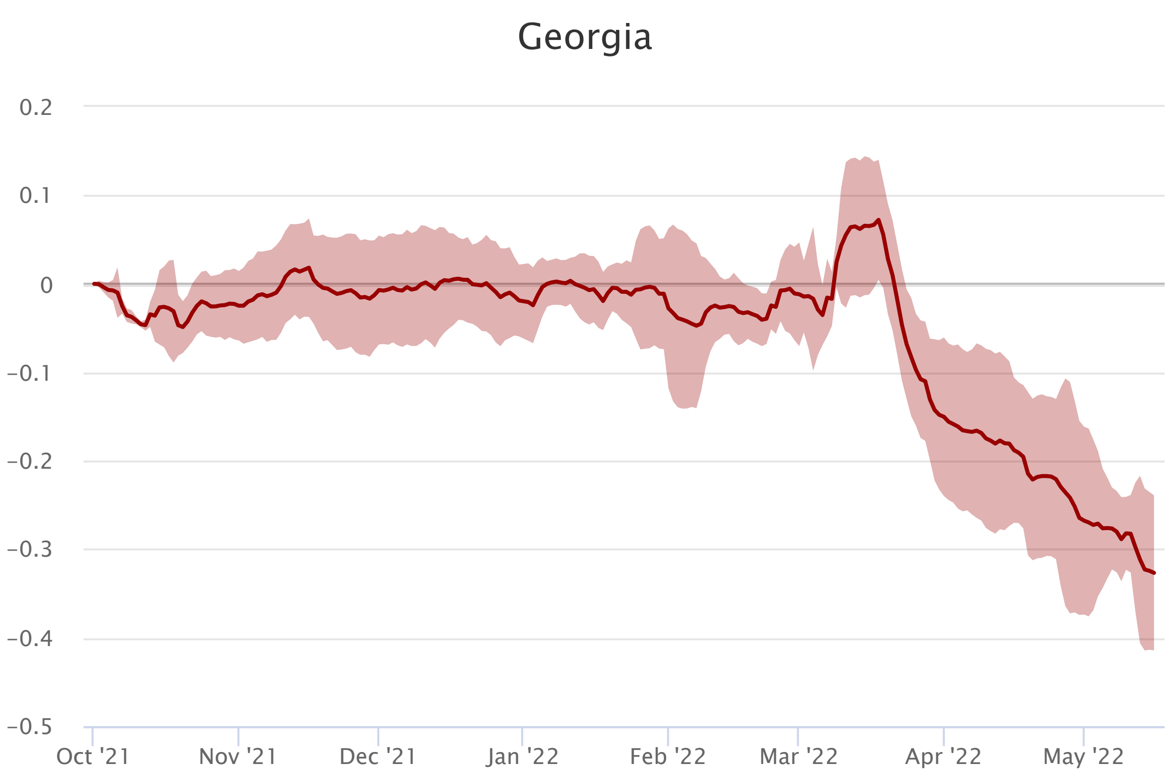
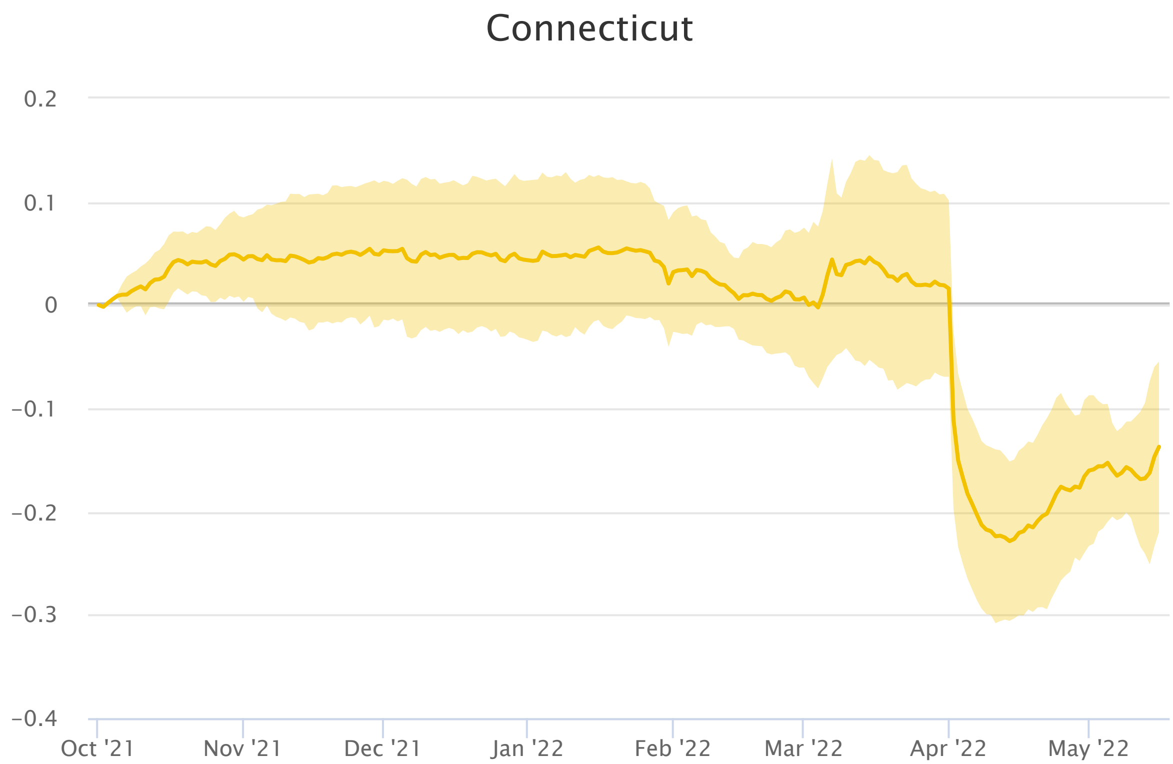
- 3a: Maryland
- 3b: Georgia
- 3c: Connecticut







Synthetic control estimates

Unlike the DID approach, synthetic control methods do not rely on the common trends assumption. The process of selecting a control group is also more disciplined and data driven. The basic idea is that we can combine multiple control units in such a way that their weighted average would closely resemble the characteristics of the treated unit before the intervention.

Maryland

To estimate the causal effect of the gasoline tax holiday on gasoline prices in Maryland using the synthetic control method, we first choose a "donor pool", which is the set of potential controls. We allow the donor pool to include all the states besides Maryland, Georgia and Connecticut. Next, we find the weights that minimize the difference in our matching variables between Maryland and the weighted average of the donor pool. These matching variables are potential predictors of gasoline prices. Our matching variables include the area of each state (in square miles), the number of licensed drivers, as well as the average lagged gasoline prices between October 1, 2021, and January 31, 2022, and the average lagged gasoline prices between February 1 and March 17, 2022. Matching on some linear combination of outcomes during the pre-intervention periods allows us to control for the heterogeneous effects of observed and unobserved factors.

The states (and district) with the highest weights are Delaware (0.408), New Jersey (0.403), Florida (0.088) and Washington, D.C. (0.067). All other states have a weight that is close to 0. Table 1a reports the value of the pre-intervention matching variables of the synthetic Maryland, i.e., the weighted average of the donor pool. As the table shows, the synthetic Maryland very closely resembles the actual Maryland.

Table 1a: Gasoline price predictors, Maryland and synthetic Maryland

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Variable	Maryland	Synthetic Maryland
Area (square miles)	12406	12077
Number of licensed drivers	4454266	4456798
Gasoline price averaged Oct 2020-Jan 2021	3.669	3.658
Gasoline price averaged Feb-March 17, 2022	4.060	4.049

*Synthetic Maryland: Delaware (0.408), New Jersey (0.403), Florida (0.088), Washington, D.C. (0.067)

Figure 4a shows the state gasoline prices for the actual and synthetic Maryland from October 1, 2021, to May 16, 2022. The synthetic Maryland tracks the trajectory of gasoline prices in the actual Maryland very well before the gasoline tax holiday. This coupled with the similarity between the other matching variables suggests that the synthetic Maryland provides a good counterfactual of what the gasoline prices would have been in the absence of a gasoline tax holiday. The two prices diverged after the state gasoline tax was suspended but moved closely together again after the state gasoline tax was reinstated.

Figure 4a: Trends in gasoline prices: Maryland vs. synthetic Maryland

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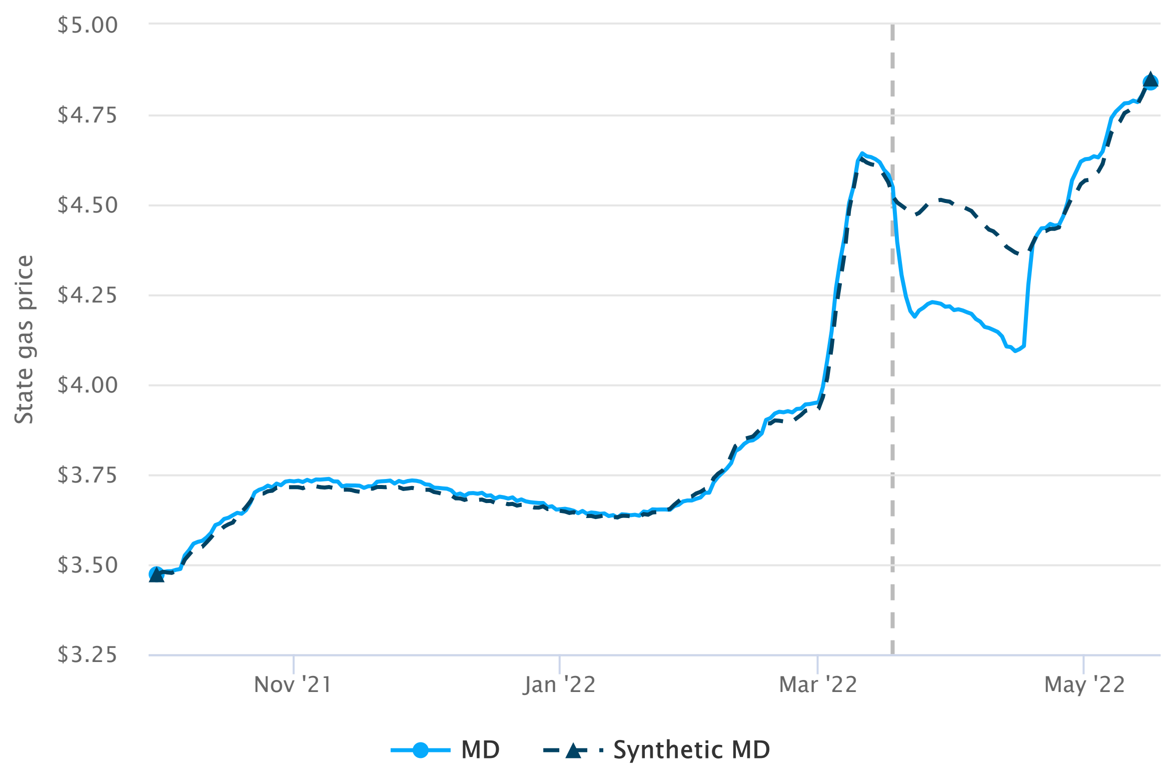

We can measure the causal effect of the state gasoline tax holiday as the difference in the gasoline prices between the actual Maryland and the synthetic Maryland. Figure 5a shows the estimates. The gasoline prices in Maryland were 11 cents lower on March 19, and the decline grew to between 25 cents and 30 cents until April 17. Afterwards, prices came back up to approximately where they would have been without the gasoline tax holiday. We find that the estimates of the effect using the synthetic control method are very close to those using the DID during the period when the gasoline tax holiday was in place, with a maximum difference of 2 cents.

Figure 5a: Gap in state gasoline prices between Maryland and synthetic Maryland

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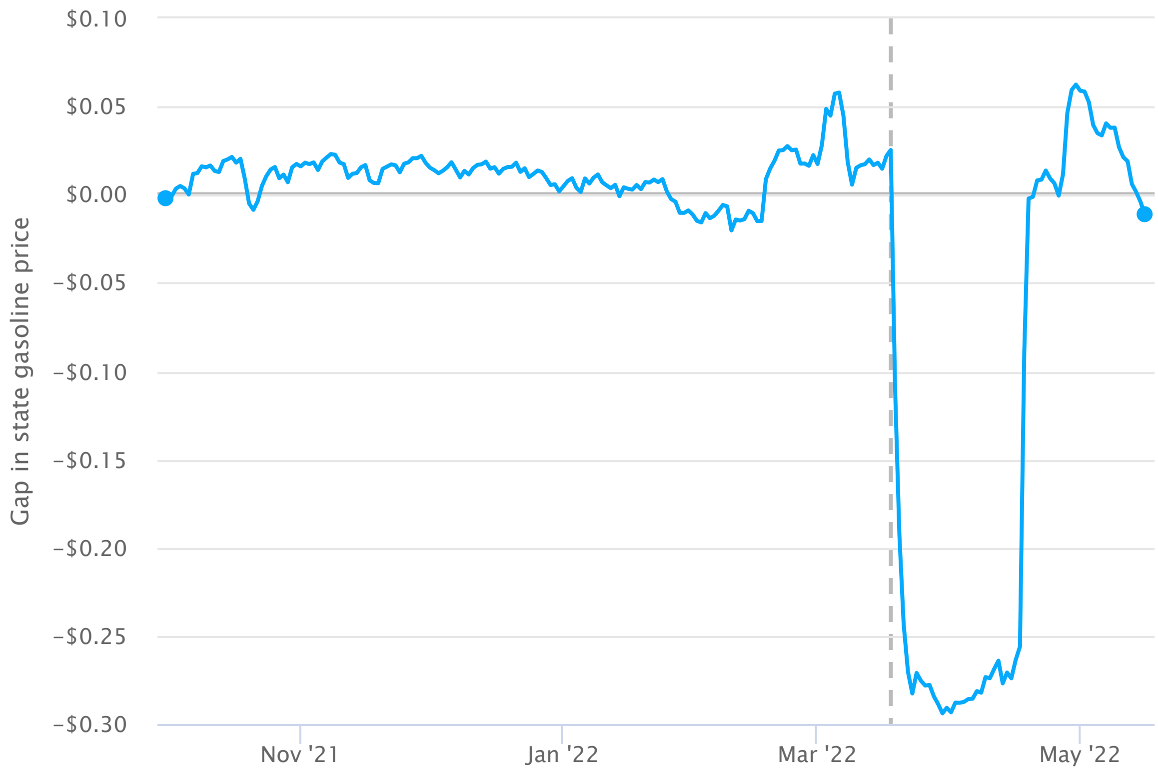

Finally, to determine whether the estimated effect is statistically significant, we conduct permutation tests, where we “pretend” every potential control state is treated and apply the synthetic control method to estimate the treatment effect. If the estimated effect for the states that actually suspended the gasoline tax is large relative to the other states, we can be confident that the gasoline tax holiday has a significant effect on lowering the gasoline prices. Figure 6a plots the synthetic control estimate for each state in the donor pool, i.e., the placebo test, while the actual treatment effect in Maryland is represented by the thick black line. We find that the gap in Maryland is much bigger compared to a state chosen at random.

Figure 6a: Gap in gasoline prices in Maryland and placebo gaps in control states

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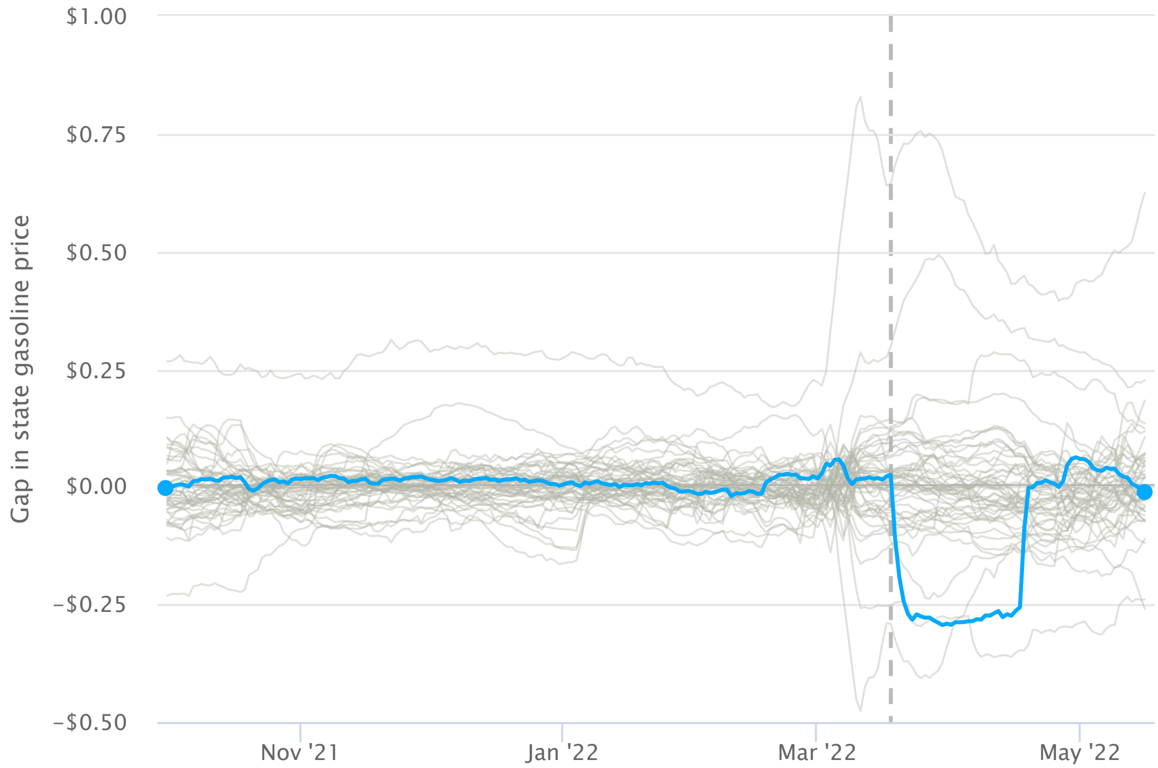

However, the placebo test for control states whose synthetic control provides a poor fit prior to the intervention is not useful in measuring the probability of getting a treatment effect as large as the one in Maryland, whose pre-intervention fit is great. Therefore, we also look at the distribution of the ratios of post and pre-intervention root mean squared prediction error (RMSPE). Figure 7a shows the histogram. We find that Maryland ranks first among the 48 states and Washington, D.C., which implies an exact p-value of 0.02. As a result, we can reject the null hypothesis that the gasoline tax holiday has no effect on the gasoline prices in Maryland at 5 percent significance level.

Figure 7a: Ratio of post and pre-gasoline tax holiday RMSPE: Maryland and control states

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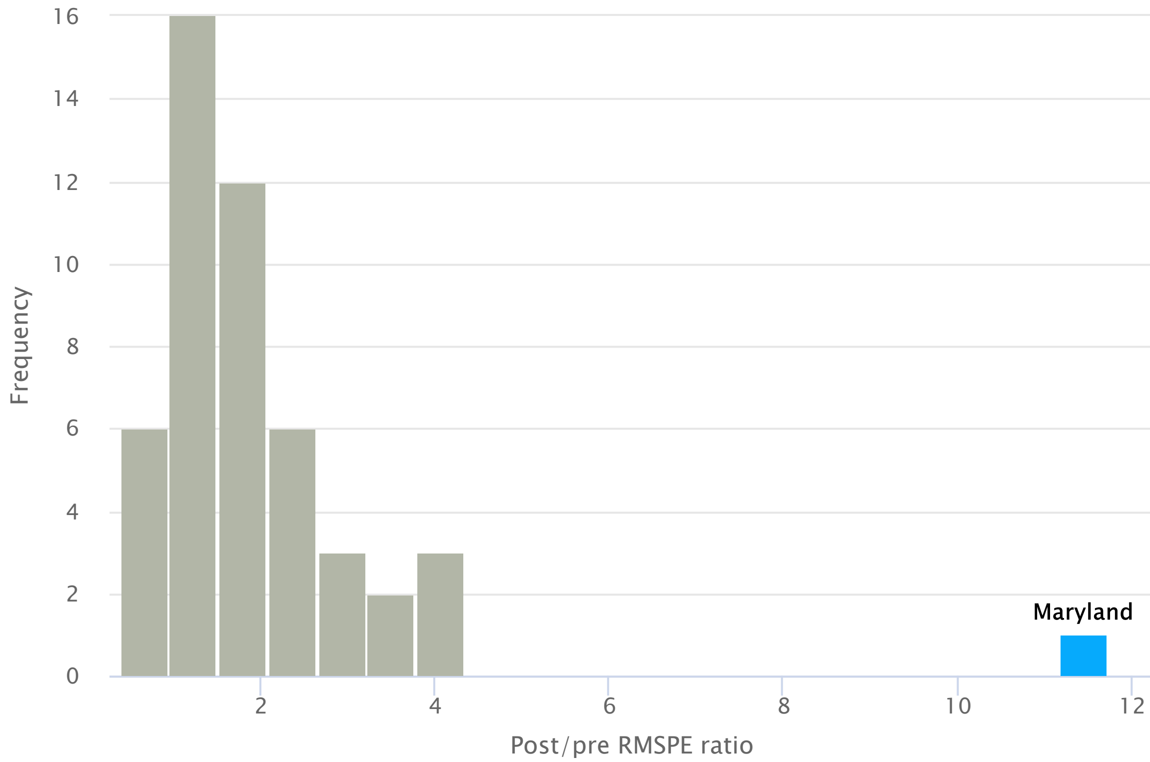

Georgia and Connecticut

Next, we apply the synthetic control method to estimate the effect of gasoline tax holiday on gasoline prices in Georgia and Connecticut. We find a positive anticipatory effect of up to 10 cents in Georgia about a week before the gasoline tax holiday went into effect that echoes the DID estimate. The synthetic control method implies smaller declines in prices by 3 to 4 cents compared to DID until late April, but the two estimates become very close afterwards. In contrast, for Connecticut, the synthetic control method implies price declines that are between 3 and 5 cents bigger than the DID estimate in April and early May, but the difference dissipates in the last few days in our sample. We also conduct permutation tests and find that we are able to reject the null hypothesis that the gasoline tax holiday has no effect on the gasoline prices in Georgia and Connecticut at the 5 percent significance level.

Table 1b: Gasoline price predictors, Georgia and synthetic Georgia

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Variable	Georgia	Synthetic Georgia
Area (square miles)	59425	59460
Number of licensed drivers	7521750	7521132
Gasoline price averaged Oct 2020-Jan 2021	3.500	3.507
Gasoline price averaged Feb-March 17, 2022	3.928	3.936

*Synthetic Georgia: South Carolina (0.535), Florida (0.202), Illinois (0.080), Texas (0.058)

Figure 4b: Trends in gasoline prices: Georgia vs. synthetic Georgia

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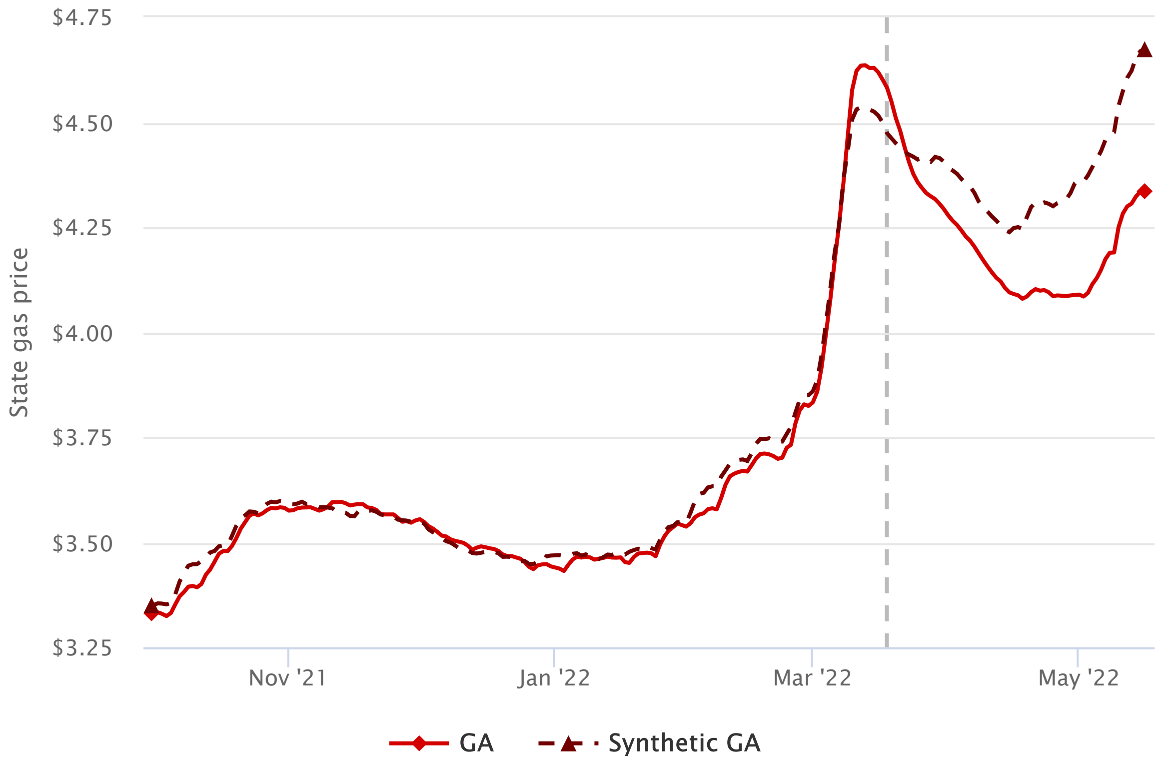

Figure 5b: Gap in state gasoline prices between Georgia and synthetic Georgia

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Figure 6b: Gap in gasoline prices in Georgia and placebo gaps in control states

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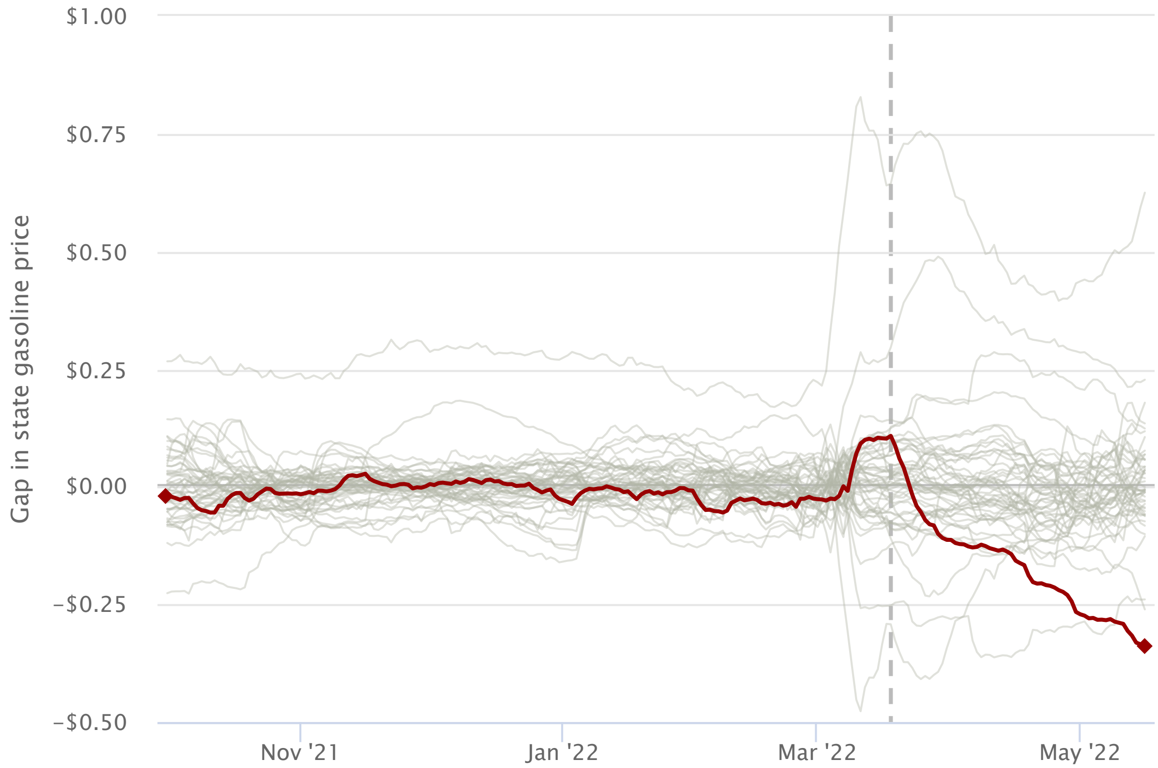

Figure 7b: Ratio of post and pre-gasoline tax holiday RMSPE: Georgia and control states

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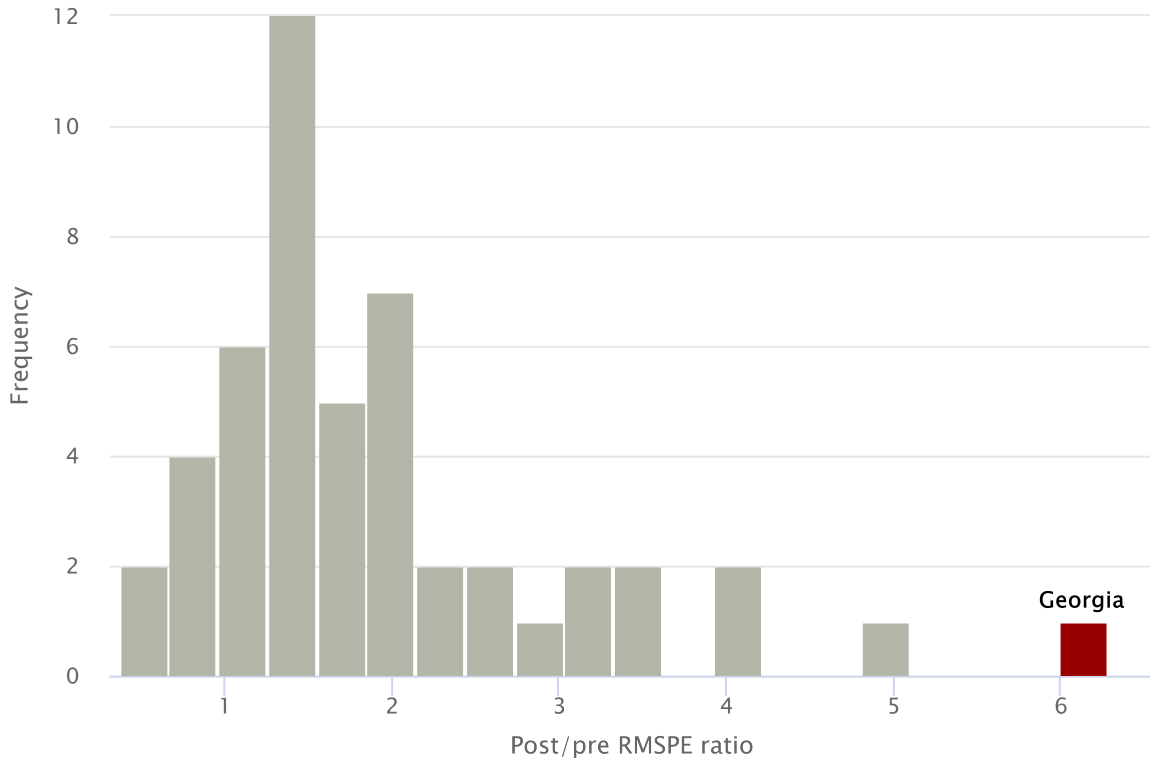

Table 1c: Gasoline price predictors, Connecticut and synthetic Connecticut

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Variable	**Connecticut**	**Synthetic Connecticut**
Area (square miles)	5543	5747
Number of licensed drivers	2508670	2510987
Gasoline price averaged Oct 2020-Jan 2021	3.758	3.761
Gasoline price averaged Feb-March 31, 2022	4.237	4.241

*Synthetic Connecticut: Rhode Island (0.537), New Jersey (0.317), Hawaii (0.106), West Virginia (0.041)

Figure 4c: Trends in gasoline prices: Connecticut vs. synthetic Connecticut

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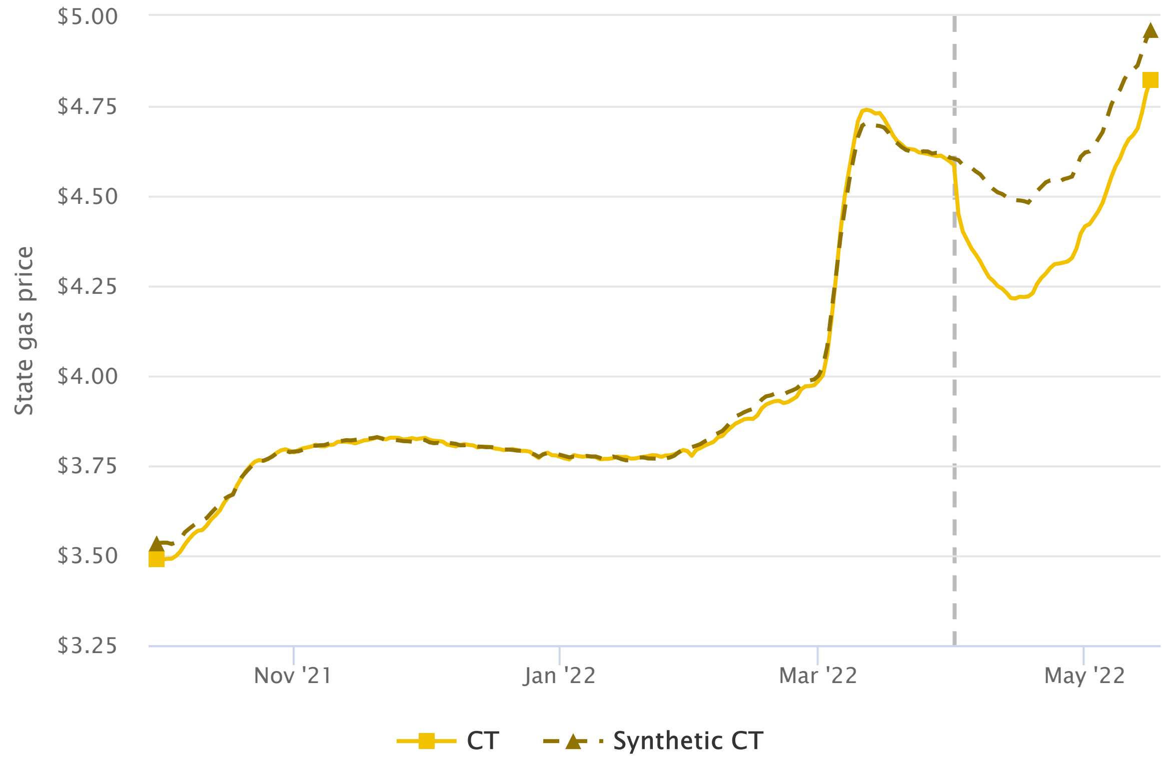

Figure 5c: Gap in state gasoline prices between Connecticut and synthetic Connecticut

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Figure 6c: Gap in gasoline prices in Connecticut and placebo gaps in control states

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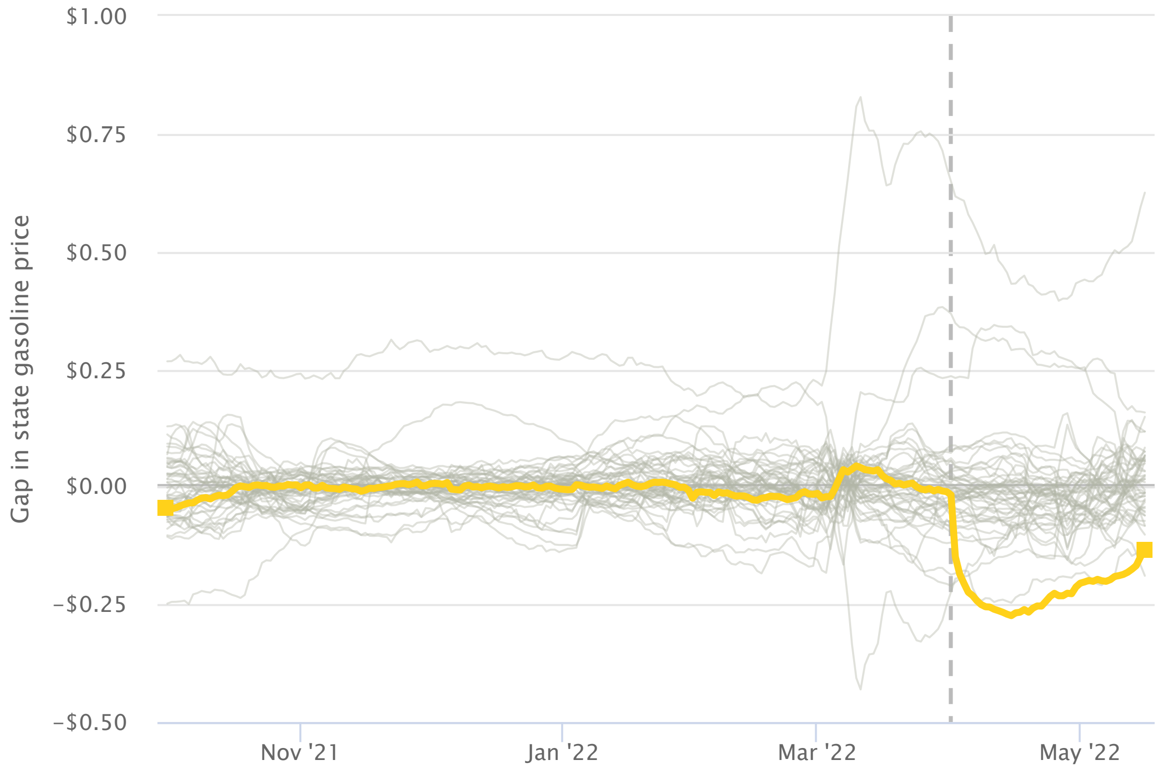

Figure 7c: Ratio of post and pre-gasoline tax holiday RMSPE: Connecticut and control states

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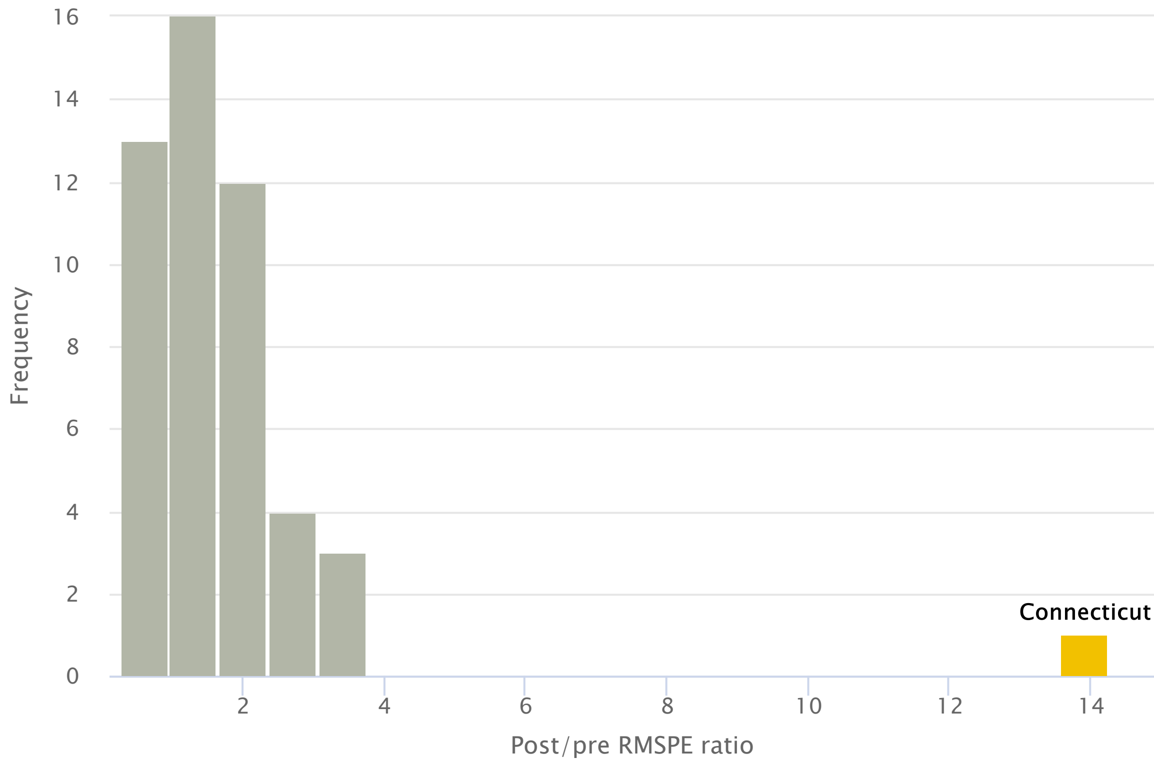

Tax incidence

We find that the suspension of the state gasoline tax in Maryland reduced prices faced by consumers by 26 cents on average over the course of the gasoline tax holiday, which implies that 72 percent of the tax decrease passed on to consumers in the form of lower prices. This result is robust to both DID and synthetic control methods.

We also find that the suspension of the state gasoline tax lowered gasoline prices in Georgia by 18.77 cents on average since the start of its gasoline tax holiday until May 16 based on DID and by 16.85 cents based on the synthetic control method, which implies that 65 percent (58 percent based on the synthetic control method) of the tax incidence was passed on to consumers during this period. Gasoline prices declined by 17.86 cents (21.72 cents based on the synthetic control method) in Connecticut on average after its gasoline tax holiday went into effect until May 16, which implies a pass-through rate of 71 percent (87 percent based on the synthetic control method) to consumers. However, the reduction in price diminished as the legislated end of the holiday got closer. We can estimate the full effects of the gasoline tax holidays in Georgia and Connecticut once more data on gasoline prices in these states over time become available.

This analysis was prepared by Zheli He and Xiaoyue Sun under the direction of Richard Prisinzano. Prepared for the *website by Mariko Paulson.*

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1. We focus on the effects of gasoline tax suspension in this brief. Similar analysis can be conducted to study the effects of diesel tax suspension. ↩