Structural Changes in the Automobile Industry and State Tax Revenues*

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February 27, 2025

Abstract

We study the impact of structural changes in the automobile industry – the rise of electric vehicles that new manufacturers directly sell to consumers – on state tax revenues. We develop an equilibrium model of automobile dealers competing against the new electric vehicle manufacturers by setting prices for differentiated products in local markets and by making campaign contributions in state legislative elections to maintain the direct sale ban. The model is estimated with data on vehicle registrations and campaign contributions of dealer groups in Texas counties during 2018-2023. We use the estimates to simulate gasoline and vehicle sales tax revenues with the counterfactual repeal of the direct sale ban and reduced consumption utility of electric vehicles that new manufacturers directly sell to consumers. We also simulate the counterfactual direct sale ban probability with reduced political spending of dealer groups.

*All errors are our own.

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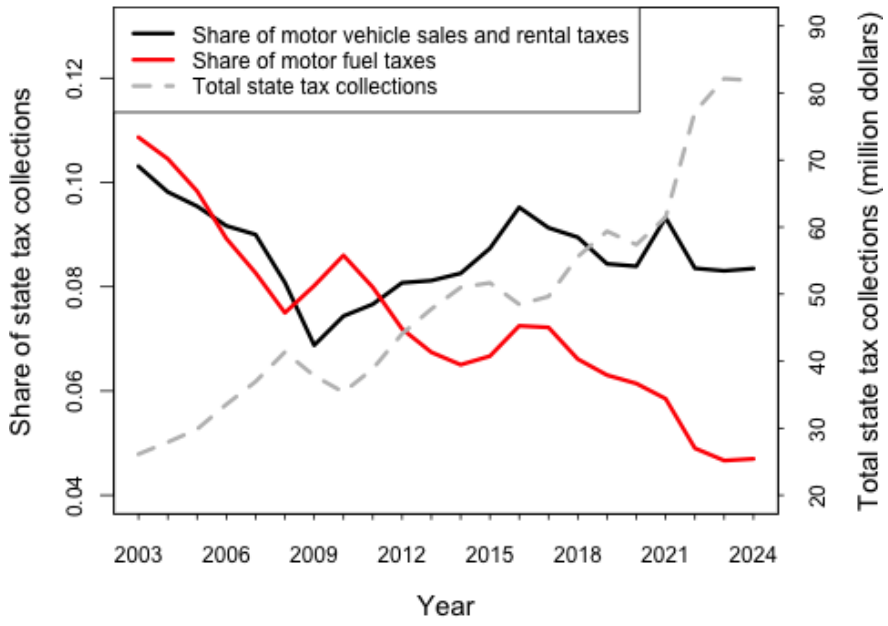
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1 Introduction

Structural changes in the automobile industry impact the fiscal dynamics of state governments in several important ways (Golden, 2024). First, with the increasing consumption of electric vehicles, gasoline tax revenues have fallen in terms of shares of state tax revenues. Second, per vehicle, electric vehicles contribute more to the vehicle sales tax revenues than comparable internal combustion engine vehicles, as the former carry higher price tags. Third, the entry of new electric vehicle manufacturers such as Tesla pursuing a direct sale strategy has intensified the automobile dealers' willingness to pay for state laws banning direct sales. The direct sale ban may hinder the growth of electric vehicle consumption which can have opposing effects on state tax revenues through higher gasoline tax revenues but lower sales tax revenues.

Figure 1 shows that in this paper's empirical setting of Texas, the share of gasoline tax revenues have rapidly fallen over the years, while the share of vehicle sale tax revenues have been relatively stable. In 2023, the Texas state legislature passed Senate Bill 505, which requires electric vehicle owners to pay an additional tax of $200 to make up for the lost gasoline tax revenues.

Figure 1: Vehicle sales and motor fuel taxes in Texas



Our paper studies how the rise of electric vehicles that new manufacturers directly sell to consumers impacts the state tax revenues of Texas, the state with the second-largest automobile consumption in the U.S. We consider three counterfactuals. First, how would Texas's gasoline and vehicle sales tax revenues change if the direct sale ban is repealed? Second, how would the revenues change if the consumption utility of electric vehicles sold by the new manufacturers did not rise as rapidly? Third, how would the probability of the direct sale ban change if automobile dealers reduced their political contributions? Texas automobile dealers have escalated their political spending to maintain the

direct sale ban especially as Tesla has relocated its headquarters to Texas.

We first develop an equilibrium model of competition between automobile dealers and new electric vehicle manufacturers pursuing a direct sale strategy. Dealers compete against the new manufacturers in local markets by setting prices for differentiated products. Dealers also compete by making campaign contributions in state legislative elections to maintain the direct sale ban. The direct sale ban probability is assumed to be increasing in dealers' political contributions. On the other hand, the direct sale ban creates disutility for consumers buying from the new manufacturers.

With data on vehicle registrations and political contributions in Texas counties during 2018-2023, we estimate the model parameters: consumption utility of cars sold by dealers relative to cars sold by the new manufacturers, the disutility of the direct sale ban, and the marginal effect of dealers' political contributions at raising the direct sale ban probability. We use the method of simulated moments to match key empirical patterns in how car sales vary across markets and how political contributions vary across dealer groups that serve different sets of markets.

We use the parameter estimates to assess three counterfactuals. In the first two counterfactuals, we simulate the market shares of dealers and new manufacturers with the repeal of the direct sale ban and with the reduction of the consumption utility of electric vehicles directly sold by the new manufacturers. These market shares are used to simulate counterfactual gasoline and sales tax revenues, revealing the impact of the direct sale ban and the rise of new manufacturers on state tax revenues. In the third counterfactual, we compute the change in the direct sale ban probability setting dealers' political contributions to reduced amounts. This probability change sheds light on the impact of rent-seeking behavior on state fiscal dynamics.

Paper's current status and future plan. The current draft includes a basic skeleton of the paper, including model, data, and estimation strategies. We are working on estimation and counterfactual simulations which we project to finish by the summer.

Related literature

Our paper complements empirical studies of structural changes in vertical relations. Our topic of incumbent retailers using political contributions to protect their market power against the threat of direct sale by new manufacturers is understudied in the literature. Recent work has quantified how vertical integration (e.g., Crawford et al. (2018), Luco and Marshall (2020)), direct sale (e.g., Donna et al. (2024), Donna et al. (2024)), and franchise fee contracts (e.g., Murry (2017)) impact welfare through prices and product attributes in equilibrium models with bargaining between upstream and downstream firms. Various mechanisms such as double marginalization, foreclosure, multi-product pricing, change in bargaining power, product differentiation, product search cost, and advertising efforts have been empirically investigated. We add political contributions as another

mechanism to be analyzed. Our empirical setting is also distinct in that the direct sale strategy of new manufacturers (e.g., Tesla) poses a threat to existing vertical relations and market power of incumbent manufacturers and retailers who have historically followed a pure franchise strategy to comply with state laws banning simultaneous use of direct sale and franchise strategies.

The political economy of automobile franchise laws is reviewed by Lafontaine and Morton (2010), Crane (2015), and Crane (2016), discussing how automobile dealers influence state politics to sustain the direct sale ban and the resulting potential harm to consumer welfare. We follow up on these discussions and study various determinants of dealers' spending in state politics. Moshary and Slattery (2024) find consolidations in automobile retail markets led trade associations to lobby more, suggesting mitigation of the collective action problem. Our work complements theirs by providing evidence of campaign contributions of Texas dealership groups increasing with the rise of new entrants and market size especially in years surrounding Tesla's relocation of headquarters.

2 Background on direct sale ban in Texas

The direct sale ban in Texas is established by the Texas Occupations Code Section 2301.252[1], which limits new vehicle sales to franchised dealers, and Section 2301.476 Subsection (c)[2], which prohibits manufacturers from owning, operating, controlling, or acting in the capacity of franchised dealers.

Tesla has adopted a direct sale strategy which is prohibited by Texas law. To buy Tesla vehicles, Texas consumers mostly resort to making online purchases technically out of state and then have the vehicles delivered to a Tesla service center in Texas.[3] Until recently, Texas consumers had to handle vehicle registrations and sales tax payments on their own, an additional hassle cost that can be avoided if buying at traditional dealerships. Texas consumers have also suspected that the cost of owning Tesla vehicles is uncertain due to new potential legislation limiting Tesla's operation in Texas. For example, in 2019, Tesla vehicle owners in Texas protested at the State Capitol that the Senate Bill 1415 would make it illegal for Tesla to operate service centers in Texas (KXAN, 2019). Eventually, the bill was amended to accommodate such concerns.

As listed in Table 1, Tesla has lobbied for bills that would allow direct sales in Texas but none has passed the legislature. Tesla has exerted similar efforts in other states as well to varying degrees of success (Crane, 2016). Tesla's relocation of its headquarters from Palo Alto to Austin in 2021 was perceived by the media as reinforcing the company's efforts to repeal the direct sale ban in Texas and challenging the political influence of incumbent Texas firms in automobile dealership and oil and gas industries (Chokshi et al., 2021).

[1] `https://statutes.capitol.texas.gov/Docs/OC/htm/OC.2301.htm#2301.252`.

[2] `https://statutes.capitol.texas.gov/Docs/OC/htm/OC.2301.htm#2301.476`.

[3] In other states such as New Mexico, Connecticut, and New York, Tesla has showrooms established in Native American tribal lands to bypass state restrictions on sales and repairs not provided by franchised dealers.

Table 1: Pro-Tesla bills filed in the Texas State Legislature

Bill number	Year	Description	Outcome
HB 4379	2021	Allow electric vehicle manufacturers to operate dealerships	Not pass
HB 4236	2017	Redefine dealers to include "manufacturer motor vehicle dealers"	Not pass
SB 2093	2017	Redefine dealers to include "manufacturer motor vehicle dealers"	Not pass
SB 639	2015	Allow manufacturers to operate up to twelve dealerships	Not pass
HB 1653	2015	Allow manufacturers to operate up to twelve dealerships	Not pass
HB 3828	2015	Allow electric vehicle manufacturers to operate dealerships	Not pass
HB 3351	2013	Allow electric vehicle manufacturers to operate dealerships	Not pass
SB 1659	2013	Allow electric vehicle manufacturers to operate dealerships	Not pass

Source: Texas Legislature Online Text Search (`https://capitol.texas.gov/Search/TextSearch.aspx`).

3 Model

Local markets or counties in Texas are denoted by $r \in \mathcal{R} := \{1, \cdots, R\}$, and years are denoted by $t \in \mathcal{T} := \{1, \cdots, T\}$.

3.1 Political contributions

In each year t, each Texas dealership group $g \in \mathcal{G} := \{1, \cdots, G\}$ simultaneously contributes b_{gt} to Texas state legislators to elicit their support for the direct sale ban. The set of markets served by group g is denoted by $\mathcal{R}_g = \{1, \cdots, R_g\}$. The vector of observable characteristics of group g is denoted by x_g, which includes the establishment year and the number of member dealers.

3.1.1 Dealership group profit function

Group g's profit function is

$$\pi_{gt} = \sum_{r \in \mathcal{R}_g} \tau M_{rt} \hat{\pi}_{rt} - b_{gt},$$

where M_{rt} is the size of market r, $\hat{\pi}_{rt}$ is the per-capita profit of all dealers in market r, τ is the share of the dealer profit captured by group g, and b_{gt} is group g's political contribution amount. We abstract away from the inter-dealer competition as it cannot be incorporated in our empirical analysis due to the lack of quantity data at the dealer-level.

3.1.2 Direct sale ban probability function

The direct sale ban probability function, D_t, is specified as:

$$D_t(b_{1t}, \cdots, b_{Gt}) = \frac{\sum_{g \in \mathcal{G}} \log(\rho_{gt} b_{gt})}{1 + \sum_{g \in \mathcal{G}} \log(\rho_{gt} b_{gt})},$$

where $\rho_{gt} = \rho_t + \rho_x x_g$ governs the effectiveness of group g's contribution at raising the direct sale ban probability in year t. ρ_{gt} depends on dealership group characteristics (x_g) and years.

We assume D_t is conditional on equilibrium political contributions of Tesla and Texas Automobile Dealers Association (TADA). This assumption can be justifiable if Tesla and TADA's contributions do not change significantly with respect to individual dealership groups' contributions, as the latter tend to be smaller. Another way to rationalize the assumption is through a sequential move model in which dealers decide after observing Tesla and TADA's decisions.

We interpret ρ_{gt} as shifting with Tesla and TADA's equilibrium contributions which influence the intensity of political support for the direct sale ban. For example, ρ_{gt} would decrease as Tesla ramps up its political spending to have the direct sale ban repealed, lowering D_t for a given $(b_{1t}, \cdots, b_{Gt})$. On the other hand, ρ_{gt} would increase with TADA's spending for the direct sale ban, raising D_t for a given $(b_{1t}, \cdots, b_{Gt})$.

The marginal effect of dealership group g's contribution on the direct sale ban probability is:

$$\frac{\partial D_t}{\partial b_{gt}} = \frac{(1 - D_t)^2}{b_{gt}},$$

from which $\frac{\partial^2 D_t}{\partial b_{gt}^2} < 0$ is apparent, indicating diminishing marginal effectiveness of contributions.

3.1.3 Optimal political contributions

Group g's optimal political contribution b_{gt} satisfies the following first-order condition:

$$\underbrace{\left[\sum_{r \in \mathcal{R}_g} \tau M_{rt} \frac{\partial \hat{\pi}_{rt}}{\partial D_t}\right]}_{\frac{\partial \pi_{gt}}{\partial D_t}} \underbrace{\left[\frac{(1 - D_t)^2}{b_{gt}}\right]}_{\frac{\partial D_t}{\partial b_{gt}}} = 1, \tag{1}$$

which equates the marginal return of contribution (left-hand side) to the marginal cost of contribution (right-hand side). On the left-hand side, as the marginal return of direct sale ban probability (first bracketed term) increases, the marginal effectiveness of contribution (second bracketed term) must decrease, implying the dealership group optimally contributes more.

A potential free-riding problem exists as the above first-order condition does not incorporate the positive externalities of group g's contribution on profits of other groups. The degree of this problem would be mitigated by TADA's contribution, which raises ρ_{gt} and hence the level of D_t.

3.2 Automobile markets

Automobile demand and supply in local markets are modeled at market-year level (as opposed to product-market-year level), because quantities of automobiles consumed are only observed at market-year level. Consequently, we abstract away from how competition among dealers impacts their profits. Rather, we focus on how the direct sale ban probability impacts dealers' profits and political contributions.

3.2.1 Demand

Consumers in each market make a binary decision of buying from a local dealer or not: $j \in \{0, 1\}$. The option of not buying from a dealer ($j = 0$) includes buying from manufacturers that have not adopted the dealership model such as Tesla. Whether direct sale by manufacturers is allowed by the Texas state law thus impacts the utility of not buying from a dealer. If direct sale is illegal in Texas, consumers wanting to buy a Tesla vehicle, for example, would have to take alternative steps such as buying the vehicle in a different state and having it delivered to Texas.

The indirect utility function is specified as:

$$u_{i1rt} = -\alpha p_{rt} + \delta_{rt} + \epsilon_{i1rt}$$
$$u_{i0rt} = -\gamma_t d_t + \epsilon_{i0rt},$$

where p_{rt} is the average dealer price, δ_{rt} is the average dealer quality, d_t is the direct sale ban status, and ϵ_{ijrt}, independently drawn from Type 1 Extreme Value distribution is consumer i's idiosyncratic taste for option j. Note that 1 is abbreviated from the subscripts of p_{rt} and δ_{rt}. $\alpha > 0$ and $\gamma_t > 0$ are assumed; the latter implies that the repeal of direct sale ban increases the utility of not buying from a dealer.

3.2.2 Supply

Dealers in each market face constant marginal cost c_{rt} and optimally choose the price level to maximize their variable profit specified as:

$$\pi_{rt} = M_{rt} \underbrace{s_{1rt}(p_{rt} - c_{rt})}_{\hat{\pi}_{rt}},$$

where s_{1rt} denotes the market share of dealers, and $p_{rt} - c_{rt}$ is the price-cost margin. $s_{1rt}(p_{rt} - c_{rt})$ is the per-capita variable profit of dealers in the market ($\hat{\pi}_{rt}$).

The first-order condition for optimal price level chosen by dealers is:

$$p_{rt} = c_{rt} + \frac{1}{\alpha s_{0rt}}$$

Letting $\psi_{rt} = -\alpha c_{rt} + \delta_{rt}$ denote the profitability index of dealers, the equilibrium market share of dealers must satisfy the following condition:

$$s_{1rt} = \frac{\exp(\psi_{rt} - \frac{1}{s_{0rt}})}{\exp(-\gamma_t d_t) + \exp(\psi_{rt} - \frac{1}{s_{0rt}})}. \tag{2}$$

The ex ante equilibrium profit of dealership group g is derived as:

$$\pi_{gt} = \sum_{r \in \mathcal{R}_g} \frac{\tau M_{rt}}{\alpha} \left(\frac{D s_{1rt|d=1}}{s_{0rt|d=1}} + \frac{(1-D) s_{1rt|d=0}}{s_{0rt|d=0}} \right),$$

where the summation is over the ex ante equilibrium profit of dealership group g in each market r that it operates in.

3.2.3 Marginal returns to direct sale ban probability

The marginal effect of the direct sale ban probability on the ex ante equilibrium profit of dealership group g is then derived as:

$$\frac{\partial \pi_{gt}}{\partial D_t} = \sum_{r \in \mathcal{R}_g} \tau M_{rt} \underbrace{\frac{1}{\alpha} \left(\frac{s_{1rt|d=1}}{s_{0rt|d=1}} - \frac{s_{1rt|d=0}}{s_{0rt|d=0}} \right)}_{\frac{\partial \hat{\pi}_{rt}}{\partial D_t}}. \tag{3}$$

The marginal returns to direct sale ban probability is increasing in the profitability index of dealers in each market:[4]

$$\frac{\partial^2 \pi_{gt}}{\partial \psi_{rt} \partial D_t} = \frac{\tau M_{rt}}{\alpha} (s_{1rt|d=1} - s_{1rt|d=0}) > 0.$$

The implication of positive $\frac{\partial^2 \pi_{gt}}{\partial \psi_{rt} \partial D_t}$ is intuitive: more profitable dealers have more to gain from a marginal increase in the direct sale ban probability. Another important implication in the empirical setting is that as consumers more weakly prefer buying from dealers (i.e., lower ψ_{rt}), dealers face lower marginal returns to direct sale ban probability, exerting downward pressure on political contributions.

The first-order condition (Equation (1)) for optimal political contributions can be re-formulated in

[4] This follows from differentiating $\frac{\tau M_{rt}}{\alpha}(\hat{\pi}_{rt|d=1} - \hat{\pi}_{rt|d=0})$ with respect to ψ_{rt} and applying the envelope theorem.

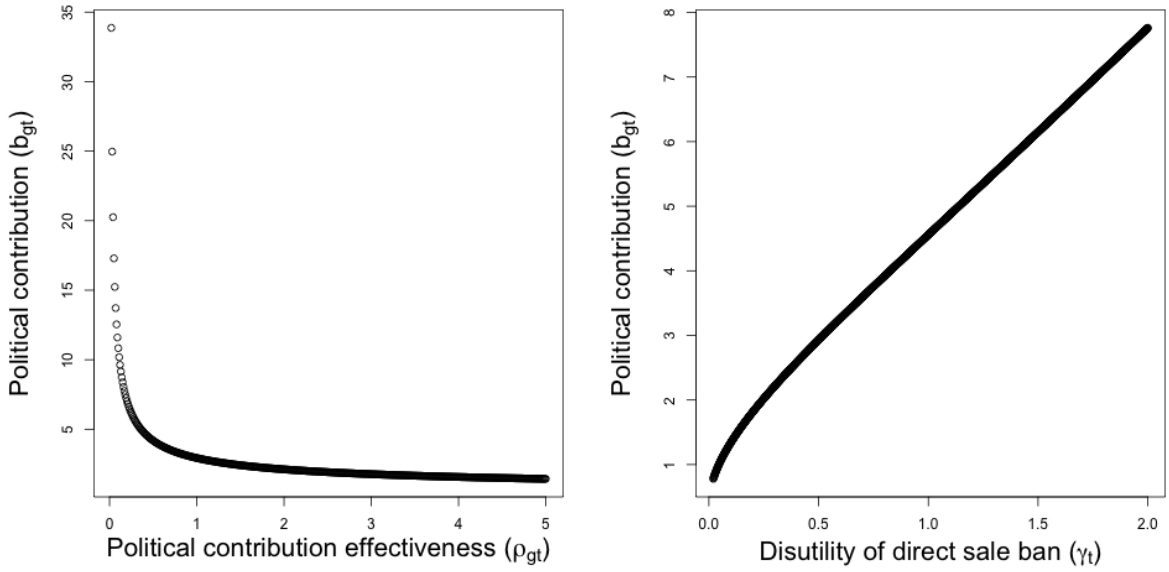
terms of equilibrium market shares as follows:

$$\underbrace{\left[\sum_{r\in\mathcal{R}_g}\frac{\tau M_{rt}}{\alpha}\left(\frac{s_{1rt|d=1}}{s_{0rt|d=1}}-\frac{s_{1rt|d=0}}{s_{0rt|d=0}}\right)\right]}_{\frac{\partial\pi_{gt}}{\partial D_t}}\underbrace{\left[\frac{(1-D_t)^2}{b_{gt}}\right]}_{\frac{\partial D_t}{\partial b_{gt}}}=1. \tag{4}$$

3.3 Numerical example

Figure 2 illustrates how political contributions change with respect to the model parameters in a numerical example. Optimal contributions of a dealership group serving a single market are found using the first-order condition (Equation (4)) assuming $\psi_{rt}=0, \tau=1, \alpha=1$, and $M_{rt}=100$. The left figure, assuming $\gamma_t=0.5$, shows the contributions increase as the political support for the direct sale ban decreases, or equivalently as the contribution effectiveness (ρ_{gt}) decreases. The right figure, assuming $\rho_{gt}=1$, shows the contributions increase as the disutility of direct sale ban (γ_t) increases. This numerical exercise foreshadows the counterfactual analysis that we aim to conduct using empirical estimates of ρ_{gt} and γ_t to answer how contributions would change if political competition was softer or consumer preference for buying directly from manufacturers was weaker.

Figure 2: Numerical example



Notes: The figures show simulated political contributions of a dealership group operating in a single market. b_{gt} satisfying the first-order condition (Equation (4)) is found assuming $\psi_{rt}=0, \tau=1, \alpha=1$, and $M_{rt}=100$. In the left figure, $\gamma_t=0.5$ is assumed. In the right figure, $\rho_{gt}=1$ is assumed.

4 Data

Our sample includes 36 automobile dealer groups operating in 231 Texas counties during the period of 2018-2023.[5] From Automotive News's ranking of "Top 150 Dealership Groups" based on annual revenues of dealer groups, we selected dealer groups that have member dealers located in Texas. The sample counties either are home counties of member dealers or are adjacent to those home counties. Four variables key to our analysis are discussed below. Details on data source and variable construction are in the appendix.

4.1 Market share of non-dealer purchase ($s_{0rt|d=1}$)

From Atlas EV Hub and Texas Department of Motor Vehicles, we observe the share of vehicles manufactured and sold by Tesla, Rivian, or Lucid among vehicles registered in each county and year. We assume this observed share is a lower bound on the unobserved market share of non-dealer purchase among newly purchased vehicles, corresponding to $s_{0rt|d=1}$ in the model.[6] We will estimate the model for a range of possible $s_{0rt|d=1}$ given its lower bound.

Our lower bound assumption is likely to hold if the market share of newly purchased vehicles manufactured by the three companies is increasing over time due to their increasing popularity. More formally, let σ_{rt}^k denote the share of vehicles registered in year t that are purchased in year $k \leq t$ with $\sum_{k=0}^{t} \sigma_{rt}^k = 1$. Assuming independent vehicle replacement rate and $s_{0rt|d=1} \geq s_{0rt'|d=1}$ for $t > t'$, the following holds:

$$\sum_{k=0}^{t} \sigma_{rt}^k s_{0rk|d=1} \leq s_{0rt|d=1},$$

where the left-had side (lower bound) is the observed share of non-dealer purchase among vehicles registered in year t, and the right-hand side is the unobserved market share of non-dealer purchase among newly purchased vehicles.

Table 2 shows that the lower bound on the market share of non-dealer purchase is generally less than one percent, but Figure 3a shows substantial heterogeneity across counties and years. As expected, non-dealer purchases tend to increase over time especially in urban counties.

4.2 Political contributions

Data on political contributions of dealer groups in Texas state elections are obtained from the OpenSecrets. Table 2 shows that dealer groups spend on average about $26,000 every year, while TADA spends about $260,000 every year. Figure 3b shows the total amount spent by all dealer groups surpasses the amount spent by TADA, suggesting that dealer groups play a significant role

[5] Texas has 254 counties.

[6] We only observe vehicle registration and model years for electric vehicles.

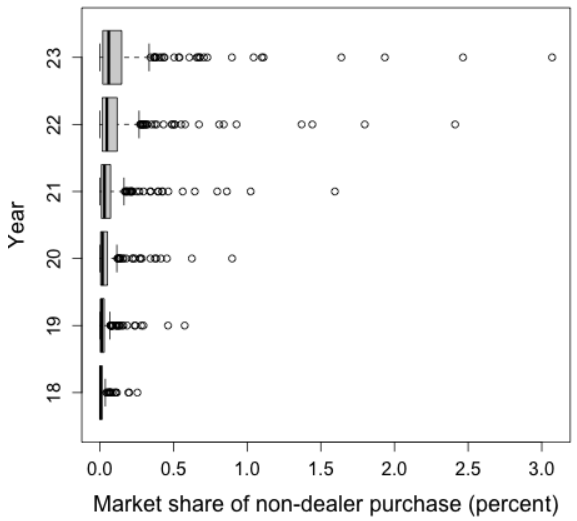
Table 2: Summary statistics

	N	Mean	Q25	Q50	Q75	SD
Lower bounds on non-dealer purchase shares (%)	1386	0.09	0.01	0.02	0.07	0.22
Dealership group attributes						
Number of member dealerships						
Establishment year						
Average market size						
Campaign contributions ($10,000)						
Dealership groups	133	2.64	0.09	0.55	2.58	4.58
TADA	6	25.75	16.65	27.57	35.89	11.42
Tesla						
County populations (mil)	1386	0.13	0.01	0.02	0.06	0.43

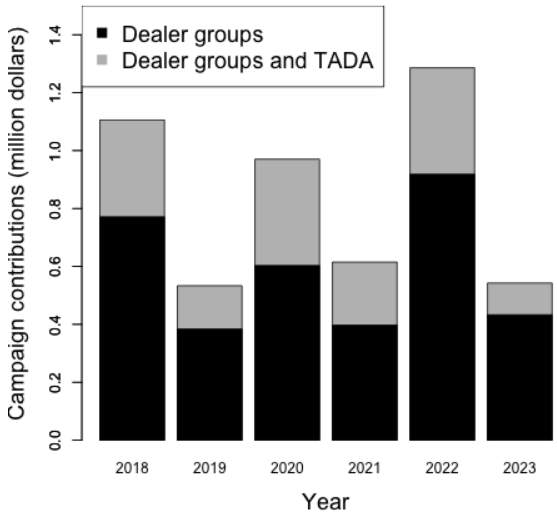
Notes: The four sets of variables shown are at county-year, firm-year, firm-year, and county-year levels, respectively. Zero non-dealer purchase shares are excluded.

Figure 3: Market shares and campaign contributions

(a) Lower bounds on market shares of non-dealers



(b) Campaign contributions of dealer groups



Notes: Figure 3a shows box plots of lower bounds on market shares of non-dealers in each county and year. Figure 3b plots total annual campaign contributions of dealer groups and TADA in Texas state elections.

in influencing state electoral outcomes to promote the business interests of automobile dealers. Figure 3b also shows the political spending is noticeably higher in the even numbered years when the House elections are held; gubernatorial and Senate elections are held in midterm election years.

4.3 Market sizes (M_{rt})

We assume market size (M_{rt}) is county population times an unknown coefficient. We assume this coefficient is absorbed by $\frac{\tau}{\alpha}$, another unknown coefficient on market size in the first-order condition (Equation (4)), since we normalize $\frac{\tau}{\alpha}$ in Section 4. Table 2 shows that the county population distribution is right skewed and that populations grew in more than half of the county-year observations compared to the previous years.

5 Empirical strategy

Data consist of dealers' market shares conditional on direct sale ban ($\left\{s_{1rt|d=1}\right\}_{r\in\mathcal{R},t\in\mathcal{T}}$), political contributions made by dealership groups ($\{b_{gt}\}_{g\in\mathcal{G},t\in\mathcal{T}}$), market sizes ($\{M_{rt}\}_{r\in\mathcal{R},t\in\mathcal{T}}$), and dealership group characteristics ($\{x_g\}_{g\in\mathcal{G}}$). Our objective is to use these data to estimate the model and quantify how Tesla's relocation impacted the amount of political contributions made by automobile dealers. The model parameters to be estimated include the direct sale ban probability function parameters (ρ_{gt}) and the disutility of direct sale ban when not buying from dealers (γ_t).

In this section, we first discuss identification and then propose an estimation method.

5.1 Identification

5.1.1 Direct sale ban probability function parameter (ρ_{gt})

The direct sale ban probability function parameter (ρ_{gt}) governs the effectiveness of political contributions at raising the direct sale ban probability. ρ_{gt} is identified by across-year covariation between dealership groups' political contributions and the sizes of markets they serve conditional on market shares. To see this, suppose group g earns equal market shares in years t and t' (i.e., $s_{rt|d=1} = s_{rt'|d=1}\ \forall r \in \mathcal{R}_g$), implying equal profitability indices (i.e., $\psi_{rt} = \psi_{rt'}\ \forall r \in \mathcal{R}_g$) and equal per-capita returns to direct sale ban probability (i.e., $\frac{\partial\hat{\pi}_{rt}}{\partial D_t} = \frac{\partial\hat{\pi}_{rt'}}{\partial D_{t'}}\ \forall r \in \mathcal{R}_g$). In this case, the group faces different contribution incentives in the two years partly depending on the change in market sizes. If $M_{rt} > M_{rt'}$ for some $r \in \mathcal{R}_g$, the group would have more to gain from a marginal increase in the direct sale ban probability in year t, exerting an upward pressure on contribution in year t. How much more the group contributes in year t reveals how much more effective its contribution is at raising the direct sale ban probability in year t. A downward (upward) pressure would be exerted on the contribution if it is more (less) effective at raising the direct sale ban probability, corresponding to higher (lower) ρ_{gt}.

The above intuition is apparent in the ratio of first-order conditions (Equation (4)) for group g's contributions in years t and t' conditional on market shares:

$$\underbrace{\left[\frac{\sum_{r\in\mathcal{R}_g} M_{rt}}{\sum_{r\in\mathcal{R}_g} M_{rt'}}\right]}_{\frac{\frac{\partial \pi_{gt}}{\partial D_t}}{\frac{\partial \pi_{gt'}}{\partial D_{t'}}}} \underbrace{\left[\frac{b_{gt'}}{b_{gt}}\frac{(1-D_t)^2}{(1-D_{t'})^2}\right]}_{\frac{\frac{\partial D_t}{\partial b_{gt}}}{\frac{\partial D_{t'}}{\partial b_{gt'}}}} = 1.$$

The equation requires that the group's contributions b_{gt} and $b_{gt'}$ equate the ratio of the marginal returns to the direct sale ban probability (first bracketed term) to the inverse ratio of slopes of direct sale ban probability function (second bracketed term). If the group serves larger markets in year t but contributes only slightly more, then we learn that the group's contribution is relatively effective at raising the direct sale ban probability in year t.

5.1.2 Disutility of direct sale ban (γ_t)

The disutility that consumers face due to the direct sale ban when not buying from dealers is governed by the utility parameter γ_t. This parameter is identified by the covariation of dealership groups' political contributions and market shares. To see this, first note that as γ_t increases, dealership groups earning higher market shares (i.e., operating in markets with higher profitability indices ψ_{rt}) have more to gain from a marginal increase in the direct sale ban probability:

$$\frac{\partial^2}{\partial s_{1rt|d=1}\partial\gamma_t}\frac{\partial \pi_{gt}}{\partial D_t} = \frac{\tau M_{rt}}{\alpha} > 0.$$

The positive sign of the above derivative along with the first-order condition (Equation (4)) implies that as γ_t increases, dealership groups earning higher market shares would contribute more.

Hence, as we observe a larger conditional covariance between the contributions and market shares earned by groups within year, a larger γ_t can be inferred. This intuition is apparent in the ratio of first-order conditions (Equation (4)) for contributions of groups g and g' in year t:

$$\underbrace{\left[\frac{\sum_{r\in\mathcal{R}_g} M_{rt}\left(\frac{s_{1rt|d=1}}{s_{0rt|d=1}} - \frac{s_{1rt|d=0}}{s_{0rt|d=0}}\right)}{\sum_{r'\in\mathcal{R}_{g'}} M_{r't}\left(\frac{s_{1r't|d=1}}{s_{0r't|d=1}} - \frac{s_{1r't|d=0}}{s_{0r't|d=0}}\right)}\right]}_{\frac{\frac{\partial \pi_{gt}}{\partial D_t}}{\frac{\partial \pi_{g't}}{\partial D_t}}} \underbrace{\left[\frac{b_{g't}}{b_{gt}}\right]}_{\frac{\frac{\partial D_t}{\partial b_{gt}}}{\frac{\partial D_t}{\partial b_{g't}}}} = 1.$$

Suppose group g earns higher market shares than group g'. Then, as argued previously, as γ_t increases, the ratio of the marginal returns to the direct sale ban probability (first bracketed term) increases, implying that the ratio of the slopes of the direct sale ban probability function (second bracketed term) must decrease. Put differently, group g must contribute increasingly larger amount

compared to group g'.

5.2 Implementation

We use the method of simulated moments to estimate the model parameters. For each candidate parameter vector, $\{\tilde{\rho}_t, \tilde{\rho}_x, \tilde{\gamma}_t\}_{t\in\mathcal{T}}$, we simulate the equilibrium political contributions, $\{b_{gt}\}_{g\in\mathcal{G},t\in\mathcal{T}}$ using the first-order condition (Equation (4)). We search for $\{\tilde{\rho}_t, \tilde{\rho}_x, \tilde{\gamma}_t\}_{t\in\mathcal{T}}$ that match the following simulated moments to their empirical counterparts:

- Mean and variance of contributions conditional on dealership group attribute quartile.
- Covariance between contributions and average market sizes conditional on average market shares quartile.
- Covariance between average market shares and contributions conditional on dealership group attribute quartile.

The above set generates 24 (=16+4+4) moments to estimate 18 (=8+2+8) parameters. The first set of moments aids identification of the level of $\{\rho_t, \rho_x, \gamma_t\}_{t\in\mathcal{T}}$, since if all dealership groups tend to contribute more, a higher level of $\{\rho_t, \rho_x, \gamma_t\}_{t\in\mathcal{T}}$ can be inferred. The second set of moments aids identification of $\{\rho_t, \rho_x\}_{t\in\mathcal{T}}$ as discussed in Section 4.1.1. The third set of moments aids identification of $\{\gamma_t\}_{t\in\mathcal{T}}$ as discussed in Section 4.1.2.

The equilibrium political contributions are simulated for each candidate vector $\{\tilde{\rho}_t, \tilde{\rho}_x, \tilde{\gamma}_t\}_{t\in\mathcal{T}}$ by taking the following steps:

1. Compute profitability indices of dealers using Equation (2) as:

$$\psi_{rt} = \log(s_{1rt|d=1}) - \log(s_{0rt|d=1}) + \frac{1}{s_{0rt|d=1}} - \tilde{\gamma}_t.$$

2. Compute market shares of dealers without direct sale ban using Equation (2) as:

$$s_{1rt|d=0} = \frac{\exp(\psi_{rt} - \frac{1}{s_{0rt|d=0}})}{1 + \exp(\psi_{rt} - \frac{1}{s_{0rt|d=0}})}.$$

3. Compute marginal returns to the direct sale ban probability using Equation (3) as:[7]

$$\frac{\partial \pi_{gt}}{\partial D_t} = \sum_{r\in\mathcal{R}_g} M_{rt} \left(\frac{s_{1rt|d=1}}{s_{0rt|d=1}} - \frac{s_{1rt|d=0}}{s_{0rt|d=0}} \right).$$

[7]Recall the normalization of $\frac{\tau}{\alpha} = 1$ made in Section 3.2.3.

4. Solve for political contributions satisfying Equation (4) (first-order condition) as:

$$\frac{\partial \pi_{gt}}{\partial D_t} \frac{(1 - D_t)^2}{b_{gt}} = 1,$$

where $\frac{\partial \pi_{gt}}{\partial D_t}$ is computed in the previous step, and the direct sale ban probability (D_t) is a function of $(\tilde{\rho}_t, \tilde{\rho}_x)$.

6 Results

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Appendix

A Data

A.1 Vehicle registrations

We use two datasets. First, vehicle registrations data are obtained from the Texas Department of Motor Vehicles (DMV).[8] This dataset reports the number of registered vehicles in each county and year during 2012-2023. Second, electric vehicle registrations data are obtained from the Atlas EV Hub.[9] This dataset reports registration dates and manufacturers of registered electric vehicles in each ZIP code and year during 2018-2023.[10] If the manufacturer of a registered electric vehicle is Tesla, Lucid, or Rivian, then we classify the vehicle as a non-dealer purchase ($j = 0$). We merge the two datasets to obtain county-year level observations on the share of non-dealer purchase among registered vehicles (s_{0rt}). This share is computed as (number of non-dealer purchase among registered electric vehicles)/(number of registered vehicles).

A.2 Political contributions

Political contribution data is collected from OpenSecrets' Donor Lookup.[11] We search for the names of sample dealer groups and the names of their member dealer appearing as either contributors and employers. We retain entries where either the contributor or employer is associated with a dealer group's name, key personnel within the dealer group (identified from the dealer group's website), or specific dealer names (also sourced from the dealer group's website). Since some larger dealer groups operate beyond Texas, we focus only on donations from Texas dealers or from dealers in other states that contribute to Texas politicians.

The political contribution data includes the following information: contributor name, employer, donation date, donation amount, and recipient. In some cases, the donation amount is negative. This typically indicates a refund or correction to a previous donation. Negative amounts serve to adjust financial records, ensuring accuracy and transparency in donation reporting.

A.3 County populations

County population data are obtained from the U.S. Census.[12][13] Intercensal estimates are used when needed.

[8] https://www.txdmv.gov/reports-and-data?field_publication_category_target_id=3226.

[9] https://www.atlasevhub.com/market-data/state-ev-registration-data/.

[10] These data are collected on January 1 of each year during 2019-2024. Monthly data are available from October 2023. If a ZIP code belongs to multiple counties, we randomly assigned one of those counties to the ZIP Code.

[11] https://www.opensecrets.org/donor-lookup/advanced.

[12] https://www.census.gov/data/tables/time-series/demo/popest/intercensal-2010-2020-counties.html.

[13] https://www.census.gov/data/tables/time-series/demo/popest/2020s-counties-total.html.