Tax Incidence in Consumer Financial Markets: Evidence from Auto Leases

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Abstract

Using a novel dataset on auto leases and a tax policy change by the state of Georgia, we estimate the tax pass-through rate and study its determinants. We find that (1) auto dealers (not lenders) capture a substantial portion of this tax subsidy and (2) consumers spend about 50% of their subsidy to upgrade and lease a more expensive vehicle. In contrast to prior literature on consumer credit markets, we find no evidence that demand factors including credit score and past experience affect this pass through rate. Our findings suggest that the market structure of auto lease market is the main driver of the heterogeneity in the pass-through rate.

1 Introduction

Tax incidence stands as a foundational concept in public economics, integral to examining the impact of policy interventions on the overall economy (Kotlikoff and Summers 1987). Although theoretical frameworks provide valuable insights into directional trends, they fall short of accurately predicting how the burden of a tax will be shared among various agents within the economy (Chetty and Bruich 2012). Ongoing empirical research aims to identify factors that shape the pass-through of taxes. While empirical studies exist on tax pass-through for straightforward products like cigarettes and alcoholic beverages, there is a noticeable gap in research regarding the pass-through of taxes on durable goods.

Durable goods merit attention due to distinctive features that set them apart from other commodities. Notably, durable goods make up a significant portion of household expenditures, often supported by financing arrangements. The market structure for durable goods is also unique, featuring intermediaries that facilitate financing. Additionally, the purchase of durable goods is subject to upgrading and downgrading effects, implying that even for a specific product, there are varying qualities to consider. As such, delving into the tax incidence on durable goods provides crucial insights into economic dynamics that extend beyond the scope of more conventional products. This paper delves into the examination of tax incidence on automobiles, one of the largest purchases in life for U.S. households (Campbell 2006). In particular, the focus of this study is directed towards understanding the tax implications within the auto lease market.

In January 2018, the state of Georgia altered its tax policy regarding auto leases with the aim of enhancing consumer welfare. Prior to the new tax policy, lessees were subject to paying taxes on the entire vehicle value, regardless of the short-term nature of their leases. However, starting in 2018, lessees became liable for taxes calculated on the depreciated value of the leased vehicle. This marked a significant departure from the previous tax system and led to a 60% decrease in tax liability for an average lessee. In this paper, we use this tax policy change as a laboratory for several reasons. First, unlike commodity-like products, auto leases are

multi-dimensional, with some dimensions of them being more salient than others. Second, consumers often obtain financing through sophisticated intermediaries. Third, leasing is tied to the purchase of durable goods that have adjustable features. Given that the aim of the new policy is a fair taxation system for consumers, understanding how these factors affect the pass-through of this tax subsidy is a first-order economic question. In this paper, we study three specific questions. First, how much do consumers benefit from the new tax policy? Second, do dealers as financial intermediaries affect consumer welfare? Third, how do consumers respond to this tax subsidy? in particular, do they lease higher-quality vehicles?

Using a difference-in-differences design, we estimate the pass-through effect of this policy by comparing auto leases originated in Georgia to auto leases originated in border states that did not experience the tax cut, one year before and after the tax policy change. We find (1) a sharp increase in demand for auto leases and (2) only a portion of the tax cut passed through to consumers. We find that monthly payments inclusive of taxes decrease by 5.4 percent, suggesting that consumers receive 60 percent of the tax subsidy, and (3) consumers use 46 percent of this tax subsidy to lease higher-quality vehicles.

One concern regarding our identification strategy is that there may be some state-level omitted variables varying over time. These variables can be correlated with the tax policy change and can also affect the demand and monthly payments for auto leases. To rule out this possibility, we provide two main robustness checks. First, we find no effect on consumers' demand and lease prices in pre-reform years, providing evidence in support of parallel trends identifying assumption. Second, we use auto loans as a placebo test. In particular, using a difference-in-differences design, we re-estimate the effect of the 2018 tax policy change on auto loans. Since auto loans remained unaffected by the tax policy change, this test allows us to control for unobservable state-level time-varying variables. Our results reveal that there is no differential change in the demand and monthly payments of auto loans after 2018, reducing concerns surrounding potential bias in our findings.

Next, we investigate the mechanism through which this tax policy change affects consumer welfare. Consistent with theoretical predictions, we find that competition among auto dealers drives the heterogeneity in the pass-through rates, with a 70 percent pass-through rate in the most competitive markets. However, we find no heterogeneity in pass-through rates across consumers with high and low credit scores and consumers with prior lease experience. Our findings suggest that the market structure of the auto lease market, rather than demand elasticity, drives our results. This also may highlight that the auto lease market is more opaque than other markets such as auto loans.

To gain a deeper insight into whether our findings signify a shift along the quality of borrowers or changes in lease contract terms, we delve into the impact of the tax cut on the lessees' composition. In this analysis, we evaluate various factors, such as credit score, income, co-signer involvement, and future default rates within the lessee pool post the implementation of the tax change. Our investigation reveals no significant deterioration in these attributes post-2018. This implies that the effects we have documented are not driven by changes in the lease contract terms or quality of lessees.

We contribute to several distinct strands of literature. First, our study contributes to empirical literature on estimating tax pass-through (Kenkel 2005; Marion and Muehlegger 2011; Harding, Leibtag, and Lovenheim 2012; Benzarti and Carloni 2019; Conlon and Rao 2020; Benzarti et al. 2020; Baker, Sun, and Yannelis 2020). Our work diverges from prior studies that predominantly explore tax incidence in the context of standard products. Instead, our focus lies on the tax incidence related to durable goods. This departure is crucial as the unique features of durable goods can yield markedly different outcomes in pass-through rates. Particularly, our study centers on a state (local) - level tax cut, where the supply elasticity is assumed to be perfectly elastic (Evans, Ringel, and Stech 1999). Conventional economic theories predict a complete pass-through of the tax under such circumstances. However, our findings reveal a surprising deviation from this expectation, as we document an incomplete pass-through in our study.

In addition, prior studies by Gallagher and Muehlegger 2011, Chetty, Looney, and Kroft 2009, and Chetty and Saez 2009 suggest that more complex tax policies can generate much different results from those expected by standard models due to optimization errors made by individuals. This complexity is more pronounced in the realm of auto leases, as auto leases are more opaque relative to other consumer products, have more shrouded attributes, and tax depends on various factors such as residual value which consumers are not fully familiar with. Our findings indicate that a large portion of tax benefits is being captured by dealers, exploiting this complexity in the auto lease market.

Second, our study contributes to the existing literature by examining the impact of competition on the pass-through rate in the face of a market-wide shock. Previous research has presented a mixed perspective on this relationship. Some empirical studies indicate a negative correlation between competition and the pass-through rate (Doyle Jr and Samphantharak 2008; Miller, Osborne, and Sheu 2017; Stolper 2018), while others suggest a positive association (Cabral, Geruso, and Mahoney 2018; Montag, Sagimuldina, and Schnitzer 2020; Genakos and Pagliero 2022; Dimitrakopoulou et al. 2023). Aligning with the theoretical predictions advanced by Weyl and Fabinger 2013, our results show that heightened competition among auto dealers may indeed yield benefits for consumers by increasing the tax pass-through rate. Our study demonstrates that the market structure is a pivotal factor influencing the tax pass-through rate.

Third, we add to the role of financial intermediaries in retail financial markets (Woodward and Hall 2010; Egan 2019; Robles-Garcia 2019). Our work is closely aligned with the insights presented in Grunewald et al. 2023. They find that eliminating auto dealers can increase consumer welfare. We complement this literature by providing a well-identified estimation of the extent to which auto dealers as financial intermediaries exploit consumers. This nuance adds depth to the ongoing discourse surrounding the role of financial intermediaries in shaping market dynamics and underscores the specific impact of auto dealers on consumer outcomes.

Lastly, we contribute to the debate regarding how firms set their prices at the local level. On the one hand, consistent with traditional models, Butters, Sacks, and Seo 2022, show that firms optimize their pricing strategies at the local level. However, DellaVigna and Gentzkow 2019 show that firms lose billions of dollars by setting uniform pricing across all local markets. Using granular lease-level data, we reconcile this discrepancy by separating the pricing strategies set by automakers and local auto dealers. Our results suggest that car manufacturers use uniform pricing strategies and that the variation in local pricing comes from auto dealers' market power.

2 Institutional background

2.1 Leases

Leasing is a widespread and important topic that has not received enough attention in both economic and legal literature (Merrill 2020). A lease often represents a contractual arrangement where the lessee gains the right to use an asset for a predetermined period in exchange for a rent. In particular, a consumer auto lease refers to a contract in which the consumer uses the leased vehicle in exchange for fixed monthly payments. Technically, the pre-tax monthly payment of an auto lease depends on its depreciation rate, the lease term, and the financing costs associated with the lessee's risk:

$$\text{Pre-Tax Monethly Payment} = \frac{C - R}{T} + (C + R) \times F \tag{1}$$

where C denotes adjusted capitalized costs, representing the negotiated price between the dealership and the lessee, adjusted for factors such as trade-in allowances, rebates, non-cash credits, or any cash down payments made by the lessee to reduce the overall cost. R represents the residual value of the leased vehicle at which the lessee can opt to purchase

the vehicle at the end of the lease contract. To estimate R, lessors often use the Automotive Lease Guide (ALG) residual values as their main benchmark.[1] The difference between the capitalized cost and the residual value provides the depreciation value, signifying the decrease in the vehicle's value over the course of its usage.

The parameter F, known as the money factor, is derived from the annual percentage rate of interest and reflects the evaluated default risk of the lessee.[2] Since auto leasing is not classified as financing, lessors are not required to disclose the money factor; instead, they display the total finance charges, which include the sum of monthly finance fees. The money factor comprises two components: the buy rate, representing the interest received by the lessor, and a markup imposed by the dealer. Finally, T indicates the length of the lease contract which is typically around 36 months.

In the United States, consumer auto leases can be categorized as open-end leases and closed-end leases. The former category refers to leases in which the lessee takes the residual value risk. In other words, if the lessee does not purchase the vehicle at the end of the lease, the lessee pays (receives) the difference between the market value of the vehicle and the residual value if this difference is negative (positive). Under a close-end contract, a lessor takes the residual value risk, and the lessee may walk away from the lease contract if the lessee does not purchase the vehicle at the end of the lease.

In addition to the key parameters, lessors may enforce several guidelines in a leasing contract: (1) the lessee is required to restrict the mileage on the vehicle (typically between 10,000 and 15,000 miles per year) or face a penalty, (2) the lessee must maintain insurance coverage to safeguard against potential losses and adhere to a predetermined maintenance schedule, typically at locations designated by the lessor. This approach is designed not only to preserve the residual value of the vehicle but also, at times, to ensure a ready inventory of

1. ALG, a privately held company, has been the benchmark for residual values in the United States and Canada. ALG uses an objective depreciation rate based on historical data as well as a subjective expert opinion to precisely estimate the residual values.

2. Unlike interest rates for auto loans, the money factors are expressed as a decimal. To convert a money factor into an annual percentage rate, one should multiply the money factor by 2400.

high-quality cars for dealers, enabling profitable sales (Hendel and Lizzeri 2002), and (3) the lessee may face a penalty for a premature termination of the lease contract. In the case of purchasing the car, the lessee is obligated to pay any outstanding monthly payments along with the lease balance and additional fees intrinsic to the vehicle's sale. The lease balance is computed as the aggregate of the base monthly payments yet to be remitted and the residual value, offset by the unearned rent charges and sales taxes.

2.2 The auto lease market

Leasing is a common way to acquire new vehicles in the U.S. auto market, with more than 30 percent of new vehicle sales in 2016 (Edmunds Lease Market Report). Its market penetration varies across consumers, states, and vehicle types: leasing is more likely among millennials, consumers living in tri-state area, and for luxury vehicles. Moreover, given its structure, leasing offers far stronger loyalty rates than financing (S&P Global Mobility Report).

Both captive and non-captive lessors are the players in this market. Captive lessors, however, use their franchise dealers to compete against independent lessors such as banks, resulting in financing the majority, surpassing 90 percents, of leases for new vehicles. This is consistent with the fact that automakers have a strong incentive to use their captive lessors to gain market share in both new and used vehicle markets.

Due to state franchise laws, automakers must lease their new vehicles through franchise dealerships. In a standard lease transaction, the consumer and dealer agree to a price. The dealer then solicits bids for the lease from one or more lessors, oftentimes just their captive. Once the dealer receives the buy rate, they can incorporate a markup. The dealer then proceeds to sell the vehicle to the lessor at the negotiated price. Upon the signing of the contract, the lessee commits to making monthly payments to the lessor.

2.3 Lease taxes in Georgia

In the state of Georgia, every newly leased vehicle is subjected to the Title Ad Valorem Tax (TAVT), functioning akin to sales taxes for leasing vehicles. This tax system, instituted in 2013, replaced traditional sales taxes and annual ad valorem taxes within the state. Typically, the TAVT is rolled into the monthly lease payments rather than being paid upfront payment in nearly all instances.

Between 2013 and 2017, lessees had to pay taxes on the fair market value of their leased vehicles. This fair market value was defined as the mutually agreed-upon sales price of the vehicle, inclusive of dealer fees like the acquisition cost, net of the combined value of trade-ins and any manufacturer cash rebates, if applicable [3]. The TAVT was computed by multiplying this fair market value by the tax rate, which stood at 7 percent from 2015 to 2019. This taxation approach posed challenges as it required lessees to pay taxes on the full value of the vehicle, despite using it for a limited duration. In other words, the taxation was applied to the full value of the vehicle rather than the depreciation value. Furthermore, at the end of the lease contract, if lessees opted to purchase the vehicle, they were burdened with paying TAVT based on the residual value, creating a form of double taxation. This peculiar situation arose because the state of Georgia treated the purchase of a leased vehicle in the same manner as a new sale.

To address the above challenges and tax lessees fairly, on May 8, 2017, the state of Georgia signed the House Bill 340 into law which changed the way the Title Ad Valorem Tax (TAVT) is calculated for leased vehicles. HB 340 which became effective as of January 1, 2018, and presented lessees with two options. The first option allowed lessees to adhere to the traditional system where taxation is based on the fair market value of the leased vehicle. Under this approach, the fair market value is determined as the vehicle's price minus trade-in values or any applicable rebates. The second option entails taxation solely on the value of

3. In essence, it is the amount of cash a consumer would need to purchase the vehicle outright if there were no taxes. In lease parlance, it is equal to the adjusted capitalized cost (= gross capitalized cost - capitalized cost reductions) plus any down payments used to reduce the gross capitalized cost.

the lease payments made throughout the lease period. In this alternative, lessees are not allowed to deduct any rebates or trade-in values. In most cases, the former is much lower than the latter, and hence this change generated significant potential tax savings for most lessees[4].

For instance, consider a 36-month lease on a vehicle with a fair market value of $35,000. Suppose the residual value of the vehicle is $22,000, and that the consumer receives a promotional financing rate from the manufacturer of 0 percent. If the consumer puts no extra cash down on the lease (as is most often the case), then the TAVT would have been $2,450 prior to 2018, or $68.05 per month. However, after the enactment of House Bill 340, the TAVT would be $910, or $25.28 per month, which is a 63 percent reduction in taxes relative to the prior regime. If the full amount of these tax savings were passed through to the consumer, then the monthly lease payment (inclusive of taxes) would decline from $429.16 per month to $386.39, a savings of 9 percent. This significant potential tax saving comes from changing tax calculation based on the total depreciation value of leased vehicles.

2.4 Response to House Bill 340

We begin our analysis by estimating the effect of this tax change on auto lease demand. We first focus on the number of auto leases that were originated one year before and after the implantation of House Bill 340. To better estimate the impact of this tax policy change, we use five adjacent states: Alabama, Florida, North Carolina, South Carolina, and Tennessee as our control group. Our identification assumption is that, in the absence of this tax change, economic conditions in these adjacent states would have evolved in tandem. In Figure 1 (a), we find that relative to leases originated in border states (or all other states), auto leases in the state of Georgia experienced a significant increase in demand after January 2018.

4. Technically, the base for calculating the TAVT under House Bill 340 also included down payment amounts that were used to reduce the gross capitalized cost. We are comfortable ignoring this for two reasons. First, the vast majority of consumers do not make such down payments. Second, even when consumers do make such down payments, the amounts tend to be less than a few thousand dollars, making the impact on the TAVT small. We note that such down payments are distinct from cash due at signing, which includes both the first monthly payment on the lease and various dealer and state fees

This shift in auto lease demand is less likely driven by differences in economic conditions of the state of Georgia and other states for at least two reasons: (1) we find no evidence of a pre-trend in demand among treated and control groups, and (2) as a placebo test, in Figure 1 (b), we find no evidence of the effect of this tax change on the demand for auto loans. Moreover, using a difference-in-differences framework, in Table A.2, we find that the number of auto leases originated in Georgia increased by 30 percentage points relative to the number of leases originated in the adjacent states. Furthermore, using the same framework, we find no evidence of the effect of this tax policy on the number of auto loans originated in the state of Georgia and adjacent states.

3 Data and sample

To conduct our tests, we use two data sources. The first is data on the population of auto leases from Equifax Inc. The second is data on securitized auto leases from Regulation AB II, which provides us with supplemental information on the vehicles being leased as well as their contract terms. Below, we provide more details about these two data sources.

Our population auto lease data is part of a larger data set that contains the credit histories of the entire United States population.[5] For each auto lease, the data contains information on its (tax inclusive) monthly payment, its lease term, the extent to which it is delinquent or past-due on its payments, the credit score of its lessee, its origination date and location, and its lessor. We do some minor cleaning of the data, such as removing auto leases with monthly payments below $100. Our final sample consists of 1,786,495 auto leases that were originated in our 6 sample states during our sample period of 2017 to 2018.

One of the main drawbacks of our population auto lease data is that it does not contain information on the vehicles being leased. Having this information is crucial because consumers might adjust their vehicle choices in response to lower taxes on auto leases (Gulati, McAuslan, and Sallee 2017), and failing to control for this could bias our estimates of the

5. For more information about this data, see Avery et al. 2003 or Gopalan et al. 2023.

pass-through rate (Hankins, Momeni, and Sovich 2023). Another drawback of the population lease data is that it does not contain any other aspects of the lease contract – such as the capitalized cost, the residual value, or the money factor – besides the monthly payment and the lease term. The absence of this information prevents us from examining how lessors and auto dealers adjust their contract terms to capture part of the tax cut, if at all.

To address the above shortfalls, we merge our population auto lease data with data from Regulation AB II. Under Regulation AB II, issuers of public auto lease asset-backed securities are required to report lease-level information to the Securities and Exchange Commission on a regular basis. The Regulation AB II data contains most of the information found in the population auto lease data. However, it also contains information on the vehicle being leased, as well as additional information on both the lessee and the contract terms.

We obtain the Regulation AB II data from the Securities and Exchange Commission's website. The leases come from 7 lessors, all but 1 of which are captive finance subsidiaries. In general, the Regulation AB II is representative of the auto lease portfolios of these 6 lessors.

Using information common to both data sets, we match the auto leases in the Regulation AB II data to their corresponding entries in the population data. This results in a matched sample of 682,923 leases. Throughout the paper, we use our matched sample of 682,923 leases to estimate the pass-through rate and examine its cross-sectional behavior. We also use the matched sample to investigate whether demand-side responses drive our results, and to examine the dimensions over which auto lessors and dealers adjust their contract terms.

Table 1 reports descriptive statistics for the matched sample of 682,923 auto leases measured as of their origination dates. The average lease in our matched sample is for 37 months and has a monthly payment of $446. Around 36 percent of leases have a cosigner attached to them, and the average lessee has a credit score of 724. The average lease has a capitalized cost of $35,345 and a residual value of $22,065. Appendix A.1 presents descriptive statistics for our full sample. Across most observable dimensions, the auto leases in our matched

sample are similar to those in our full sample.

The right-most columns in Table 1 compare leases originated in Georgia during the pre-treatment period to leases originated in the five control states. In general, we find similar contract terms and lessee characteristics in the treated and control states. Moreover, while the average monthly payment is indeed higher in Georgia than in the control states, this is to be expected given the unfavorable tax treatment of leases in Georgia prior to 2018.

Furthermore, we test if the timing of the tax policy change in state of Georgia is correlated with other state-level macroeconomic factors. In particular, we compare the macro economic factors between the state of Georgia and other neighbouring states. In Table 2 Columns (3) and (4), we find that there is no significant differences across treated and control states in state-level macro economic factors. As shown in figure 2, there are no significant changes in macroeconomic variables across treated and control states in the years leading to the policy change.

4 Tax incidence in the lease market

In this section, we examine how the 2018 Georgia tax change impacted the cost of auto leasing. We find that although monthly lease payments declined following the Georgia tax change, the size of the decline was less than the potential amount of tax savings. As a result, suppliers in the leasing market, such as auto lessors and dealers, captured a significant portion of the potential tax savings.

4.1 Monthly payments

To begin, we estimate the effect of the Georgia tax change on the average monthly lease payment. The regression model is:

$$y_{i,t} = \alpha + \Gamma \cdot \text{Treated}_s \cdot \text{Post}_t + \delta_s + \delta_{l,t} + \delta_{c,t} + \delta_{j,t} + \varepsilon_{i,t}, \tag{2}$$

where the outcome variable is either the natural log or the dollar amount of the monthly payment of lease i originated in state s in month t. As in Equation 2, the variable Treated_s is equal to one if state s is Georgia and zero otherwise, and the variable Post_t is equal to one for all months t at-or-after January 2018 and zero otherwise. In our baseline specification, we include state fixed effects (δ_s) and lessor-month fixed effects ($\delta_{l,t}$) to ensure that the treatment effect (Γ) is estimated using within-state variation after netting out common lessor-level shocks. We also include separate month fixed effects for each 25-point credit score bin ($\delta_{c,t}$) and for whether the lessee has a cosigner ($\delta_{j,t}$) to control for the slight pre-treatment differences in these variables across treated and control states. The coefficient of interest, Γ, measures the average percentage change in monthly payments for auto leases originated in Georgia relative to auto leases originated in the control states. We estimate the model on our sample of 682,923 auto leases originated between 2017 and 2018. Standard errors are clustered at the ZIP code level to strike a balance between having a sufficient number of clusters and matching the geographic assignment of treatment.

Table 3 reports the coefficient estimates from Equation 2. We find that the average monthly lease payment in Georgia declined significantly after the 2018 tax change, suggesting that consumers captured at least some portion of the tax savings. Relative to auto leases originated in the control states, auto leases originated in Georgia experienced a 2.90 percentage point reduction in their average monthly payments. In dollar terms, this translates to around $11.14 in tax savings per month, or $416.64 over the life of the average 37-month lease.

While our results in Table 3 suggest that consumers did benefit from the Georgia tax change, it is also the case that a significant portion of the potential tax savings did not end up being passed on to them. To see this, recall from Section 2 that the average auto lease in Georgia stood to save around 9 percent on its monthly payment from the tax change. Given that the actual decline in the average monthly lease payment was just 2.90 percent, this implies that only 32 percent of the potential tax savings were passed on to consumers, with

a 95 percent confidence interval of 19.59 to 44.86 percent. Suppliers in the market, such as auto lessors and dealers, captured the remaining 68 percent.

If consumers became more aware of the tax change over time (or perhaps just more price sensitive to it), then the pooled coefficient estimate in Table 3 might understate the longer term pass-through rate. Thus, to examine how the price impact of the tax change evolved over the sample period, we estimate the following regression model:

$$y_{i,t} = \alpha + \sum_{\tau=-4}^{3} \Gamma_\tau \cdot \text{Treated}_s \cdot \text{D}_{t,\tau} + \delta_s + \delta_{l,t} + \delta_{c,t} + \delta_{j,t} + \varepsilon_{i,t}, \tag{3}$$

where $\text{D}_{t,\tau}$ is equal to one if month t is τ quarters from the treatment date. We exclude the second quarter prior to the treatment date ($\tau = -2$) as the reference quarter. Therefore, the Γ_τ coefficient captures the average difference in monthly lease payments in quarter τ relative to the average difference two quarters prior to the treatment date.

Figure 3 plots the coefficient estimates from Equation 3. Consistent with consumers capturing a larger portion of the tax savings over time, we find that the reduction in average monthly lease payments in Georgia steadily increased (in terms of absolute value) throughout the sample period. The terminal coefficient estimate for the fourth quarter of 2018 is 3.5 percent, which almost 1.2 times our pooled coefficient estimate of -2.90 percent from Table 3. However, the longer run pass-through rate is still incomplete, with consumers receiving less than 39 percent of the average tax savings even as of the end of 2018.

Figure 3 also provides evidence in support of the parallel trends assumption underlying our analysis, as there are no differential pre-trends across auto leases originated in the treated and control states. Among other concerns, this finding helps rule out that concomitant shocks to the auto loan market, such as higher loan demand during tax rebate season (Adams, Einav, and Levin 2009) or the introduction of the Trump administration metal tariffs in 2018 (Hankins, Momeni, and Sovich 2023), are driving our results.

Before we proceed, we note that our estimates of the tax pass-through rate are lower

than estimates from prior studies that focus on non-financial products. For instance, Evans, Ringel, and Stech 1999 find that the pass-through rate of state-level cigarette excise taxes to consumers is around 100 percent, and Chetty, Looney, and Kroft 2009 find a similar result for state-level alcohol excise taxes. In terms of tax subsidies, Pless and Benthem 2019 find that consumers capture all of the tax benefits associated with solar panel subsidies, and Sallee 2011 and Barwick et al. 2023 find that consumers capture between 70 and 100 percent of federal electric vehicle subsidies. Throughout the rest of the paper, one of our main goals will be to understand what drives the incomplete tax pass-through in our setting.[6]

4.2 Composition of lessees

So far, we have framed our results in terms of pass-through along the intensive margin. Yet, changes in the composition of lessees along the extensive margin could have also led to lower auto lease payments during the post-treatment period. For example, in response to media coverage of the tax change, some consumers in Georgia might have considered leasing for the first time. If these new consumers were more price conscious than the average lessee prior to the tax change, then the average monthly lease payment might have declined even if consumers captured none of the tax savings. Although our fixed effects help control for changes in the composition of lessees to some extent, it is still important to have a better understanding of whether our results come from the intensive or extensive margin.

To examine the effects of the tax change on the composition of lessees, we estimate the following regression model:

$$y_{i,t} = \alpha + \Gamma \cdot \text{Treated}_s \cdot \text{Post}_t + \delta_s + \delta_{l,t} + \varepsilon_{i,t}, \tag{4}$$

where the outcome variable is either the log credit score, cosigner status, or future default

6. Related to our findings, Rothstein 2010 argues that a significant portion of Earned Income Tax Credit payments are captured by employers via lower wages. In addition, Hastings and Washington 2010 find that grocery stores capture some of the benefits of Supplemental Nutrition Assistance programs via higher prices.

rate of lease i originated in month t. The coefficient of interest is Γ, which measures the average change in lessee characteristics in Georgia relative to the control states.

Table 4 reports the coefficient estimates from Equation 4. Consistent with our prior results capturing tax pass-through along the intensive margin, we find no material changes in lessee characteristics following the Georgia tax change. While we do find a slight increase in the average credit score of lessees that is statistically significant at the 10 percent level, the magnitude of this coefficient estimate is small (0.25 percent) and it is economically insignificant. Moreover, we find no economically or statistically significant changes in the likelihood of having a cosigner or the future default rate following the tax change.

Figure 3 plots the evolution of lessee characteristics around the treatment date. We continue to find no material changes in the composition of lessees in Georgia following the 2018 tax change. Furthermore, in support of the parallel trends assumption, we find no evidence of differential pre-trends across the treated and control states.[7]

4.3 Alternative explanations

The Georgia tax change had the potential to impact the auto lease market along multiple dimensions. Below, we examine several alternative explanations for our results but find that none are supported in the data.

4.3.1 Vehicle choices and upgrading

As noted in Gulati, McAuslan, and Sallee 2017, a tax cut in the automobile market might induce consumers to upgrade their vehicles and purchase additional options or features. In addition, Argyle et al. 2021 find evidence that consumers purchase more expensive vehicles in response to cost savings from better financing terms. If the Georgia tax change generated similar vehicle consumption responses, then our baseline estimate of the tax pass-through

7. In the auto loan market, there are multiple studies that find no changes in the composition of borrowers in response to moderate changes in loan terms. See Argyle, Nadauld, and Palmer 2020, Argyle, Nadauld, and Palmer 2023, Hankins, Momeni, and Sovich 2023, and Gopalan, Kalda, and Sovich 2023.

rate in Table 3 would be understated, as it would capture the offsetting effects of tax savings and higher vehicle prices. For example, suppose a consumer saved $3,000 as a result of the Georgia tax change but used $2,500 of those savings to upgrade from a Honda Civic to a Honda Accord.[8] If, as in our current model, we did not control for this substitution effect across vehicle models, then we would estimate that the monthly lease payment declined by $11.14, even though the true tax savings were $42.77 per month.

To examine the importance of vehicle consumption responses in our setting, we re-estimate Equation 2 after including separate month fixed effects for each vehicle make-model and make-model-trim to hold the choice of vehicle fixed when estimating the pass-through rate.

Column 1 in Table 6 reports the coefficient estimates from the model before controlling for the choice of vehicle. We find that the average monthly lease payment in Georgia declined 2.9 percent in response to the tax change. However, after we hold the vehicle make-model fixed in Column 2, our coefficient estimate almost doubles from -2.9 percent to -5.38 percent. Adding more granular controls for vehicle options and trims does not change this estimate much -5.38 to -5.77 percent), suggesting that most of the consumption responses are occurring across make-models and not within.

We draw two main conclusions from Table 6. First, even after controlling for consumption responses, the pass-through rate to consumers is still incomplete. Our point estimate for the tax pass-through rate is 60 percent, and the 95 percent confidence interval ranges from 51 to 68 percent. Second, our results reveals a flight to quality within the auto lease market, as a side effect of the tax policy change. We show that in markets characterized by products differing across multiple dimensions, tax changes can result is substitution effects. In particular, our results show that consumers shift from lower-quality cars to higher-quality

8. Such a large response could occur if consumers are liquidity constrained (Attanasio, Goldberg, and Kyriazidou 2008) or if they target specific monthly payments (Argyle, Nadauld, and Palmer 2020). For context, Gulati, McAuslan, and Sallee 2017 find that 80 percent of the observed increase in vehicle prices in response to tax subsidies comes from product upgrading, and Argyle et al. 2021 find that a 100 basis point decrease in auto loan interest rates causes the average borrower to spend 1.95 percent more on their vehicle, with 60 percent of this effect coming from substitution across vehicle make-models.

cars, utilizing 46 percent of their tax savings. This stands in contrast to the findings of Espinosa and Evans 2013, who observed no similar shift from generic to name-brand cigarettes in response to changes in excise taxes.

4.3.2 Falsification test

One potential concern is that our results might be capturing the effects of an economic shock specific to Georgia that coincides with the 2018 tax change. To help alleviate this concern, we perform a falsification test using auto loans. If an omitted state-level shock is driving our results, then there should have been a significant change in auto loan demand or loan contract terms during the post-treatment period, similar to leases. However, if our results capture the causal effect of the Georgia tax change, then we should find no material effect on auto loans, as the causal effect should be concentrated within auto leases.[9]

To conduct the above test, we draw a random sample of 1,000,000 auto loans that were originated in Georgia and the control states between 2017 and 2018. We then re-estimate Equation 2 with various auto loan contract terms and borrower characteristics as the outcome variables. Table 5 reports the coefficient estimates from the models. Consistent with our results capturing the causal effect of the Georgia tax change, we find no differential changes in auto loan contract terms and borrower characteristics during the post-treatment period. Figure 4 further shows that treated and control loans trended in tandem both before and after the tax change. Thus, for a state-level economic shock to still be driving our results, it needs to also be specific to auto leases and cannot affect auto loans.[10]

9. Given that auto leases and loans are substitutes to some extent, there could have been a general equilibrium adjustment in auto loan demand in response to the Georgia lease tax change. However, as shown in Figure A.1, there is no material change in auto loan demand in practice.

10. Table A.3 repeats the falsification test for credit cards and mortgages. Similar to auto loans, we find no economically significant changes in the Georgia credit card or mortgage markets.

4.3.3 Unobservable selection on consumer price elasticity

As stated earlier, the Georgia tax change might have induced some price sensitive consumers to consider leasing a vehicle for the first time. As a result, the average lessee in Georgia might have become more price sensitive following the tax change, which could explain some of the observed decline in the average monthly lease payment.

While we cannot definitively rule out such forms of unobservable selection, there are three pieces of evidence that suggest that it does not drive our results. First, we find no economically significant changes in consumer-level characteristics that Grunewald et al. 2023 find to be correlated with price sensitivities in the auto loan market, such as credit scores and household incomes. Second, although Attanasio, Goldberg, and Kyriazidou 2008 find that auto loan maturities positively correlate with consumer price elasticities, we find no significant increases in auto lease maturities in response to the tax change ($\Gamma = -0.49$ months; s.e. $= 0.05$). Third, our estimated pass-through rate becomes larger after we control for vehicle choice in Table 6, even though Busse, Silva-Risso, and Zettelmeyer 2006 argue that more price sensitive borrowers should opt for less expensive vehicles.

4.4 Robustness

We conduct several tests to ensure that our results are robust to our choice of fixed effects and our assumptions about the standard errors. For a more thorough discussion of these robustness tests, see Sections A.4 and A.5 in Appendix.

5 Economic channels

In tax incidence literature, a fundamental question is who ultimately bears a tax change, and delving into this literature reveals a profound insight: if taxes are imposed on consumers, it does not necessarily translate to consumers bearing it entirely. Rather, the burden of a tax change is often shared between consumers and suppliers. The degree to which a tax change

is shared among consumers and suppliers depends on multiple factors including relative elasticity of demand and supply curve, the demand curvature, and market structure.

In a perfect competition scenario, the distribution of tax burden is determined by the elasticity of demand and supply. This means that the extent to which consumers or suppliers bear the impact of tax changes depends on their respective reliance on the market. When consumers are highly sensitive to price changes, resulting in elastic demand, suppliers absorb the full burden of the tax change. Conversely, if consumers are less responsive to price shifts and continue consuming regardless, they bear the full of the tax burden. In cases where the responsiveness lies between these extremes, the tax burden is shared between consumers and suppliers.

In imperfect competition scenarios such as monopolies and oligopolies, where firms have control over prices, the pass-through rate of tax changes is influenced by the demand curvature and the level of competition among firms. Demand curvature refers to the shape of the demand curve. If the demand curve is concave, indicating that consumers become more price-sensitive with higher prices, suppliers stand to lose a significant portion of their output due to price increases. Consequently, the pass-through rate in such cases tends to be lower. Conversely, if the demand curve is convex, indicating that consumers are less sensitive to price changes, the pass-through rate is higher. In oligopoly environments, the extent to which costs are passed through to prices is also influenced by the interactions among firms. This impact is uncertain and varies based on the marginal costs.

Therefore, in this section, we explore two pivotal factors that shape the pass-through rate. We will closely examine the dynamics of the demand and consumer behavior within the auto lease market, alongside delving into the influence of competition on the pass-through rate within this particular market.

5.1 The Demand Channel

To advance our understanding of how the demand characteristics of lessees affect the degree of tax pass-through, we examine if higher pass-through rates are associated with those lessees less responsive to price changes, as suggested by previous studies. We assess the impact of consumer demand using two indicators. First, drawing from the findings of Grunewald et al. 2023 which observed that individuals with lower credit scores exhibit a lower sensitivity to price changes, we split our sample into two groups based on the median credit score of our sample population. Therefore, we estimate the following triple-differences model:

$$\begin{aligned} y_{i,t} = \alpha + \beta \cdot \text{Low credit score}_i \cdot \text{Treated}_l \cdot \text{Post}_t + \Gamma \cdot \text{Treated}_l \cdot \text{Post}_t + \\ \theta \cdot \text{Low credit score}_i \cdot \text{Treated}_l + \delta_s + \delta_{l,t} + \delta_{c,t} + \delta_{j,t} + \varepsilon_{i,t} \end{aligned} \tag{5}$$

Where the outcome variable is monthly payments of lease i originated in quarter t, and Low credit score $_i$ is equal to one when lease i has a below-median credit score and zero otherwise. The coefficient of interest, β, measures the differential effect of the tax cut on leases with below-median credit score relative to leases with above-median credit scores. If the demand channel contributes to our results, then we should expect that the effect of the tax cut will be more pronounced among leases with below-median credit scores.

Table 8 Columns (1) and (2) present the estimated coefficients derived from the model for the logarithm of monthly payments as our dependent variable. Across these specifications, the value of β is not statistically and economically different from zero. In Columns (5) and (6), we repeat the same regressions with monthly payments as our dependent variable and find similar results. This indicates that the rate at which taxes are passed on to lessees with credit scores below the median is not statistically different from that of lessees with credit scores above the median.

Second, we investigate whether individuals with recent leasing history exhibit a greater pass-through rate. The rationale behind this is that customers who have recently leased a

vehicle are likely to have a better understanding of the leasing process, thus making them more reactive to the pricing of lease agreements. Table 8 Columns (3) and (4) display the coefficients of Equation 5 after substituting Low credit score$_i$ with the recent lease $_i$ variable for the logarithm of monthly payments as our dependent variable. This variable is assigned a value of one for leases initiated within a 60-month period prior to the current lease, and zero otherwise. If the demand channel contributes to our results, then we should expect that the effect of the tax cut will be more pronounced among lessees with prior lease experience. In Columns (7) and (8), we repeat the same analysis for the monthly payments as our main dependent variable.

The findings indicate that the rate at which tax cuts are passed through to consumers with prior lease experience does not statistically vary from those without previous leasing experience. Our results are robust when considering whether lessees had entered into previous lease within 36 or 48 months of the current lease. In summary, these results imply that (1) consumer demand does not play a decisive role in shaping the pass-through rate, and (2) the demand curve is linear within the auto lease market.

5.2 The Competition Channel

The impact of competition on the pass-through of industry-wide cost shock is ambiguous, and that depends upon whether the marginal cost is constant or increasing. According to the theoretical model proposed by Weyl and Fabinger 2013, in cases where the marginal cost remains constant, as the intensity of competition increases, the rate of pass-through also rises. This is because in more competitive environments, firms tend to add a smaller markup to their marginal costs, limiting their capacity to offset changes in taxation, which leads to a more substantial pass-through rate. In the case of an increasing marginal cost, price increases lead to decreased outputs, and subsequently, lower marginal costs, affording firms greater capacity to absorb cost change. Hence, in situations where marginal cost is increasing, there is an inverse association between the level of market competition and the

rates at which costs are passed on to prices (Ritz 2019).

To deepen our comprehension of how competition influences pass-through rates, we investigate whether markets characterized by higher competition levels demonstrate a more significant degree of pass-through. Our metric for measuring competition among dealers is the number of dealerships within 50 (or 25) miles from the center of a given ZIP code. We split our dataset into two groups: leases in ZIP codes that have a below-median dealership count and leases in ZIP codes with an above-median dealership count. Subsequently, we re-estimate Equation 5, this time substituting the "Low credit score" variable with "High competition," a variable assigned a value of one for ZIP codes exhibiting above-median competition levels, and zero otherwise.

Table 7 Columns (1) through (4) present the coefficient estimates derived from our analysis with the logarithm of monthly payments as our dependant variable. It reveals that areas with more competitive dealership environments exhibit a higher rate of pass-through. Specifically, auto leases in ZIP codes where competition levels are above the median experienced a further decrease in monthly payments by an additional 4 percentage points. In Columns (5) through (8), we repeat the same analysis with monthly payments as our dependant variable. Consistent with our prior results, we find that the pass through rate is more pronounced in more competitive markets. Our findings highlight two key insights: (1) within the auto lease market, increased competition is associated with an elevated pass-through rate, indicating that dealers are partially absorbing the benefits of tax reductions, and (2) the positive link between competition and pass-through rate implies the presence of constant marginal costs instead of increasing marginal costs.

6 Conclusion

In this paper, we estimate the tax pass-through rate for a rather complex financial product. Using a difference-in-difference design, we compare leases originated by the same lessor for

the same vehicle at the same time in the state of Georgia and in neighbouring states. We find that consumers do not fully capture the subsidy under this tax policy change. We also find that consumers spend the majority of the received subsidy to upgrade and lease a more expensive vehicle. Moreover, in contrast to prior studies, we find no evidence that the heterogeneity in the pass-through rate is driven by demand factors. In particular, we find that the pass-through rate does not vary across consumers' credit score or whether they have had a lease before. We, however, find that the local competition among auto dealers is explaining the variation in the pass-through rate in this market.

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Table 1: Descriptive statistics

	Mean	SD	P25	P50	P75	Treated	Control	Diff
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lease term	37	4	36	36	39	38	38	0
Monthly payment	446	188	314	401	531	488	443	45
Credit score	724	74	667	732	790	727	725	2
Has cosigner?	0.36	0.48	0	0	1	0.32	0.37	-0.05
Prior lessee?	1	0	0	1	1	0.52	0.58	-0.06
Residual value	22,065	8,195	15,809	20,715	26,754	22,882	22,204	678
Vehicle value	38,904	14,072	27,640	36,785	46,840	40,698	39,284	1,414

NOTE.—This table describes our matched sample of 682,923 auto leases. Descriptive statistics are as of the lease origination date. In Columns 6 through 8, we compare auto leases that were originated in Georgia during the pre-treatment period to leases that were originated in the five control states. Columns 6 through 8 are defined as follows. *Treated* is the pre-treatment mean for auto leases originated in Georgia. *Control* is the pre-treatment mean for auto leases originated in the five control states. *Diff* is the difference between the pre-treatment means in treated and control states.

Table 2: State-level macro economic factors

Variable	Georgia	Control States	Diff	t-Diff
	(1)	(2)	(3)	(4)
Unemployment rate	6.525	6.441	0.0843	(0.15)
Real GDP($billion)	421.848	347.962	73.89	(1.34)
Real GDP growth	3.903	4.02	-0.116	(-0.19)
Real GDP per capita	44588.599	39746.696	4841.9**	(3.05)
House Price Index (all transactions)	286.431	297.209	-10.78	(-0.90)
House Price Index growth (all transactions)	2.182	2.977	-0.796	(-0.51)
Average weekly earning (nonfarm)	791.062	737.392	53.67***	(3.67)
Population (million)	9.399	8.54	0.859	(0.70)
Population growth	1.28	1.043	0.238	(1.09)

NOTE.—This table shows macro economic factors at the state level in the years leading up the policy change. In Columns 3 and 4, we compare macro economic factors in Georgia during the pre-treatment period to the macro economic factors in the five control states. *Diff* is the difference between the pre-treatment means in treated and control states.

Table 3: Difference-in-differences regression: Lease payments

	log Payment (1)	log Payment (2)	Payment (3)	Payment (4)
Treated x Post	-0.0358***	-0.0290***	-14.35***	-11.14***
	(0.0058)	(0.0058)	(2.79)	(2.79)
State FE	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Lender x Month FE		Y		Y
Cosigner x Month FE		Y		Y
Credit score bin x Month FE		Y		Y
N (millions)	0.68	0.68	0.68	0.68
R^2	0.22	0.24	0.25	0.26

NOTE.—This table reports coefficient estimates from Equation 2. The dependent variable is either the natural log of the monthly lease payment or the dollar amount of the monthly lease payment. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 4: Difference-in-differences regression: Composition of lessees

	log Credit score	log Credit score	Has cosigner?	Has cosigner?	log Income	log Income	Default 12 months?	Default 12 months?
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated x Post	0.0025*	0.0012	-0.0070	-0.0029	-0.0022	-0.0045	0.0005	0.0005
	(0.0014)	(0.0015)	(0.0074)	(0.0077)	(0.0120)	(0.0118)	(0.0003)	(0.0003)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Vehicle x Month FE		Y		Y		Y		Y
N (millions)	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
R^2	0.04	0.12	0.01	0.03	0.11	0.32	0.00	0.01

NOTE.—This table reports coefficient estimates from Equation 4. The dependent variable is either the natural log of the lessee's credit score, an indicator variable for whether the lessee had a cosigner, or an indicator variable for whether the lessee was in default 12 months after originating their lease. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table 5: Falsification test: Auto loans

	log Payment (1)	log Payment (2)	Payment (3)	Payment (4)	log Credit score (5)	log Credit score (6)	Has cosigner? (7)	Has cosigner? (8)
Treated × Post	-0.0014	0.0002	0.20	0.26	0.0003	0.0009	-0.0058**	-0.0042
	(0.0021)	(0.0023)	(0.89)	(1.02)	(0.0006)	(0.0007)	(0.0027)	(0.0030)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender × Month FE		Y		Y		Y		Y
Cosigner × Month FE		Y		Y				
Credit score bin × Month FE		Y		Y				
N (millions)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
R^2	0.14	0.17	0.13	0.15	0.32	0.34	0.04	0.07

NOTE.—This table reports coefficient estimates from Equations 2 and 4. The dependent variable is either natural log of the monthly loan payment, the dollar amount of the monthly loan payment, the natural log of the borrower's credit score, or an indicator variable for whether the borrower had a cosigner. The model is estimated on a random sample of 1,000,000 auto loans that were originated in the treated and control states between January 2017 and December 2018. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 6: Alternative explanation: Vehicle choice

	log Payment (1)	log Payment (2)	log Payment (3)	Payment (4)	Payment (5)	Payment (6)
Treated x Post	-0.0358***	-0.0290***	-0.0538***	-14.35***	-11.14***	-21.87***
	(0.0058)	(0.0058)	(0.0038)	(2.79)	(2.79)	(1.67)
State FE	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Lender x Month FE		Y	Y		Y	Y
Cosigner x Month FE		Y	Y		Y	Y
Credit score bin x Month FE		Y	Y		Y	Y
Vehicle x Month FE			Y			Y
N (millions)	0.68	0.68	0.68	0.68	0.68	0.68
R^2	0.22	0.24	0.68	0.25	0.26	0.73

NOTE.—This table reports coefficient estimates from Equation 2. The dependent variable is either the natural log of the monthly lease payment or the dollar amount of the monthly lease payment. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018 that can be matched to the Regulation AB II data. Trim fixed effects are defined based on $1,000 car value bins. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 7: Triple-differences regression: Demand elasticity

	log Payment (1)	log Payment (2)	log Payment (3)	log Payment (4)	Payment (5)	Payment (6)	Payment (7)	Payment (8)
Treated x Post	-0.0375***	-0.0569***	-0.0342***	-0.0495***	-13.17***	-22.91***	-11.09***	-19.07***
	(0.0094)	(0.0057)	(0.0076)	(0.0048)	(4.02)	(2.11)	(3.59)	(2.04)
Treated x Post	0.0174	0.0063			4.18	2.10		
x Low credit score	(0.0129)	(0.0074)			(5.32)	(2.53)		
Treated x Post			0.0089	-0.0067			-0.04	-4.65
x No recent lease			(0.0071)	(0.0045)			(3.65)	(2.07)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Cross-sectional cut x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Cosigner x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Credit score bin x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
No recent lease x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Vehicle x Month FE		Y		Y		Y		Y
N (millions)	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
R^2	0.24	0.68	0.24	0.68	0.26	0.73	0.26	0.74

NOTE.—This table reports coefficient estimates from Equation 5. The dependent variable is either the natural log of the monthly lease payment or the dollar amount of the monthly lease payment. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018. The indicator variable High competition (50 miles) (High competition (25 miles)) is equal to one if lessee resides in a ZIP code with an above-median number of new car dealerships within 50 (25) miles of it. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.

* Significant at the 10% level.

** Significant at the 5% level.

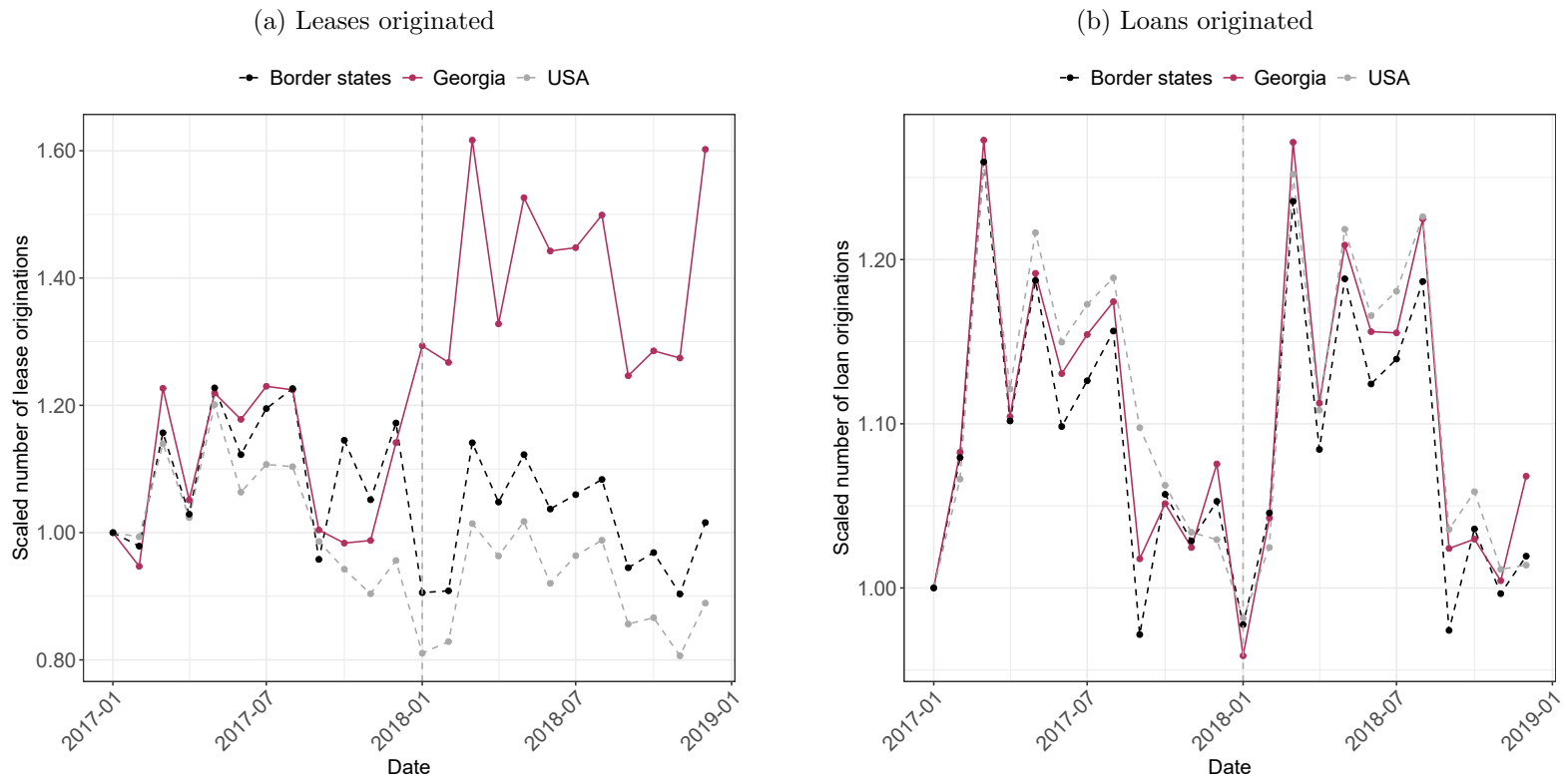
*** Significant at the 1% level.

Table 8: Triple-differences regression: Dealership competition

	log Payment (1)	log Payment (2)	log Payment (3)	log Payment (4)	Payment (5)	Payment (6)	Payment (7)	Payment (8)
Treated x Post	0.0177	-0.0197**	0.0059	-0.0244***	4.61	-11.21***	1.63	-11.32***
	(0.0129)	(0.0078)	(0.0154)	(0.0006)	(5.83)	(3.14)	(6.91)	(4.06)
Treated x Post	-0.0572***	-0.0421***			-19.39***	-13.18***		
x High competition (50 miles)	(0.0151)	(0.0091)			(6.41)	(3.40)		
Treated x Post			-0.0399**	-0.0335**			-14.69**	-12.07**
x High competition (25 miles)			(0.0169)	(0.0166)			(7.25)	(4.27)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
High competition x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Cosigner x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Credit score bin x Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Vehicle x Month FE		Y		Y		Y		Y
N (millions)	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
R^2	0.24	0.68	0.24	0.68	0.26	0.74	0.26	0.74

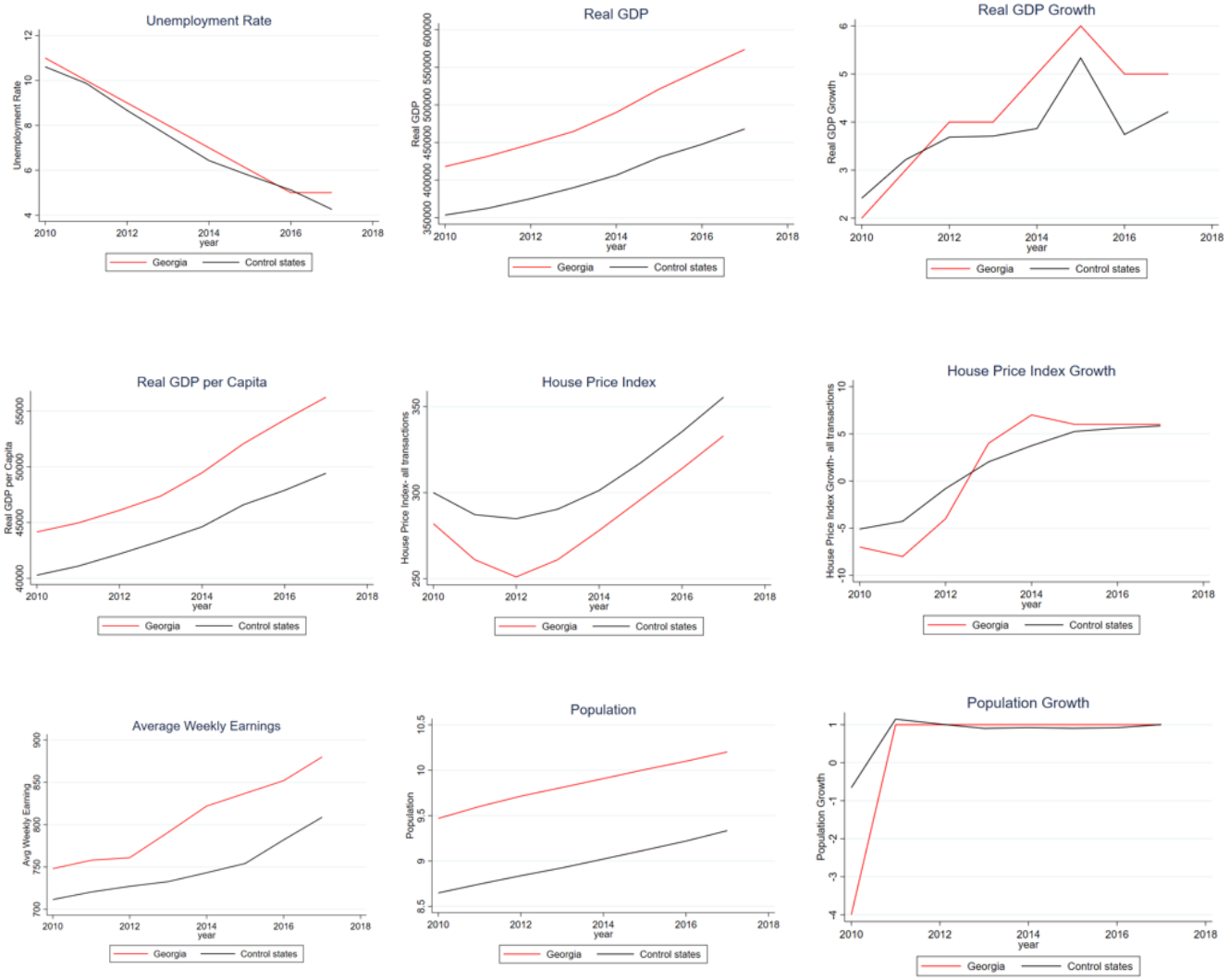
NOTE.—This table reports coefficient estimates from Equation 5. The dependent variable is either the natural log of the monthly lease payment or the dollar amount of the monthly lease payment. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018. The indicator variable Low credit score is equal to one if the lessee has a below-median credit score and zero otherwise. The indicator variable No recent lease is equal to one if the lessee has originated an auto lease within the past 60 months and zero otherwise. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Figure 1: Demand for auto leases and loans around date of Georgia tax change



NOTE.——This figure plots the number of auto leases and loans that were originated in Georgia (solid red line), its five border states (dashed black line), and all U.S. states besides Georgia (dashed gray line) between January 2017 and December 2018. In the figure, the values of each series are scaled to one as of January 2017.

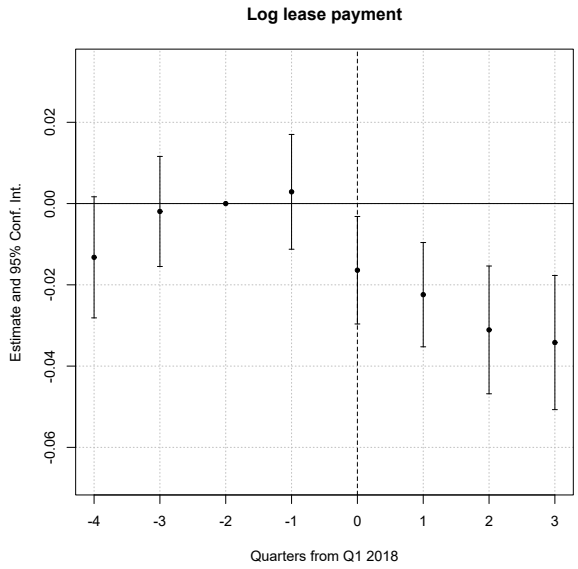
Figure 2: State-level macro economic variables



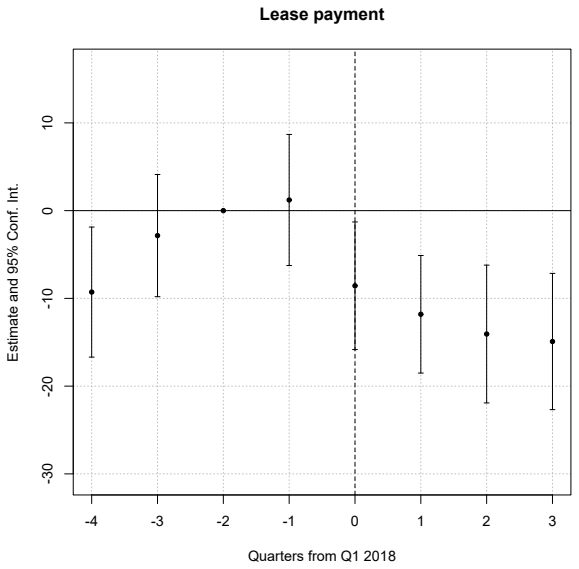
NOTE.——This figure plots macro economic factors including unemployment rate, Real GDP, Real GDP growth, House Price Index, House Price Index growth, average weekly earnings, population, and population growth in the years leading up the policy change in Georgia (solid red line) and its five border states (black line) between 2010 and 2017.

Figure 3: Response of lease terms and lessee characteristics

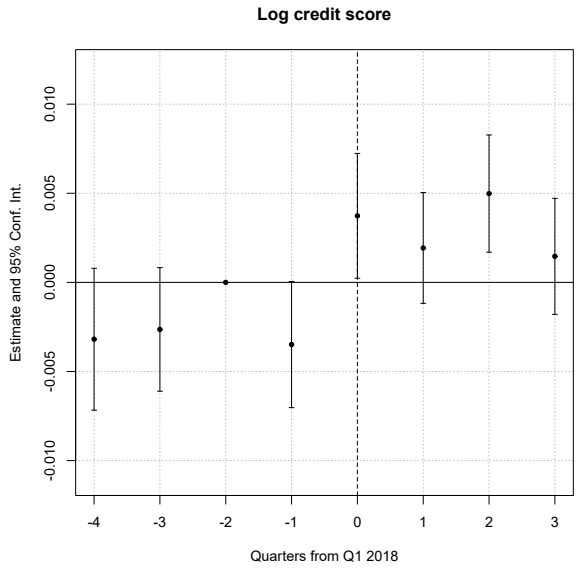
(a) Log lease payment



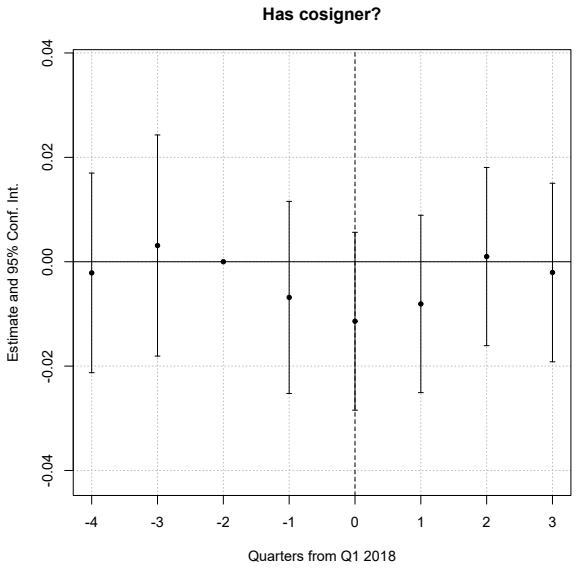
(b) Lease payment



(c) Log credit score



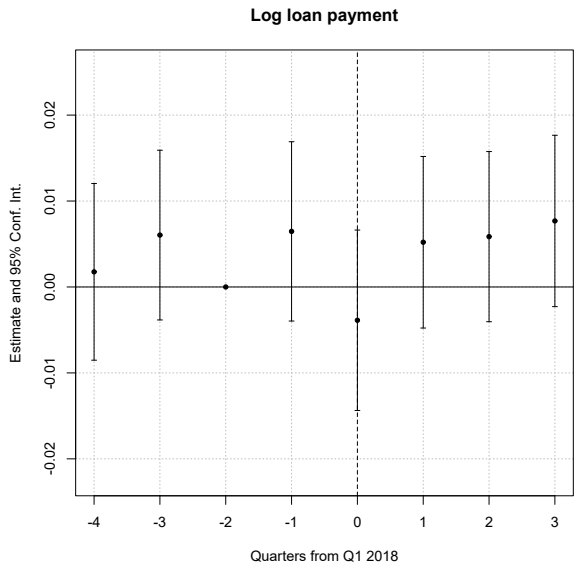
(d) Has cosigner?



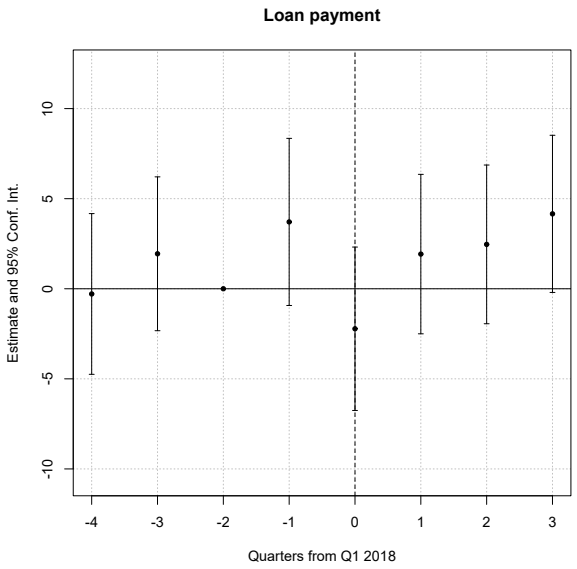
NOTE.——This figure plots coefficient estimates from Equation 3. The dependent variable is either the natural log of the lease payment, the dollar amount of the lease payment, the natural log of the lessee's credit score, or an indicator variable for whether the lessee has a cosigner. The x-axis corresponds to the number of quarters from the treatment date. The quarter $\tau = -2$ is the reference quarter. The circles correspond to the coefficient estimates, and the vertical bars correspond to 95 percent confidence intervals. Standard errors are clustered at the ZIP code level.

Figure 4: Response of loan terms and borrower characteristics

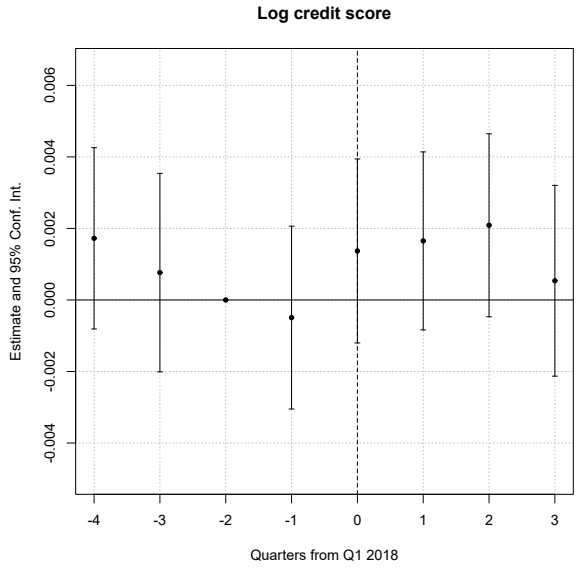
(a) Log loan payment



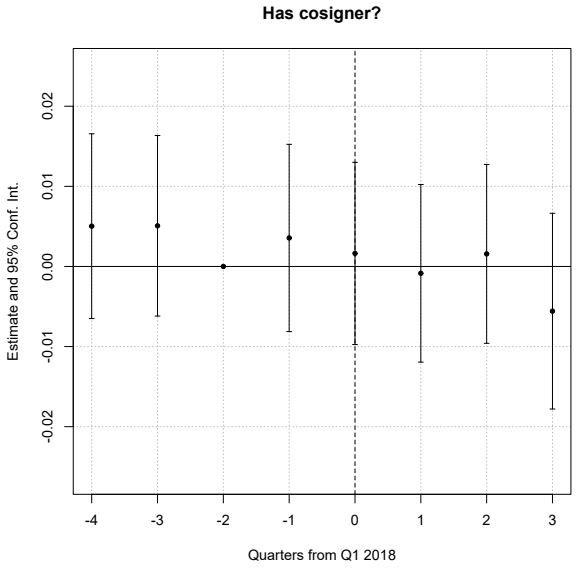
(b) Loan payment



(c) Log credit score



(d) Has cosigner?



NOTE.——This figure plots coefficient estimates from Equation 3. The dependent variable is either the log loan payment, the dollar loan payment, the natural log of the borrower's credit score, or an indicator variable for whether the borrower has a cosigner. The x-axis corresponds to the number of quarters from the treatment date. The quarter $\tau = -2$ is the reference quarter. The circles correspond to the coefficient estimates, and the vertical bars correspond to 95 percent confidence intervals. Standard errors are clustered at the ZIP code level.

Internet appendix

Table A.1: Descriptive statistics

	Mean (1)	SD (2)	P25 (3)	P50 (4)	P75 (5)	Treated (6)	Control (7)	Diff (8)
Lease term	38	5	36	36	39	38	38	1
Monthly payment	455	219	312	403	531	487	442	45
Credit score	714	84	655	725	787	708	714	-6
Has cosigner?	0.36	0.48	0	0	1	0.32	0.37	-0.05
Prior lessee?	0.54	0.50	0	1	1	0.47	0.54	-0.07

NOTE.—This table describes our full sample of 1,786,495 auto leases. Descriptive statistics are as of the lease origination date. In Columns 6 through 8, we compare auto leases that were originated in Georgia during the pre-treatment period to leases that were originated in the five control states (916,439 leases). Columns 6 through 8 are defined as follows. *Treated* is the pre-treatment mean for auto leases originated in Georgia. *Control* is the pre-treatment mean for auto leases originated in the five control states. *Diff* is the difference between the pre-treatment means in treated and control states.

Table A.2: Differences-in-differences regression: Auto lease and loan demand

	log Leases (1)	log Loans (2)	log Total (3)
Treated × Post	0.3070***	0.0074	0.0230***
	(0.0148)	(0.0074)	(0.0067)
State FE	Y	Y	Y
Month FE	Y	Y	Y
N (millions)	144	144	144
R^2	0.99	0.99	0.99

NOTE.—This table reports coefficient estimates from Equation XXX. The dependent variable is either the natural log of the number of leases originated, the natural log of the number of loans originated, or the natural log of the number of leases and loans originated. Standard errors, presented below the coefficient estimates, are clustered at the state level.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

Table A.3: Falsification test: Credit cards and mortgages

	Credit card				Mortgage			
	log Limit	log Limit	Limit	Limit	log Payment	log Payment	log Amount	log Amount
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated × Post	-0.0117**	0.0019	-21.07	1.10	0.0057	0.0084**	0.0037	0.0063*
	(0.0058)	(0.0052)	(26.58)	(25.07)	(0.0037)	(0.0035)	(0.0039)	(0.0038)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender × Month FE		Y		Y		Y		Y
Cosigner × Month FE		Y		Y				
Credit score bin × Month FE		Y		Y				
N (millions)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
R^2	0.33	0.49	0.37	0.38	0.17	0.23	0.21	0.27

NOTE.—This table reports coefficient estimates from Equation 2. The dependent variable is either the natural log of the credit card limit, the dollar amount of the credit card limit, the natural log of the monthly mortgage payment, or the natural log of the mortgage loan amount. In Columns 1 through 4, the model is estimated on a random sample of 1,000,000 credit cards that were originated in the treated and control states between January 2017 and December 2018. In Columns 5 through 8, the model is estimated on a random sample of 1,000,000 mortgages that were originated in the treated and control states between January 2017 and December 2018. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table A.4: Robustness: Alternative fixed effects

	log PMT (1)	log PMT (2)	log PMT (3)	log PMT (4)	PMT (5)	PMT (6)	PMT (7)	PMT (8)
Treated × Post	-0.0230***	-0.0211***	-0.0223***	-0.0225***	-9.66***	-8.56***	-9.19***	-9.37***
	(0.0040)	(0.0043)	(0.0043)	(0.0043)	(2.13)	(2.21)	(2.23)	(2.22)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Cosigner × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Credit score bin × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender × State FE		Y	Y	Y		Y	Y	Y
Lender × Credit score bin × Month FE			Y	Y			Y	Y
Lender × Cosigner × Month FE			Y	Y			Y	Y
Credit score bin × Cosigner × Month FE			Y	Y			Y	Y
Lender × Credit score bin × Cosigner × Month FE				Y				Y
N (millions)	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79
R^2	0.21	0.22	0.23	0.23	0.20	0.20	0.22	0.22

NOTE.—This table reports coefficient estimates from Equation 2 using different combinations of fixed effects. The dependent variable is either the natural log of the monthly lease payment or the dollar amount of the monthly lease payment. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018. Standard errors, presented below the coefficient estimates, are clustered at the ZIP code level.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table A.5: Robustness: Alternative forms of clustering

	log PMT (1)	log PMT (2)	log PMT (3)	log PMT (4)	PMT (5)	PMT (6)	PMT (7)	PMT (8)
Treated × Post	-0.0230***	-0.0230***	-0.0230***	-0.0230***	-9.66***	-9.66***	-9.66*	-9.66***
	(0.0040)	(0.0007)	(0.0086)	(0.0032)	(2.13)	(0.33)	(4.97)	(1.70)
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender FE	Y	Y	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Lender × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Cosigner × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Credit score bin × Month FE	Y	Y	Y	Y	Y	Y	Y	Y
Clustering	ZIP	State	Lender	Credit score	ZIP	State	Lender	Credit score
N (millions)	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79
R^2	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20

NOTE.—This table reports coefficient estimates from Equation 2 using different methods for computing the standard errors. The dependent variable is either the natural log of the monthly lease payment or the dollar amount of the monthly lease payment. The sample is restricted to auto leases originated in the treated and control states between January 2017 and December 2018. Standard errors, presented below the coefficient estimates, are clustered at the level listed in the row titled *Clustering*.

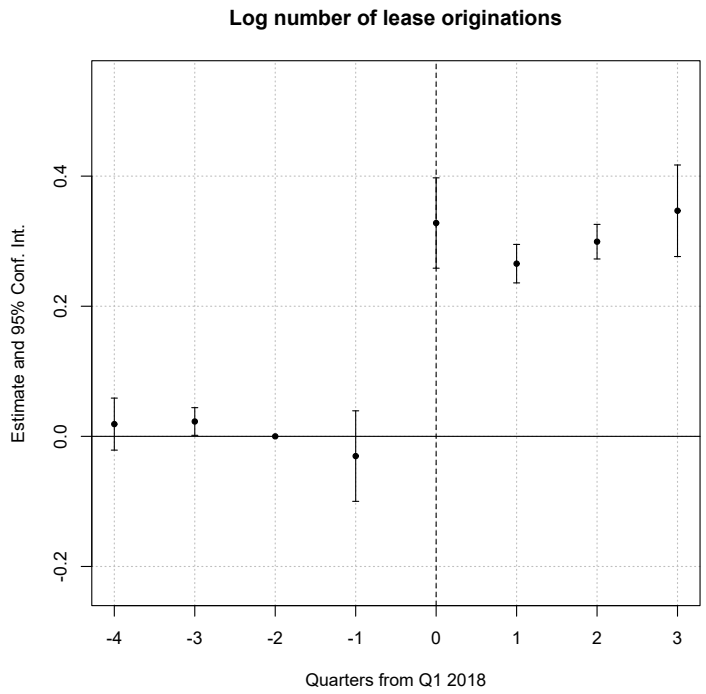
* Significant at the 10% level.

** Significant at the 5% level.

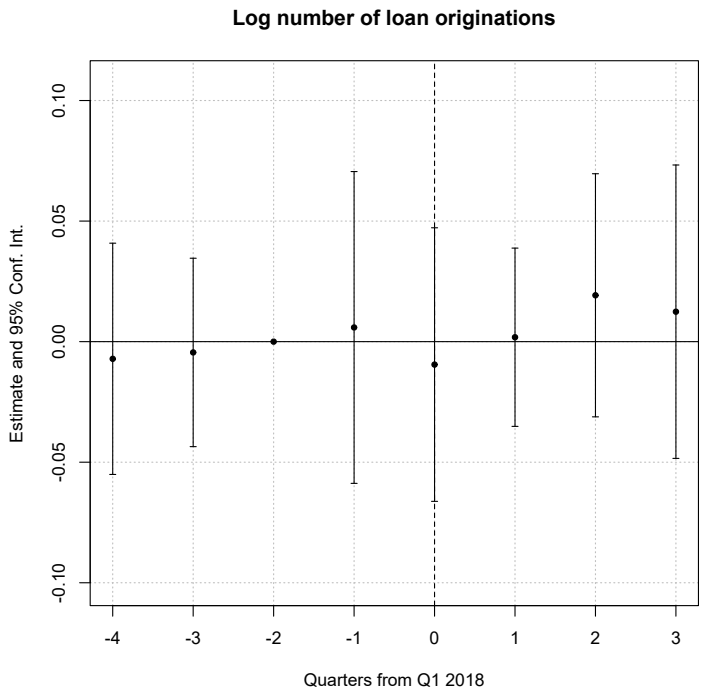
*** Significant at the 1% level.

Figure A.1: Difference-in-differences regression: Auto lease and loan demand

(a) Leases originated



(b) Loans originated



NOTE.——This figure plots coefficient estimates from Equation 3. The dependent variable is either the log number of leases originated in state s in month t or the log number of loans originated in state s in month t. The x-axis corresponds to the number of quarters from the treatment date. The quarter $\tau = -2$ is the reference quarter. The circles correspond to the coefficient estimates, and the vertical bars correspond to 95 percent confidence intervals. Standard errors are clustered at the state level.