

Tax avoidance and environmental implications: Vehicle Registrations in Mexico

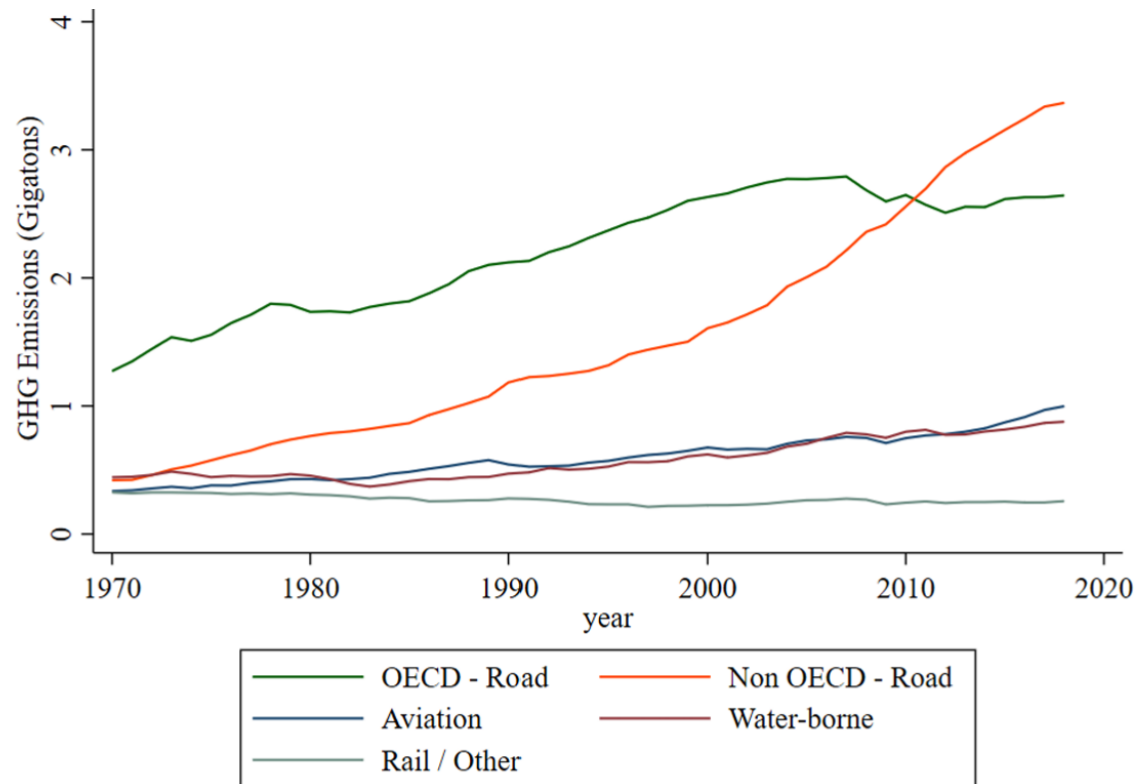
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Transportation accounts for roughly 1/5 of global CO₂ emissions, and on road emissions from the developing world are on the rise.



Source: Emissions Database for Global Atmospheric Research (European Commission (2023))

However, CO₂ emissions is only one outcome related with vehicles. Others include:

- Local pollution
- Congestion
- Fatalities

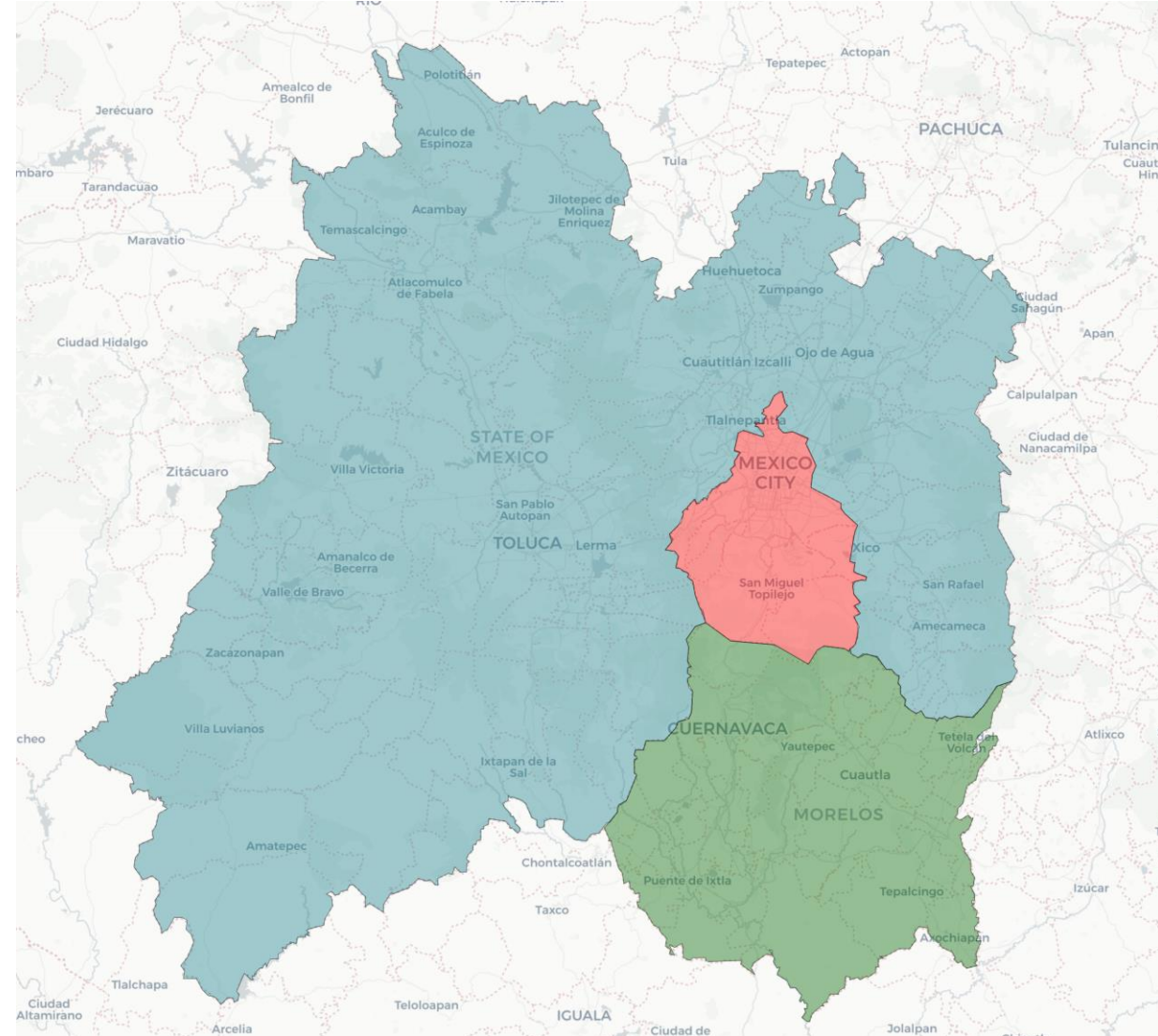
Using discrete cutoff in policies to address this issue is common

- CAFE standards on average MPG
- Cash for clunkers on vehicle age
- EV rebate on individuals' income and vehicle price

How do discrete cutoffs in tax policy and imperfect compliance shape environmental outcomes?

Context

- Decentralization of the vehicle registration fee in Mexico
- Different tax schedules adopted
 - Yearly tax a % of vehicle price
 - **Mexico City** exemption threshold \$250,000 (12,500 USD)
 - **State of Mexico** exemption threshold \$406,000 (17,000 USD)
 - Low fixed fee independent of the price.
 - **Morelos** charged roughly \$500 (25 USD)
- Easy to avoid the tax by registering elsewhere.



Those who wanted to own a car, but pay less in registration fees could buy a cheaper vehicle (price response)

Mis Finanzas

¡Bueno, bonito y barato! Estos son los autos que no pagan tenencia en CDMX

Para exentar el pago de tenencia en CDMX, los vehículos deben cumplir con las condiciones estipuladas por la Secretaría de Finanzas.



Good, pretty, and cheap! This are the cars that do not pay registration fee in Mexico City

or...

Avoid the tax (avoidance response) by registering elsewhere

EL FINANCIERO
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Estados

Así llevaron un Ferrari Monza SP2, valuado en más de 3 mdd, para ser verificado en Morelos

En Morelos, el pago del refrendo anual es de 672 pesos para autos recientes y modelos atrasados, mientras que CDMX el dueño habría pagado...



This is how they transported a Ferrari Monza valued more than 3 million dollars for its smog check in Morelos.

In Morelos, the registration fee is 672, while in Mexico City the owner would have paid...

How do discrete cutoffs in tax policy and imperfect compliance shape environmental outcomes?

Findings

- Arbitrary tax exemption thresholds increase the popularity of the cheaper cars below the cutoff.
- Cheaper vehicles improve the average fuel efficiency of the fleet but worsen tail pipe emissions.
- Avoidance mitigates distortionary effects on the vehicle fleet.
 - Vehicle owners that cheat choose the car they want since they are avoiding the tax

Contributions

- **Unintended outcomes of transportation policy in Mexico City**

- Davis, Lucas W. "The effect of driving restrictions on air quality in Mexico City." *Journal of Political Economy* 116.1 (2008): 38-81.
- Oliva, Paulina. "Environmental regulations and corruption: Automobile emissions in Mexico City." *Journal of Political Economy* 123.3 (2015): 686-724.

- **Changes in vehicles fleet composition.**

- Ito, Koichiro, and James M. Sallee. "The economics of attribute-based regulation: Theory and evidence from fuel economy standards." *Review of Economics and Statistics* 100.2 (2018): 319-336.
- Anderson, Soren T., and James M. Sallee. "Designing policies to make cars greener." *Annual Review of Resource Economics* 8.1 (2016): 157-180.

- **Tail pipe emissions regulation**

- Jacobsen, Mark R., et al. "Regulating untaxable externalities: Are vehicle air pollution standards effective and efficient?." *The Quarterly Journal of Economics* 138.3 (2023): 1907-1976.

- **Transportation in the developing world**

- Rapson, David, and Erich Muehlegger. "Global transportation decarbonization." *Journal of Economic Perspectives* 37.3 (2023): 163-188.

Road map

- Institutional setting
- Data
- Empirics
 - Choosing a control
 - Difference in difference per price bin
- Model
 - Framework
 - Calibration
 - Simulations
- Environmental outcomes

Registration fees changed across states and vehicle prices

- Registration fee is paid annually
- Before 2012 fees were:
 - Homogeneous
 - Between \$400 - \$1,000 (20-50 USD) depending on number of cylinders
- After 2012 fees were:
 - Between 3%-20% of the vehicle's price for vehicles above
 - \$250,000 in Mexico City
 - \$400,000 in State of Mexico
 - The same in Morelos as before

A new Honda CR-V with a price of \$350,000 would pay in registration fees

	2011	2012
Mexico City	\$600 (30 USD)	\$10,500 (525 USD)
Morelos	\$600 (30 USD)	\$ 400 (20 USD)

If we were looking at a new Toyota Corolla with a price of \$249,999 then it would be

	2011	2012
Mexico City	\$600 (30 USD)	\$0 (0 USD)
Morelos	\$600 (30 USD)	\$ 400 (20 USD)

Avoiding the tax by registering out of state was and still is very easy. Lots of “red tape cutter”

We help you with vehicle procedures in Mexico City, State of Mexico, and Morelos

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Requirements for registering of a foreign vehicle

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REQUISITOS PARA ALTA DE VEHÍCULO FORANEO

- FACTURA Y CARTA FACTURA (30 DIAS DE VIGENCIA) ACOMPAÑADA DE COPIA DE LA FACTURA ORIGINAL.
- IDENTIFICACION OFICIAL (INE,PASAPORTE,CARTILLA, CEDULA PROFESIONAL O LICENCIA DE CONDUCIR VIGENTE EXPEDIDA POR MORELOS)
- COMPROBANTE DE DOMICILIO
- POLIZA DE SEGURO AUTOMOTRIZ VIGENTE
- PLACAS (LAMINAS), TARJETA DE CIRCULACION O CONSTANCIA DE BAJA ACOMPAÑADA DEL RECIBO DE PAGO DE LA MISMA O ACTA DE EXTRAVIO
- 5 ULTIMAS TENENCIAS Y/O DERECHOS PAGADOS
- EN CASO DE SER PERSONA MORAL PRESENTAR:

- 1.-CEDULA FISCAL, PODER NOTARIAL, ACTA CONSTITUTIVA
- 2.-RFC,IDENTIFICACION DE REPRESENTANTE LEGAL Y COMPROBANTE DE DOMICILIO DE LA EMPRESA

INICIA EL TRÁMITE AHORA CON EL 50% DE ANTICIPO

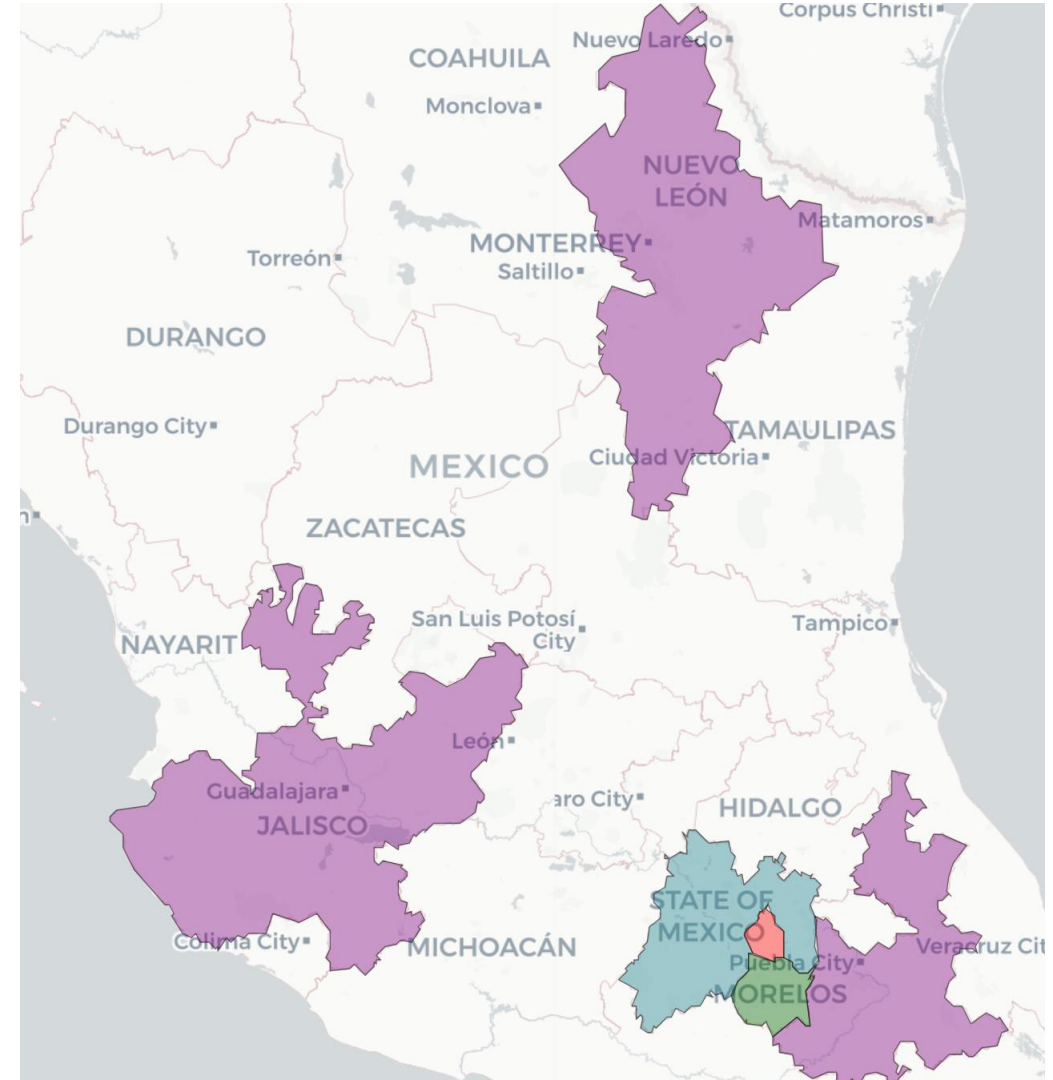
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Road map

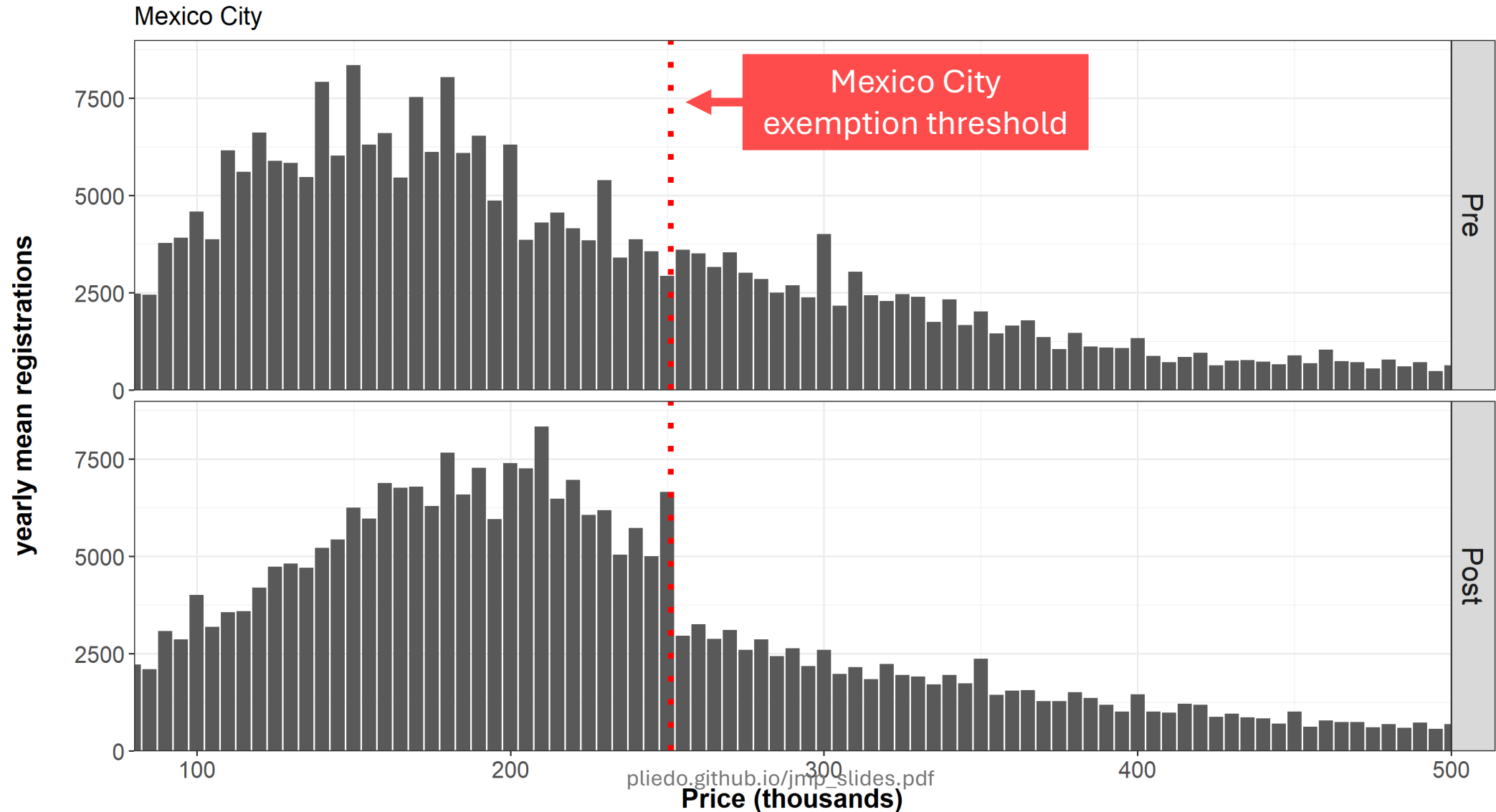
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Data requests and publicly available data

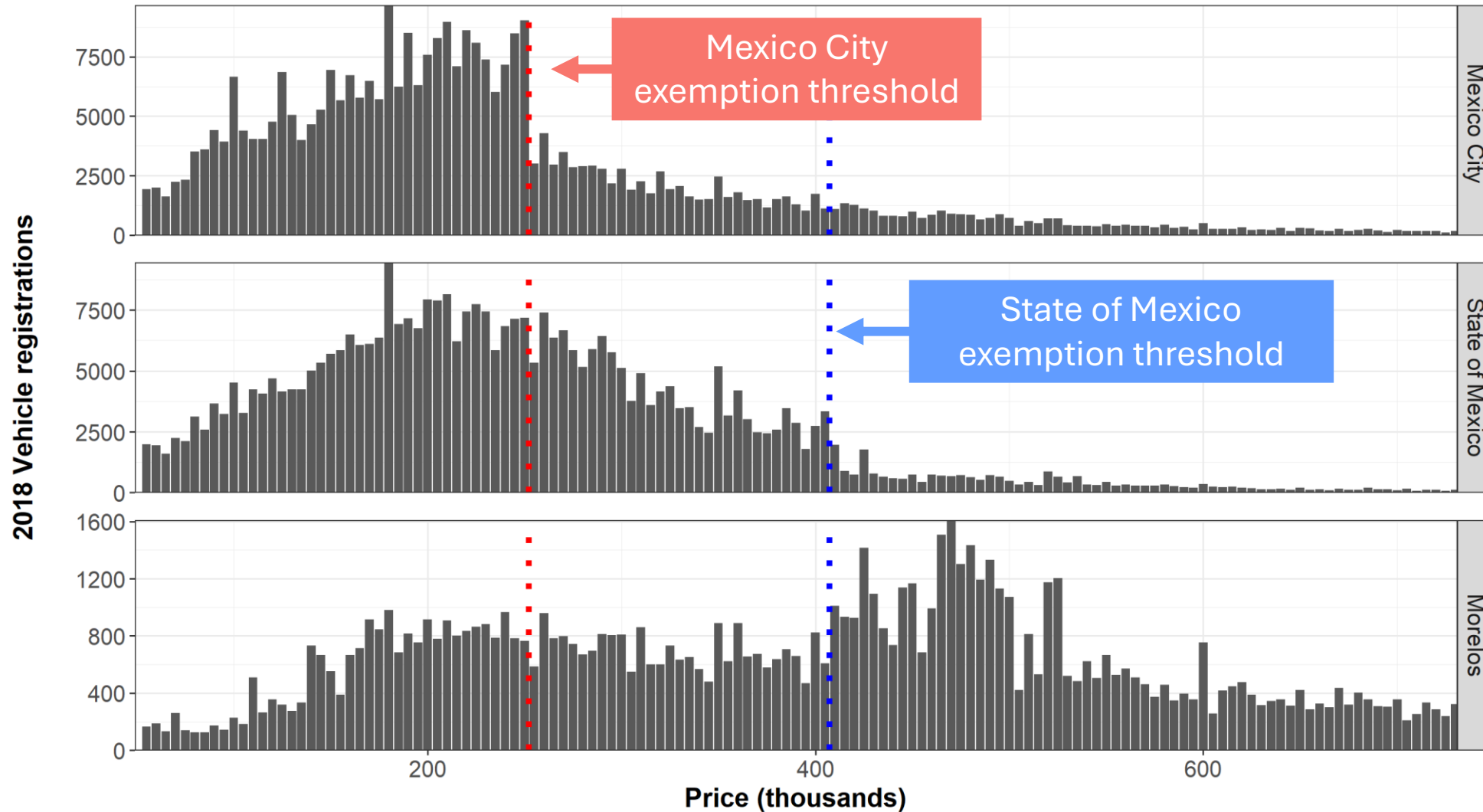
- Vehicle registry for 6 states (~50%) of country's vehicle registrations
 - Zip code
 - Price
 - Date of registration
 - Make and model
 - Plate number
- Smog check data for Mexico City
- Census 2010 and 2020
- Reported vehicle's fuel efficiency



Missing registrations above the threshold and some bunching right below the threshold.



Some vehicles avoided the tax by registering in other states, but also cutoff vehicles became more popular.



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Estimate the response in vehicle registrations of the policy by estimating a DiD per price bin i .

$$y_{z,t,i} = \beta_i(post_t * treat_z) + \gamma_m + \epsilon_{z,t,i}$$

- $y_{z,t,i}$ number of registrations in state z , month-year t , of vehicles in price bin i .
- $post$ dummy with value of one for years after 2011 and 0 otherwise.
- $treat$ dummy with value of one for Mexico City and 0 for the control zip codes.
- γ_m monthly fixed effects.

However, there is no state in the country as Mexico City.

- Mostly urban
- Higher levels of education
- Higher population density per zip code

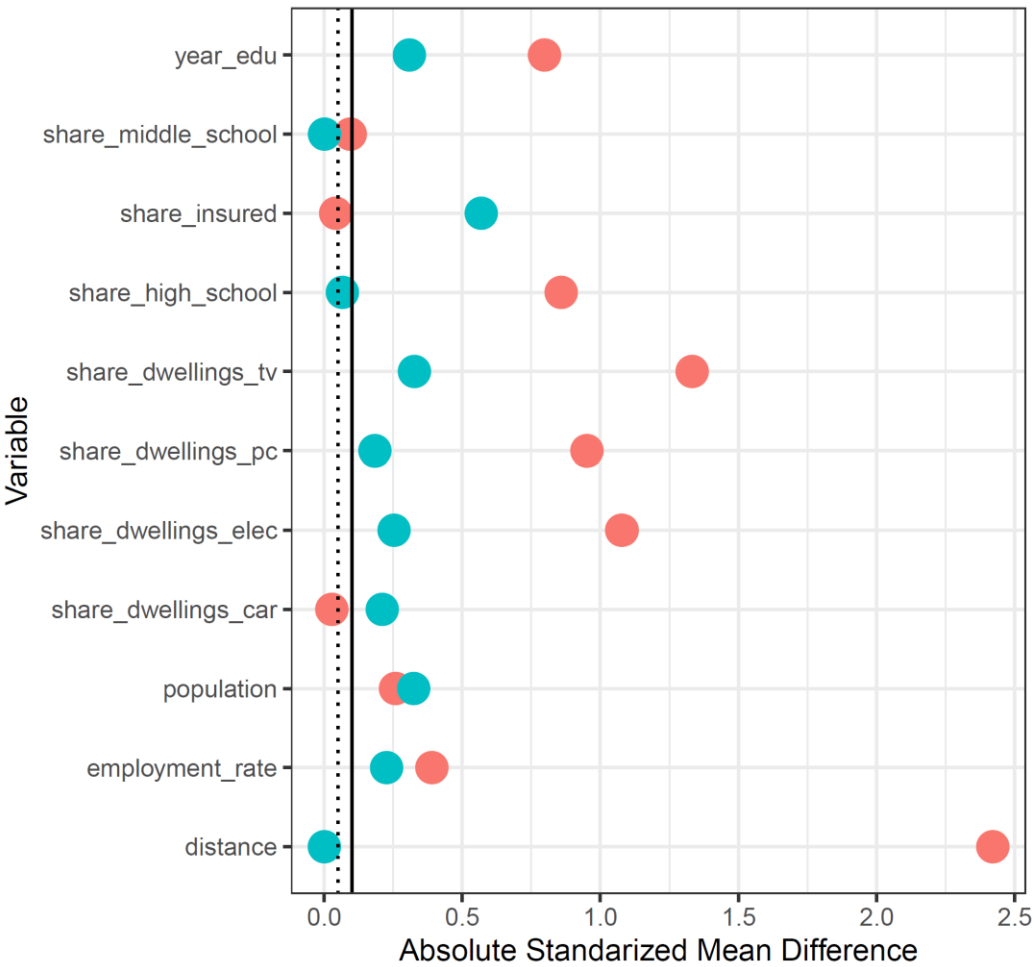
Solution: Build a synthetic Mexico City matching zip codes in Mexico City to zip code in the other states on census data.

We match on nearest neighbor with replacement and selected matched groups are robust to:

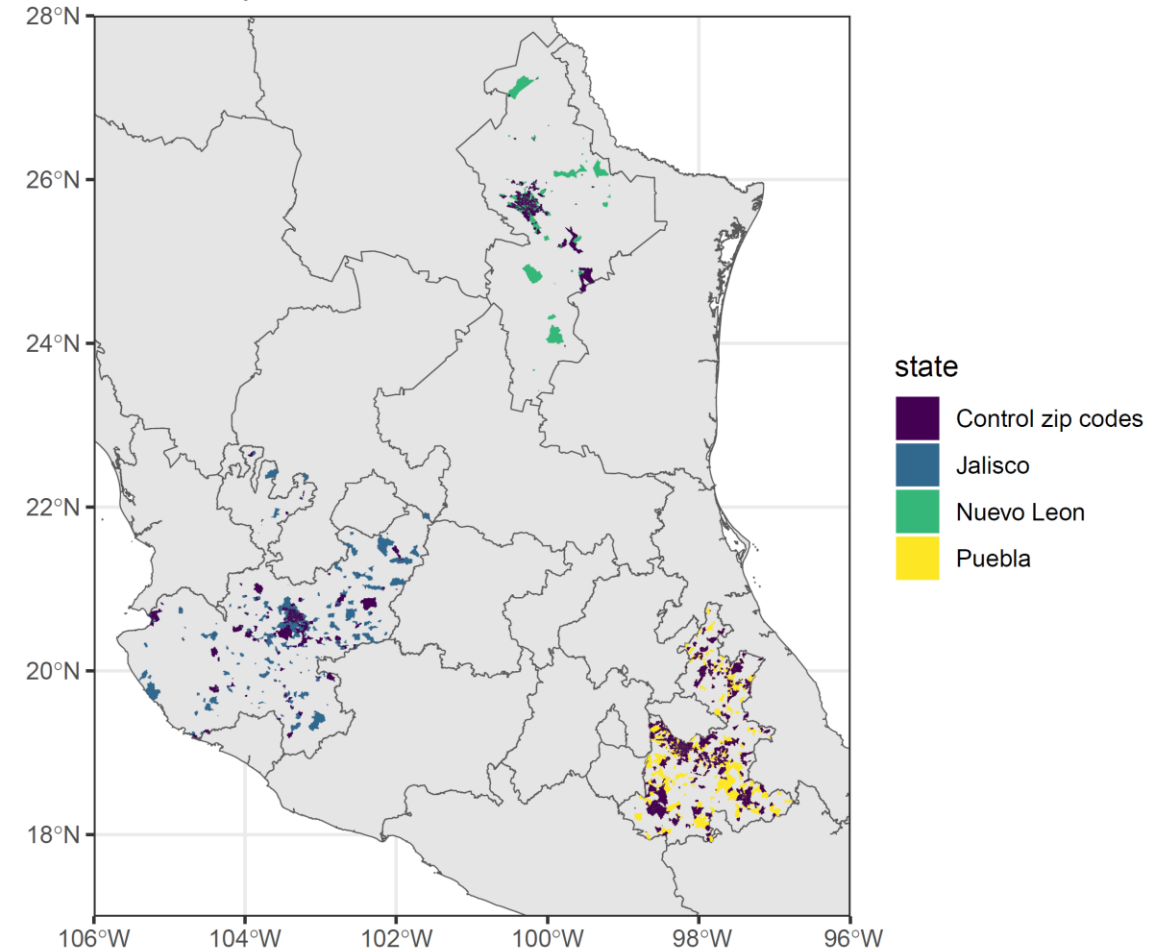
- Number of neighbors
- Variables from the census
- States used

Control zip codes for Mexico City are mostly found around the country's biggest cities

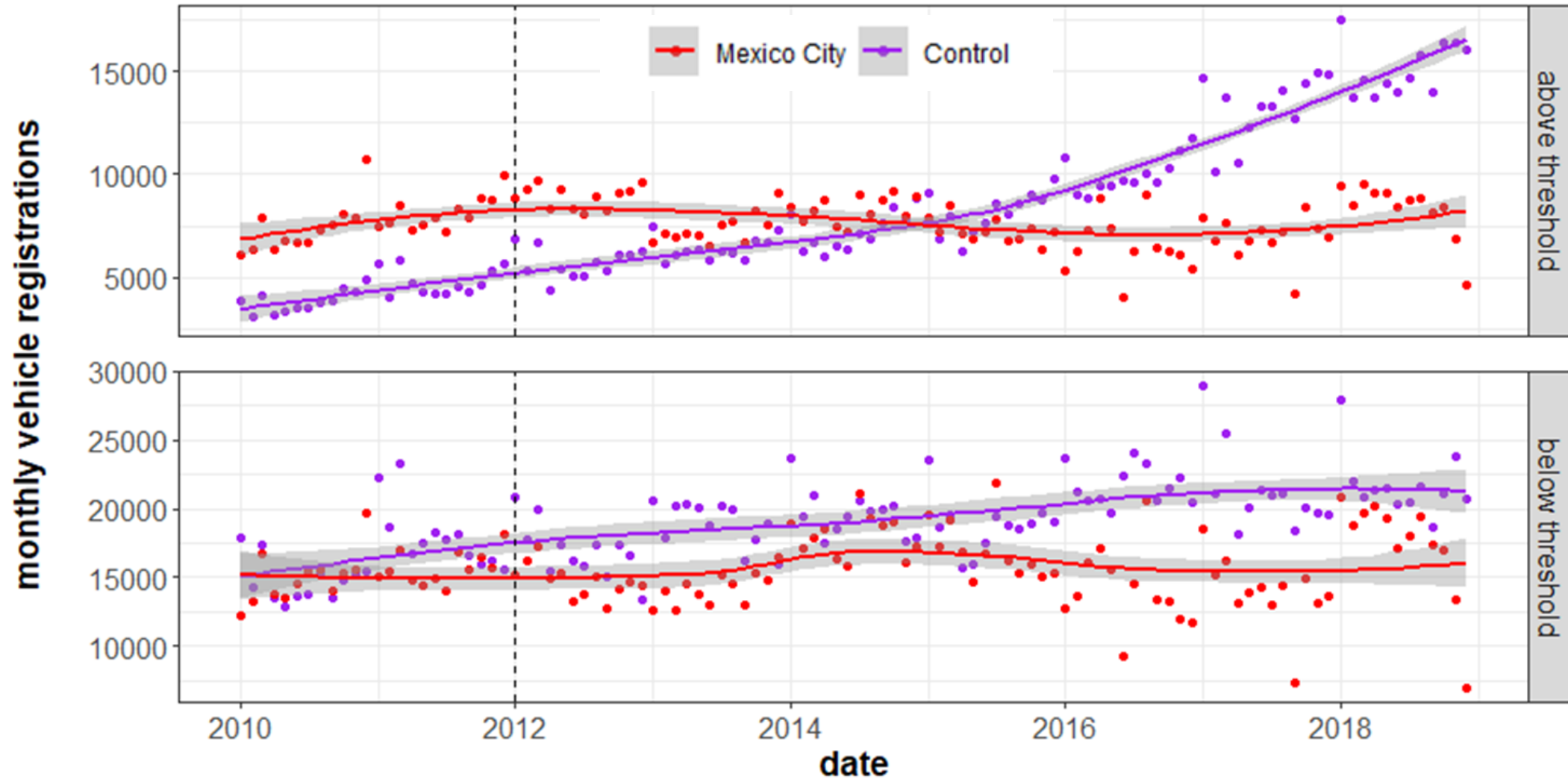
Summary of matching outcome for Mexico City



Control zip codes out of the available

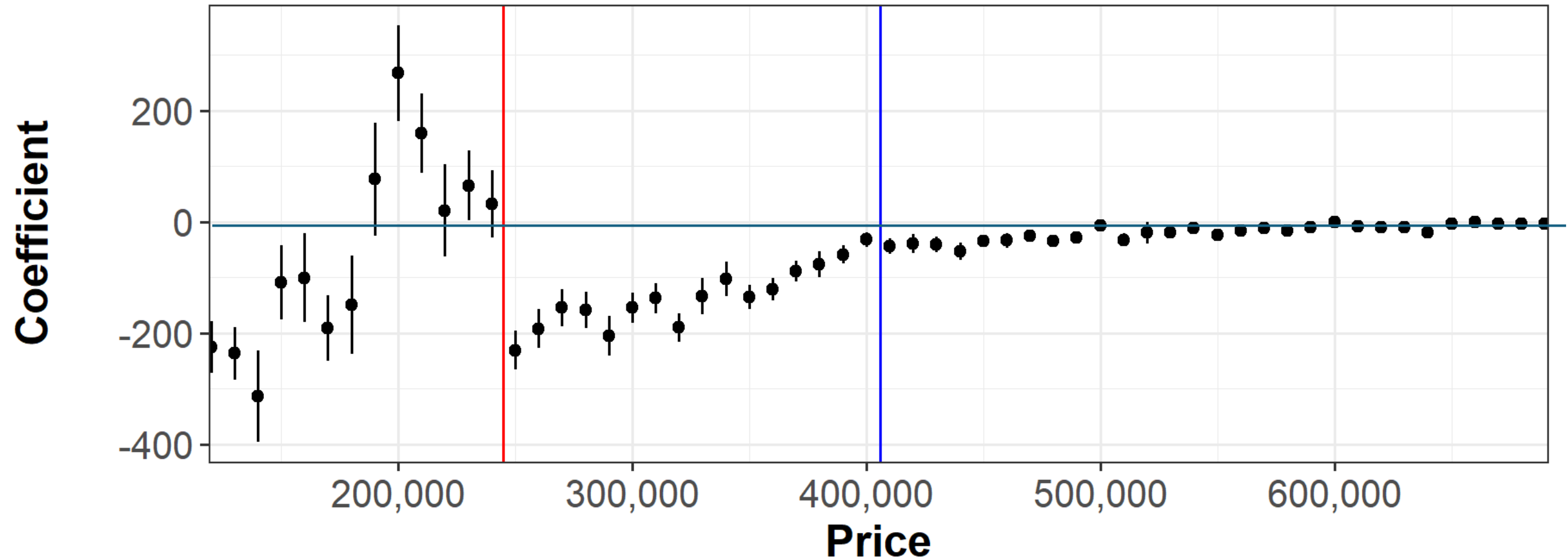


When we do two price bins, we observe parallel trends pre policy.



If instead of two price bins I do over a 100 to get the heterogeneous response.

Results for Mexico City



Results:

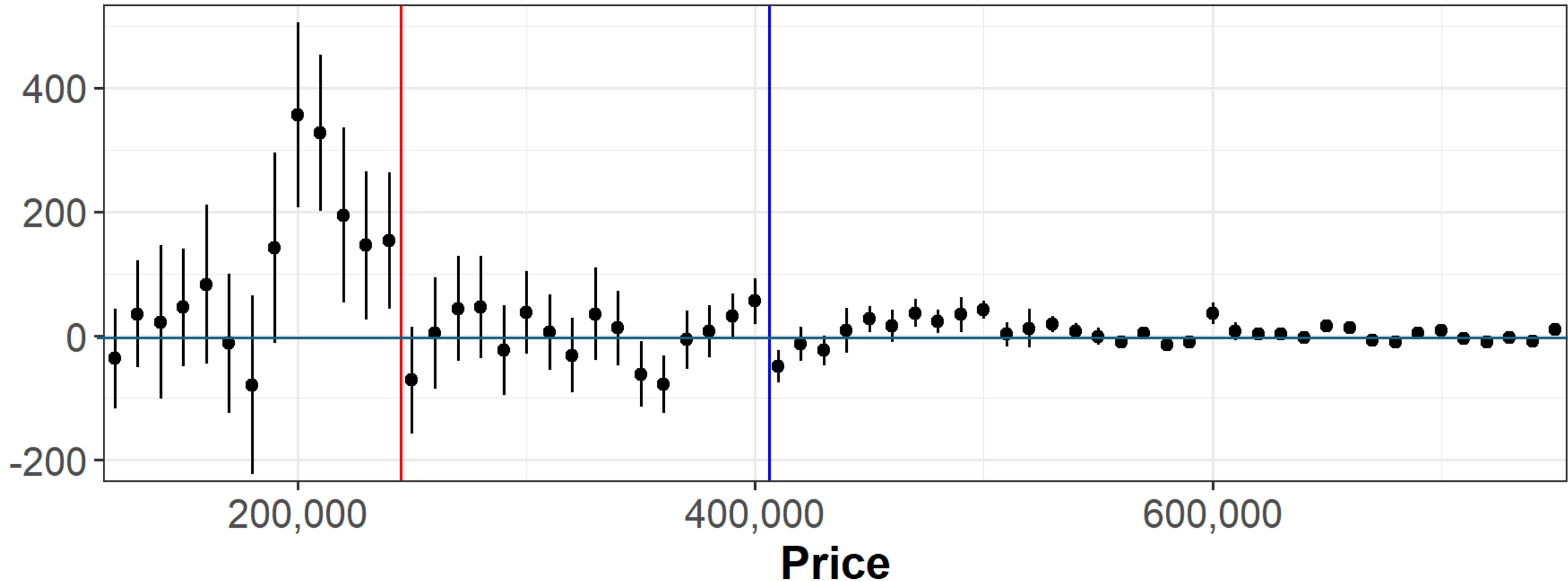
\$484 M forgone in tax revenue (10% of reported collection for that tax) from the negative coefficients after the exemption threshold. (avoidance)

Increase in the number of registrations for the vehicles right below the threshold. (price)

To study the changes in the composition of the fleet , I add the coefficients for the 3 states

Mexico City + State of Mexico + Morelos effects

Sum of coefficients



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However, the estimates do not separate avoidance and price, I need a model to:

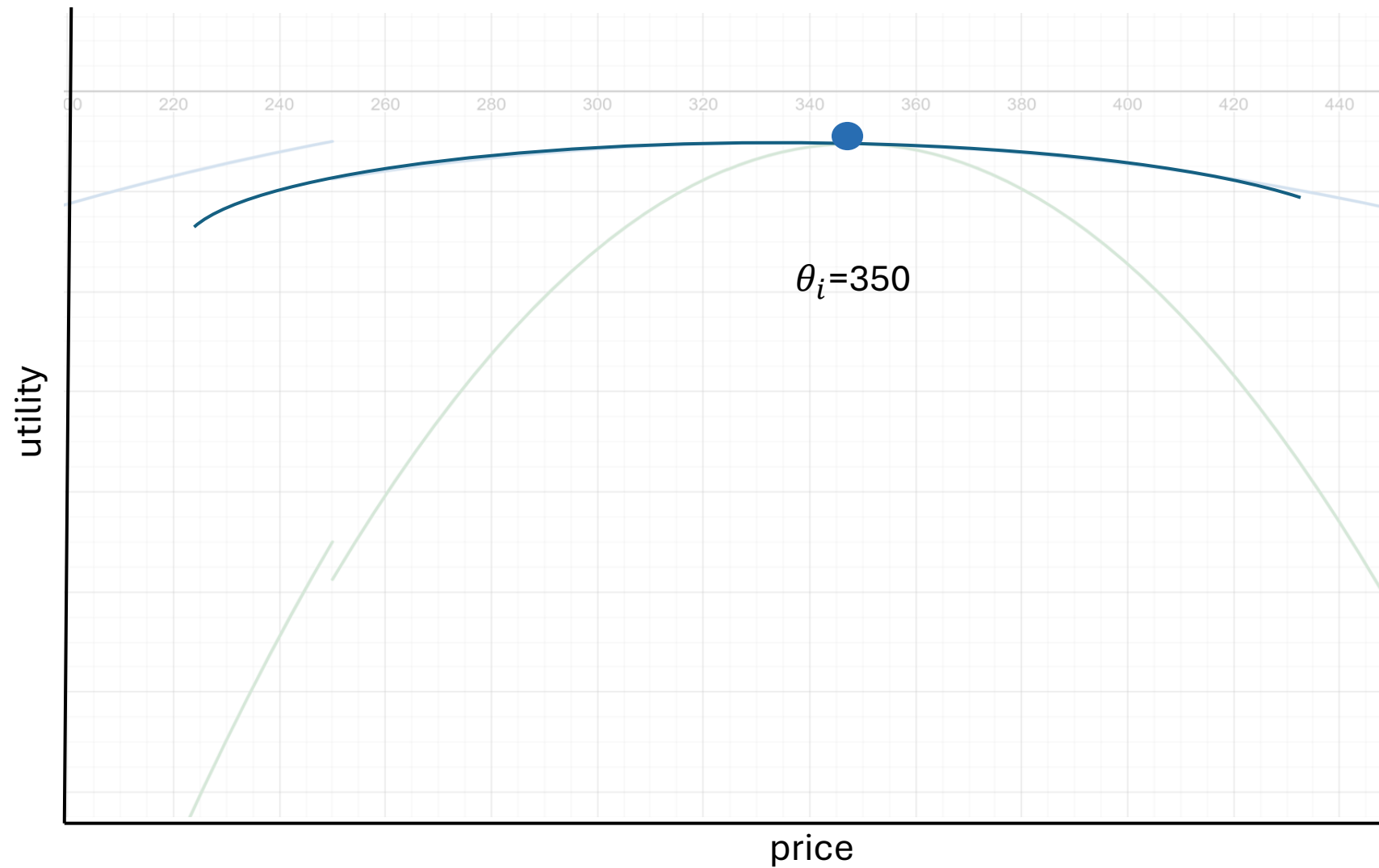
- Isolate Mexico City fleet composition effect from the 3 states
- Run counterfactual scenarios:
 - Cheating was not so easy
 - Changing the tax schedule

Individuals decide which car to purchase and whether or not to cheat:

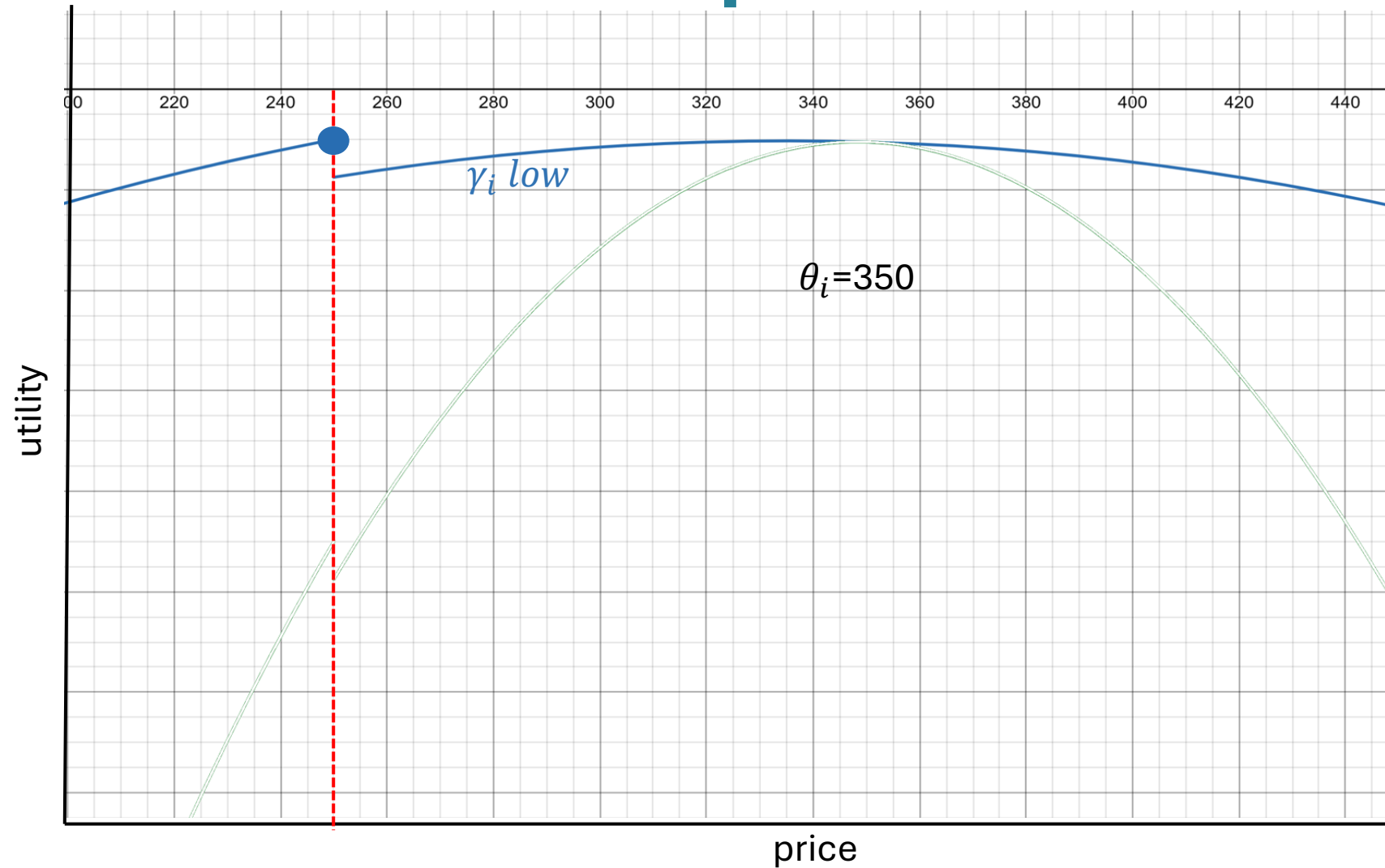
$$\max_P \{-\gamma_i(\theta_i - P)^2 - \tau P, -C_i\}$$

- γ_i disutility to choose another car
- θ_i ideal car price
- τ tax rate based on price P
- C_i cheating cost

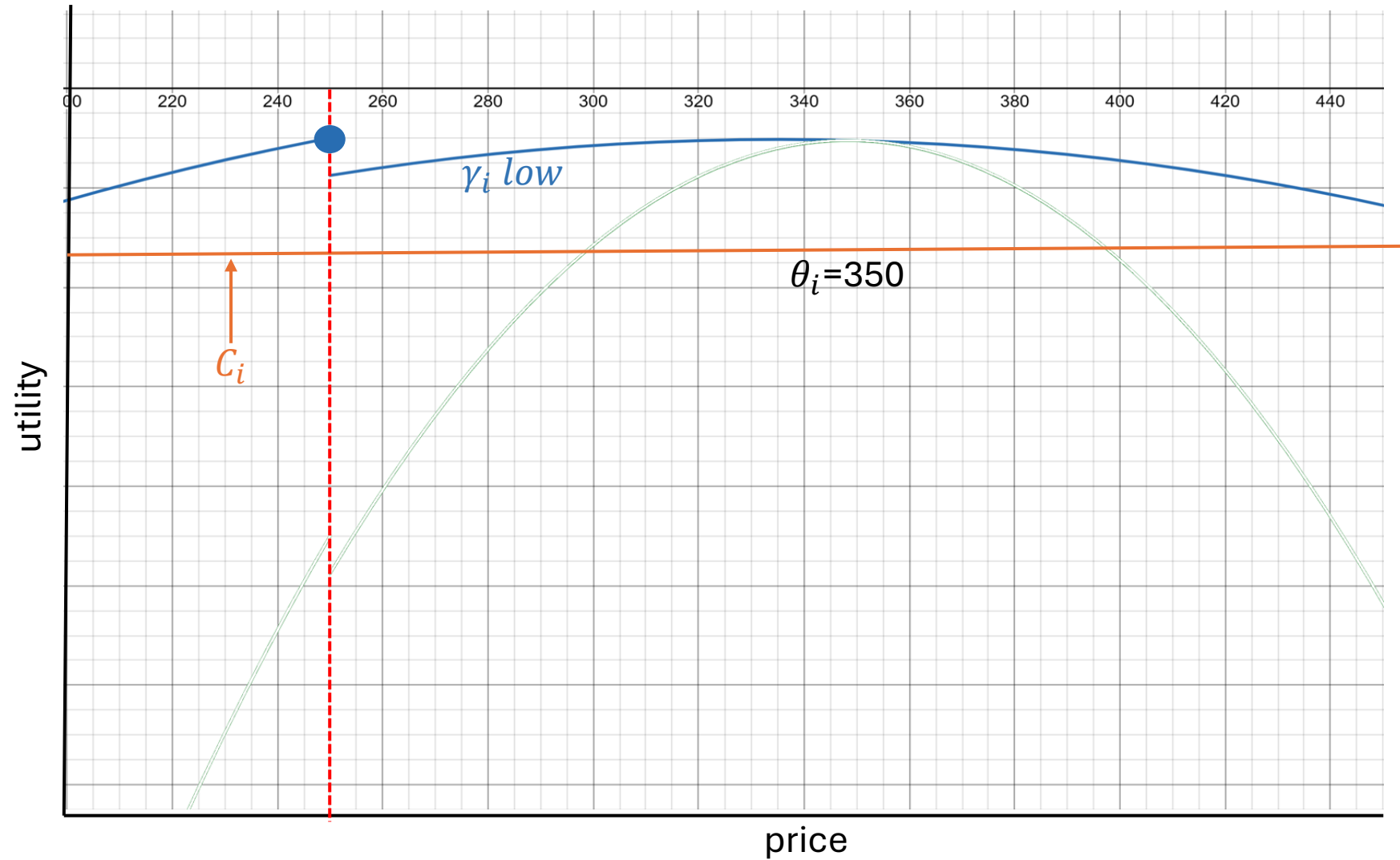
Individual i absent any taxes chooses θ_i



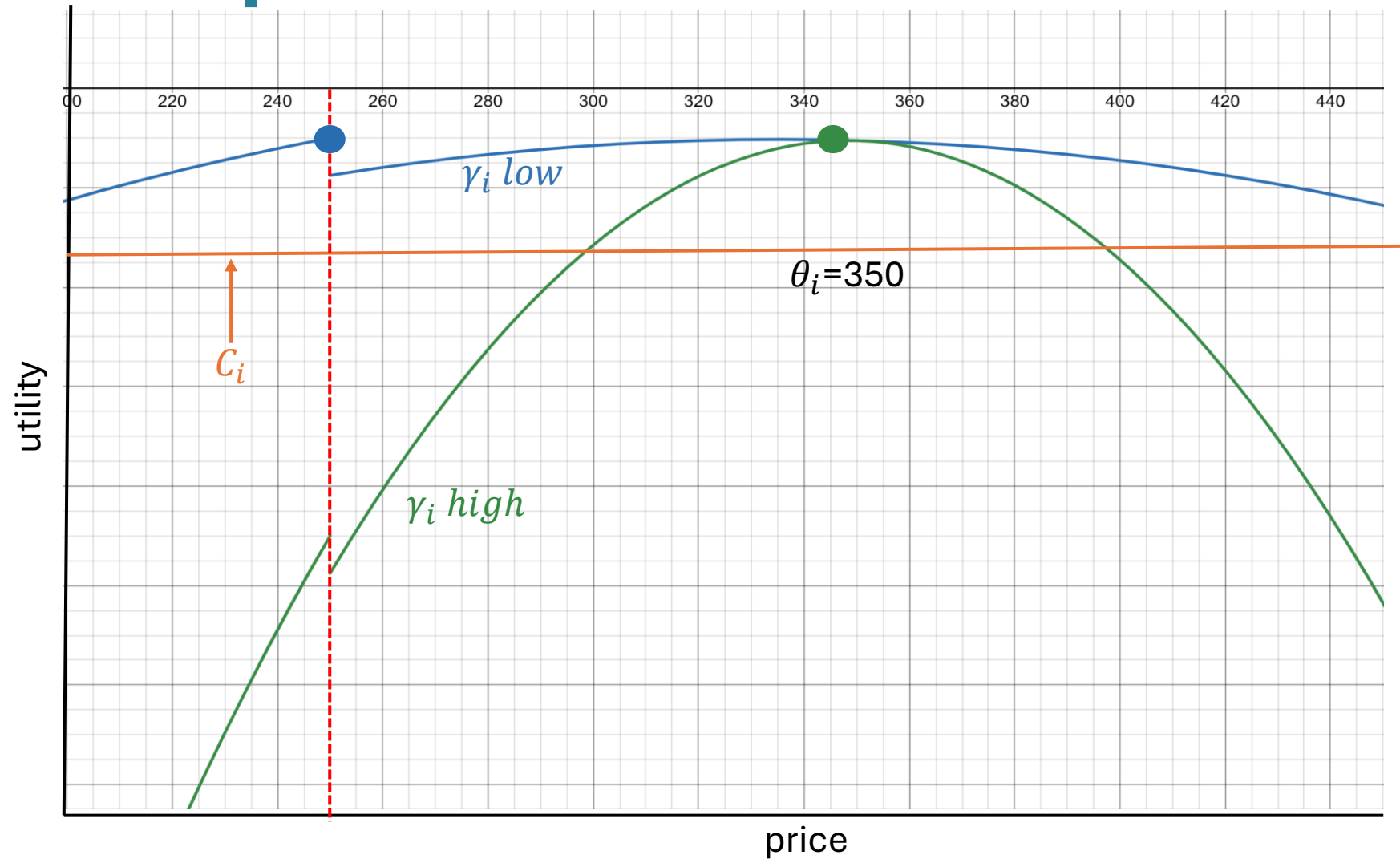
With the tax schedule with exemption threshold individual chooses a cheaper car



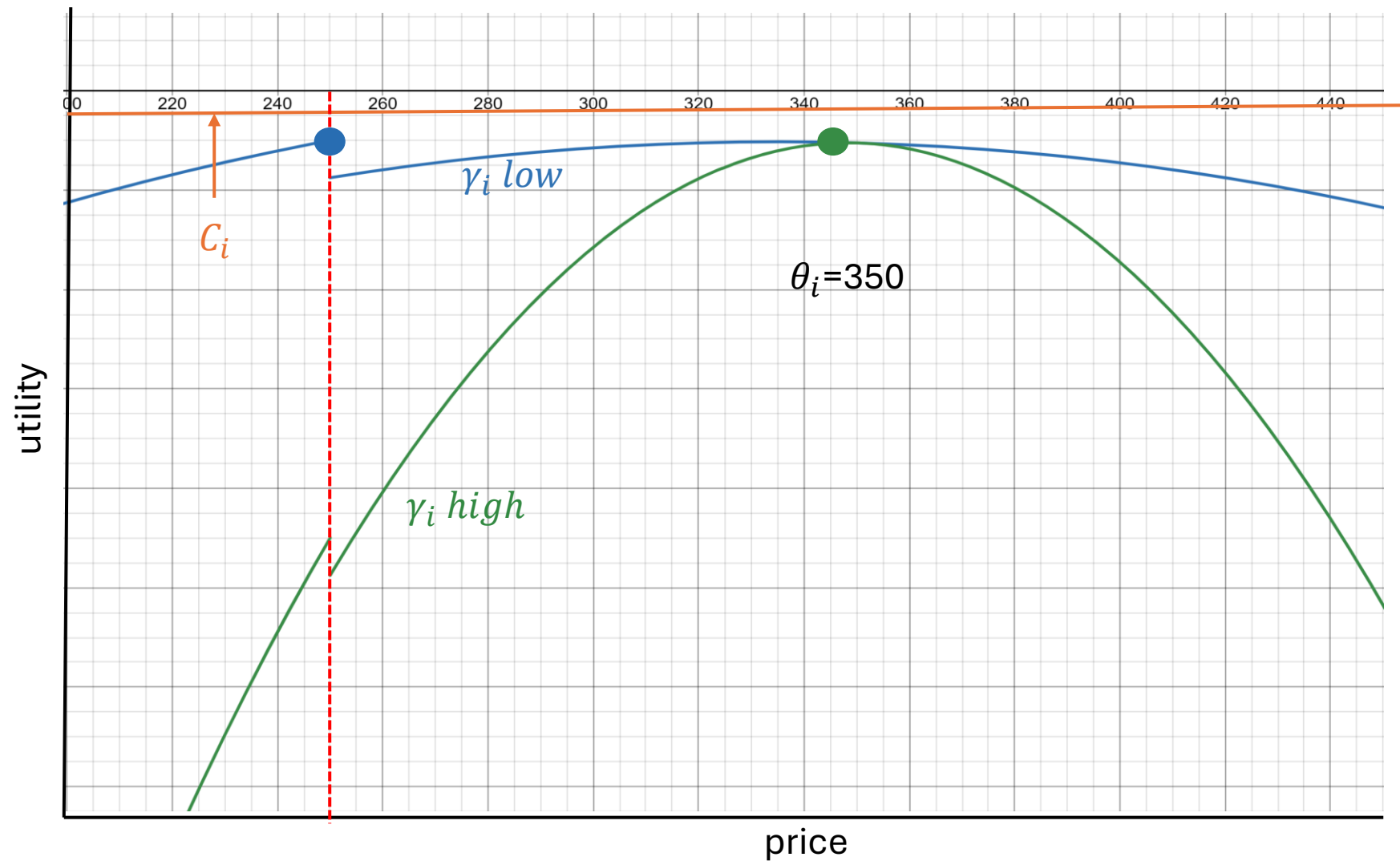
This individual faces a high cheating cost, so they don't cheat



If this individual had greater value of γ they would not get the cheaper car



If cheating cost was lower, they would register elsewhere

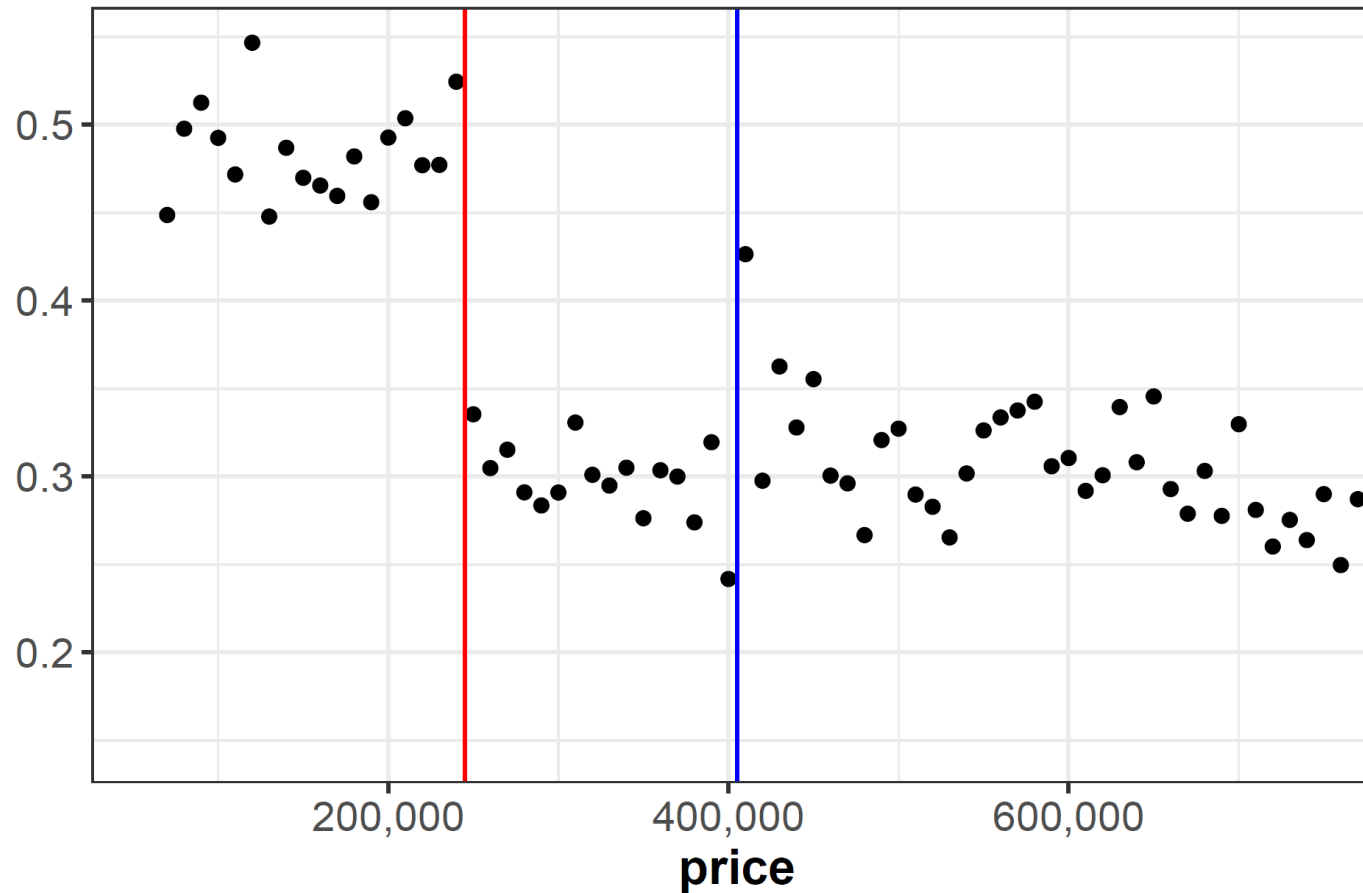


Model calibration

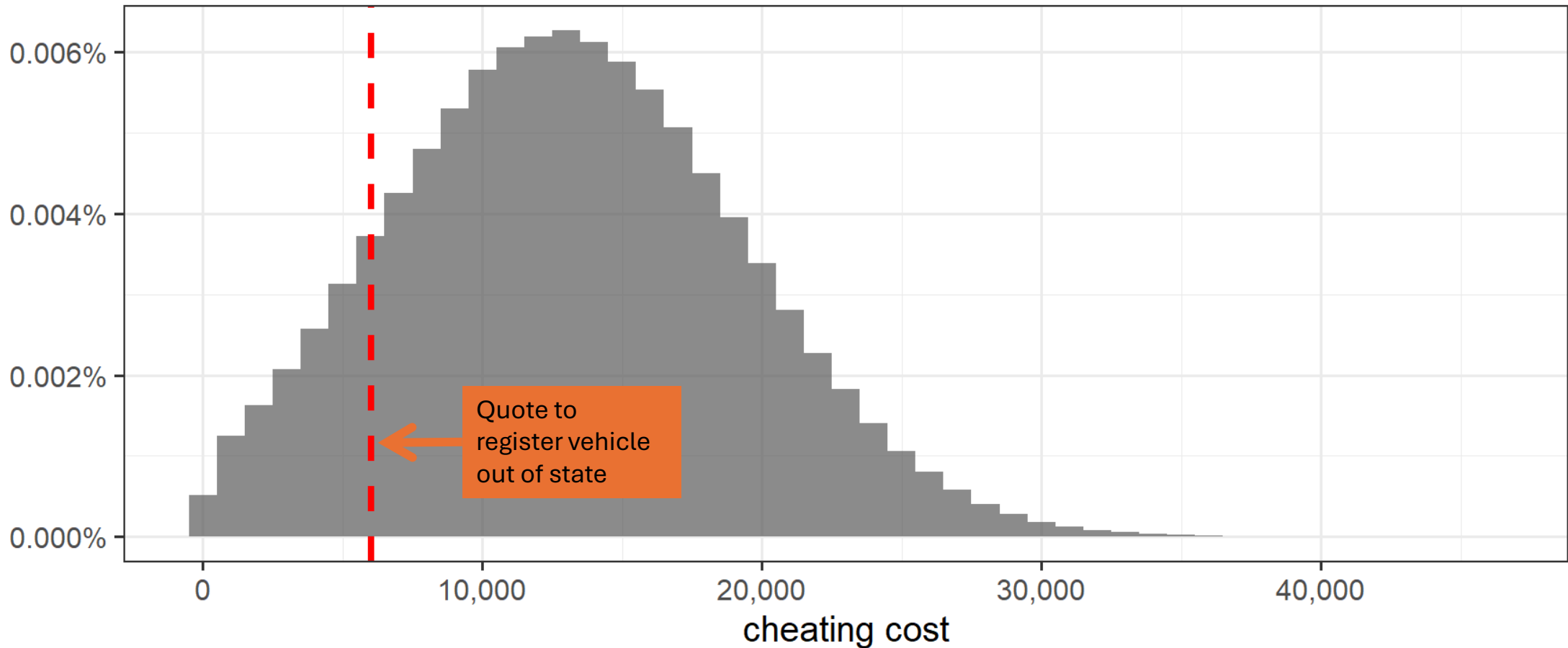
- θ_i ideal car price comes from fitting the pre policy distribution and adjusting for inflation
- γ_i from solving FOC $\gamma_i = \frac{\tau}{2(\theta_i - P)}$ using draws from θ_i and price of registrations in Mexico City post policy

Model calibration

C_i is estimated by fitting a truncated normal and identified by the discontinuity in the share of registrations from Mexico City for the 3 states across price bins

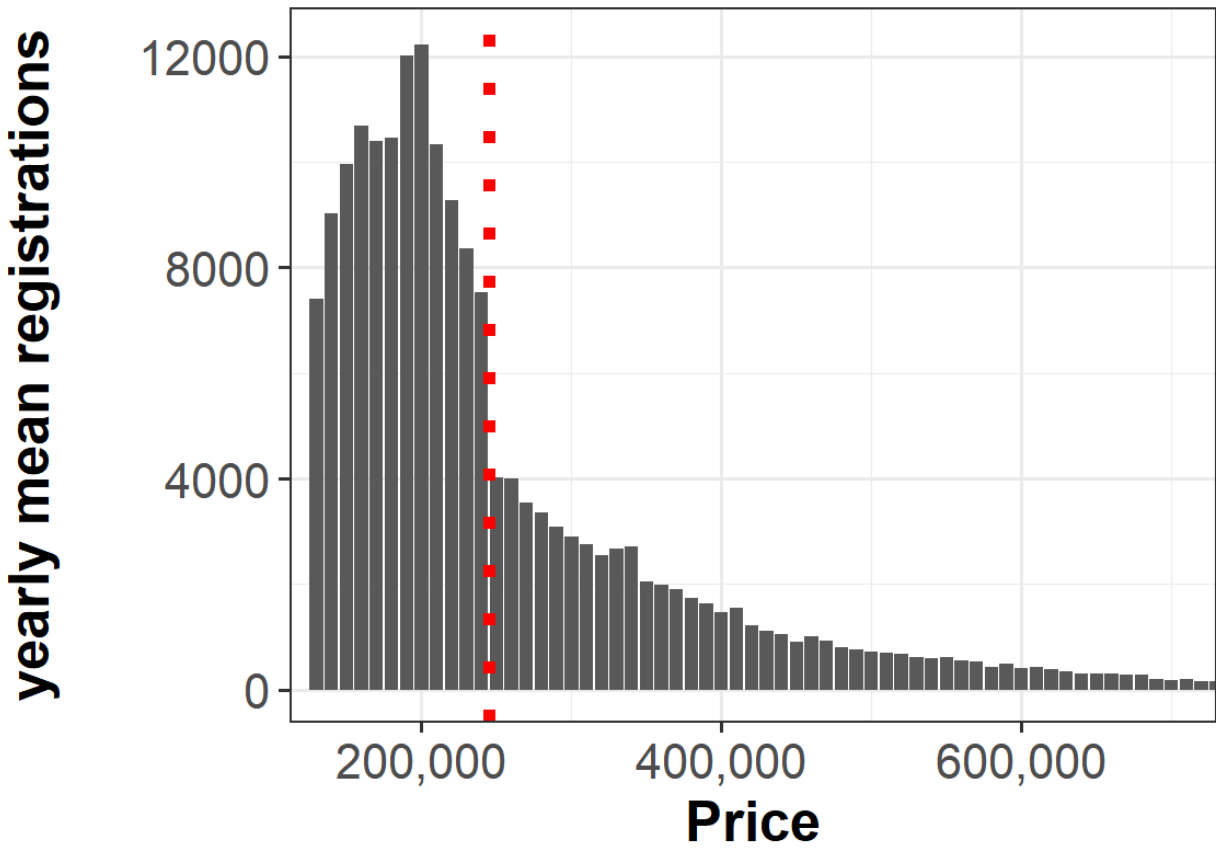


Cheating cost is ballpark with mystery shopping and new reports for the cost to hire a service to register your vehicle out of state

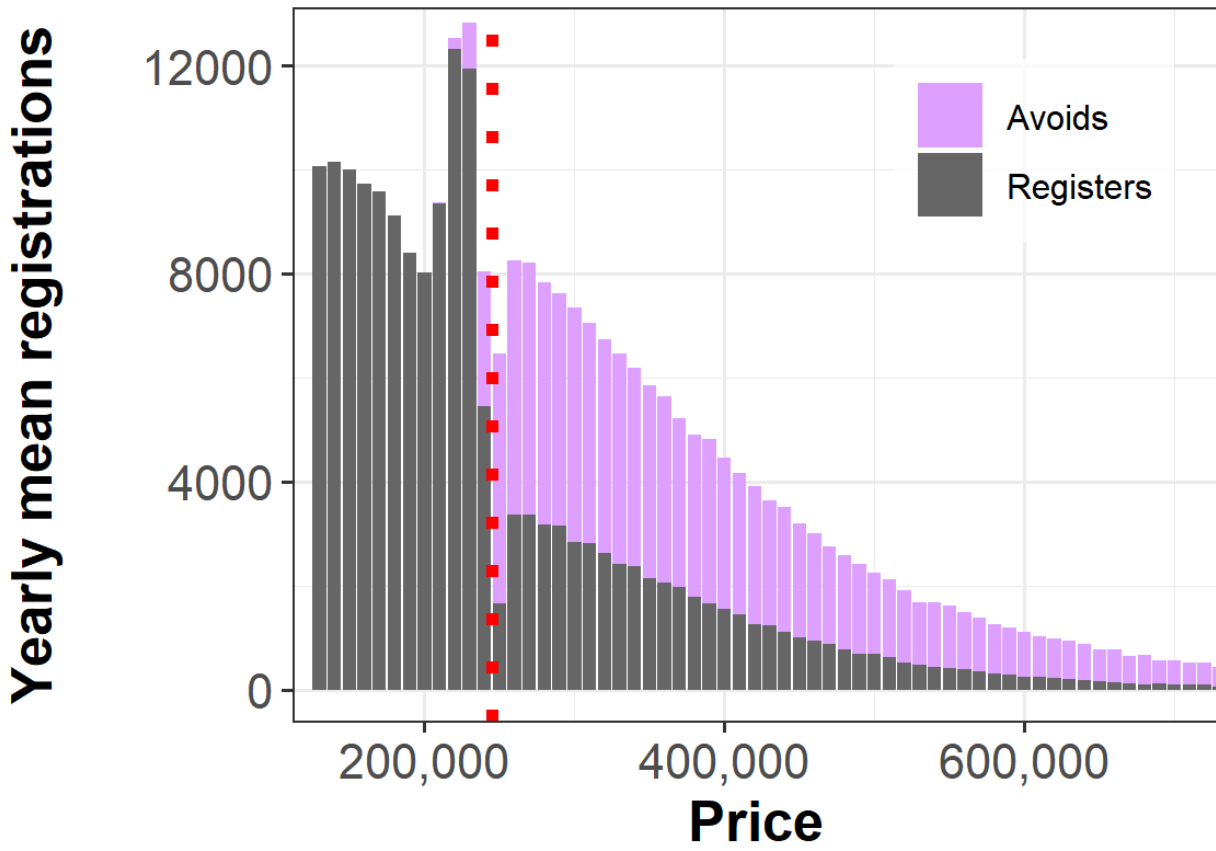


Draw from the model against observed registrations in Mexico City post policy

Observed post policy



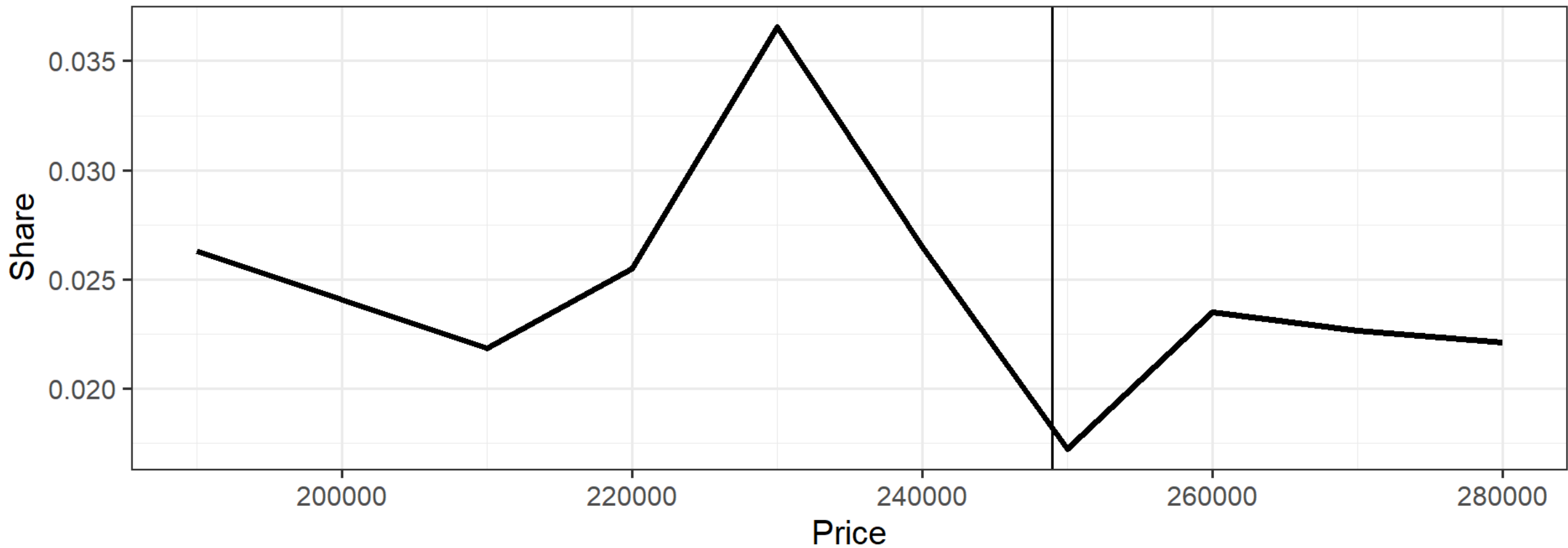
Modeled post policy



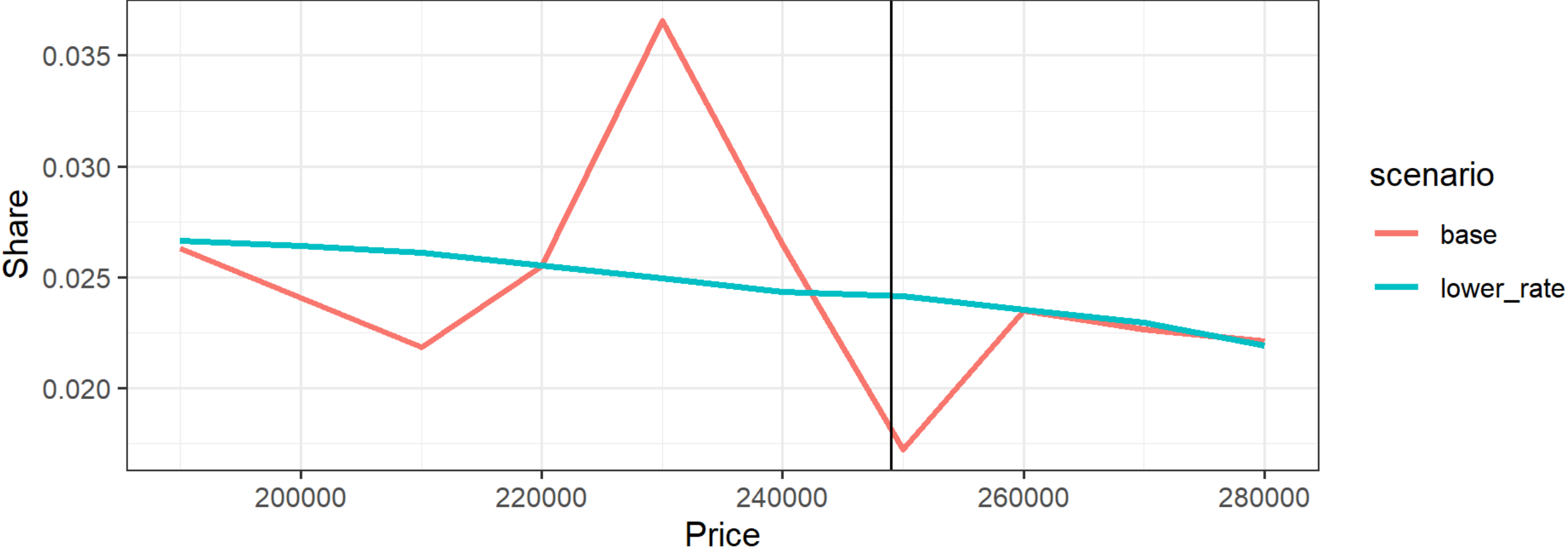
Model allow us to try different counterfactual policies

- Making cheating more costly.
 - Scale the distribution for cheating cost.
- Make tax schedule homogeneous across states to avoid the leakage
 - Modify τ and set it equal to the values for Morelos

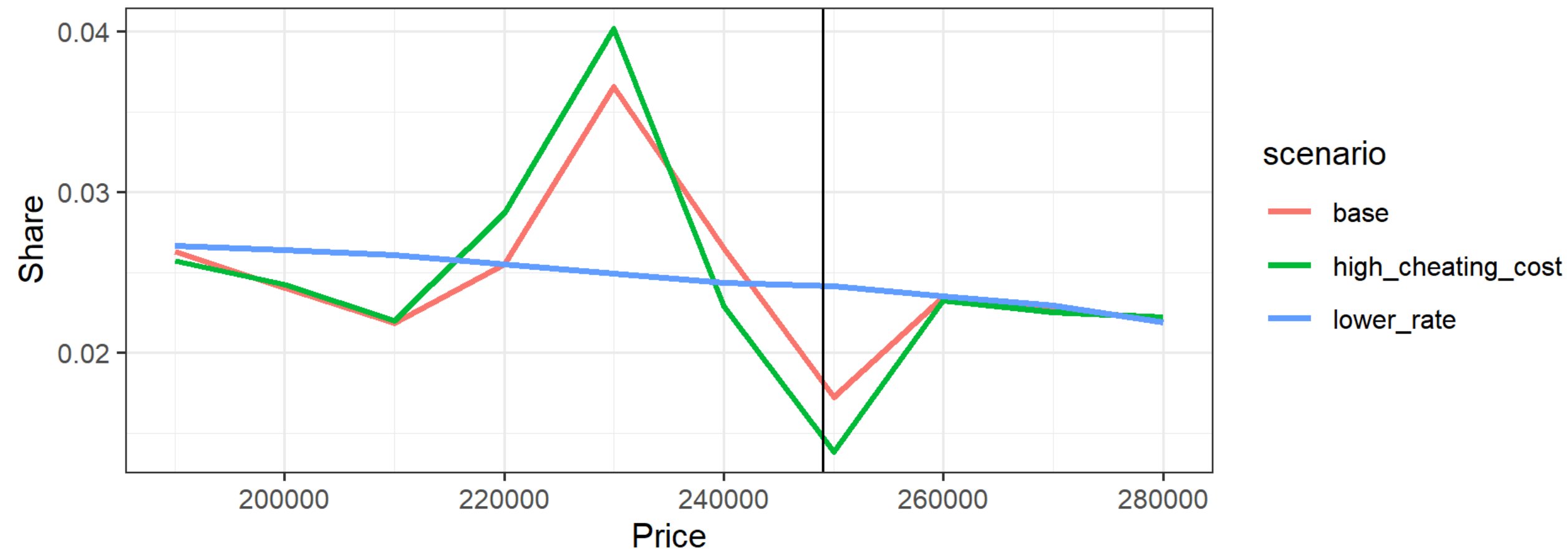
Current Scenario



Current and Lower Rate Scenarios



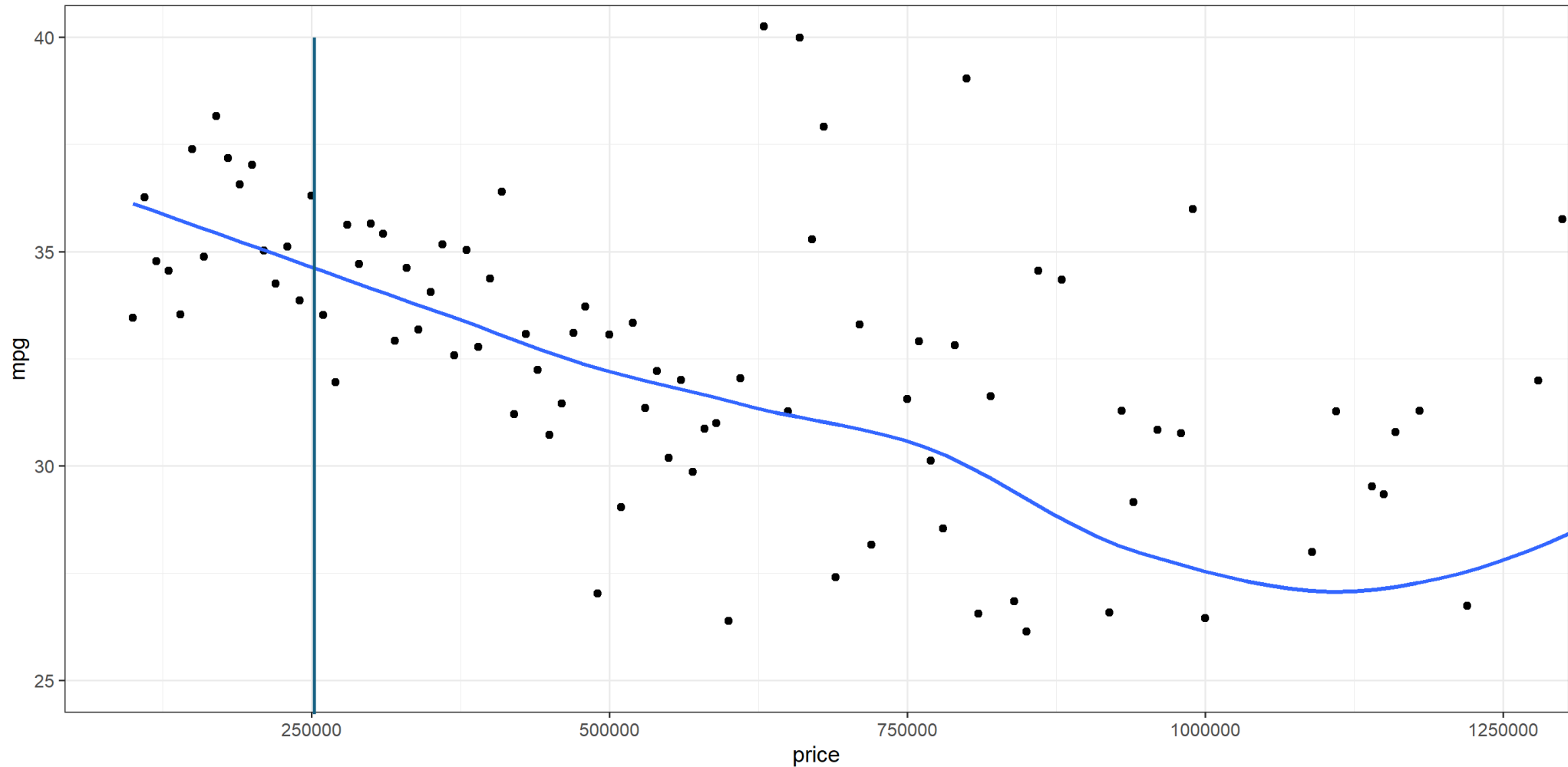
All Scenarios



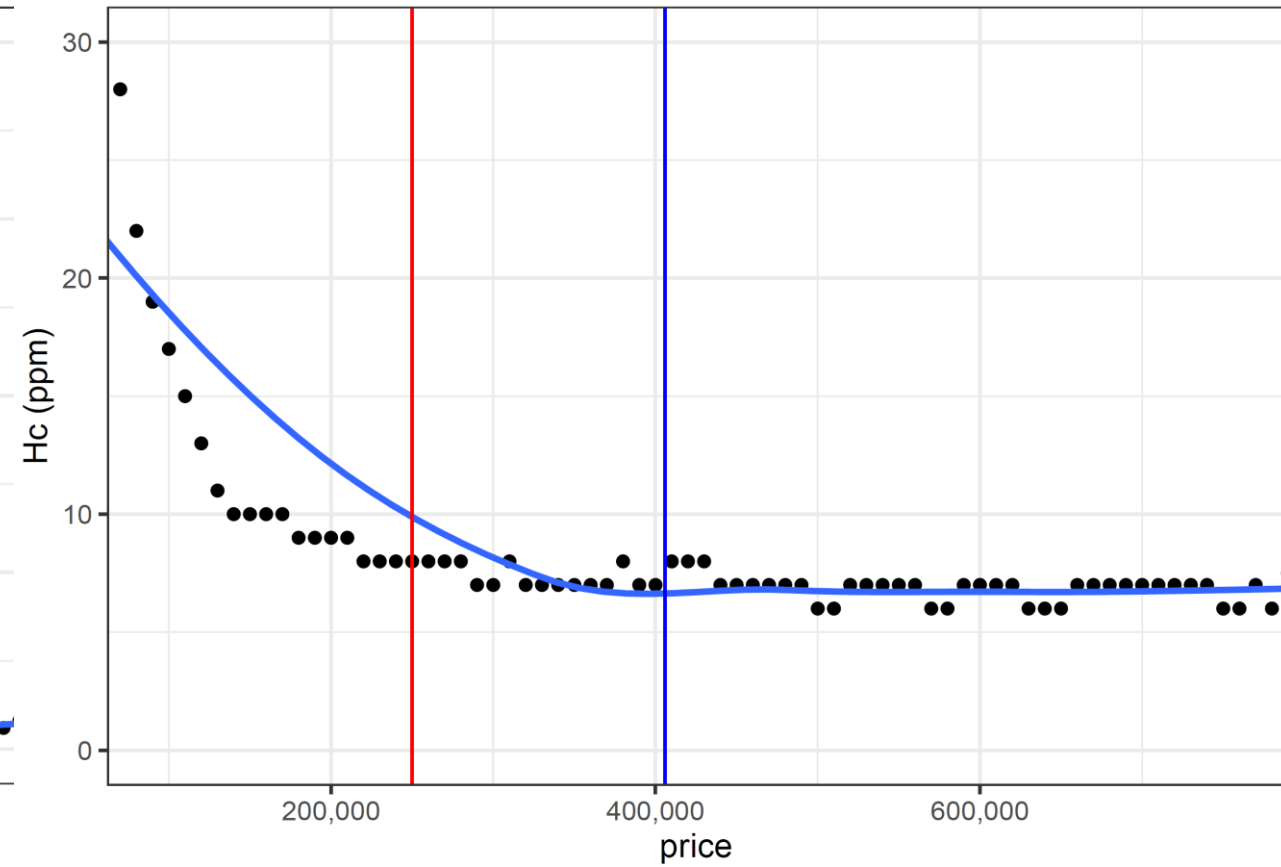
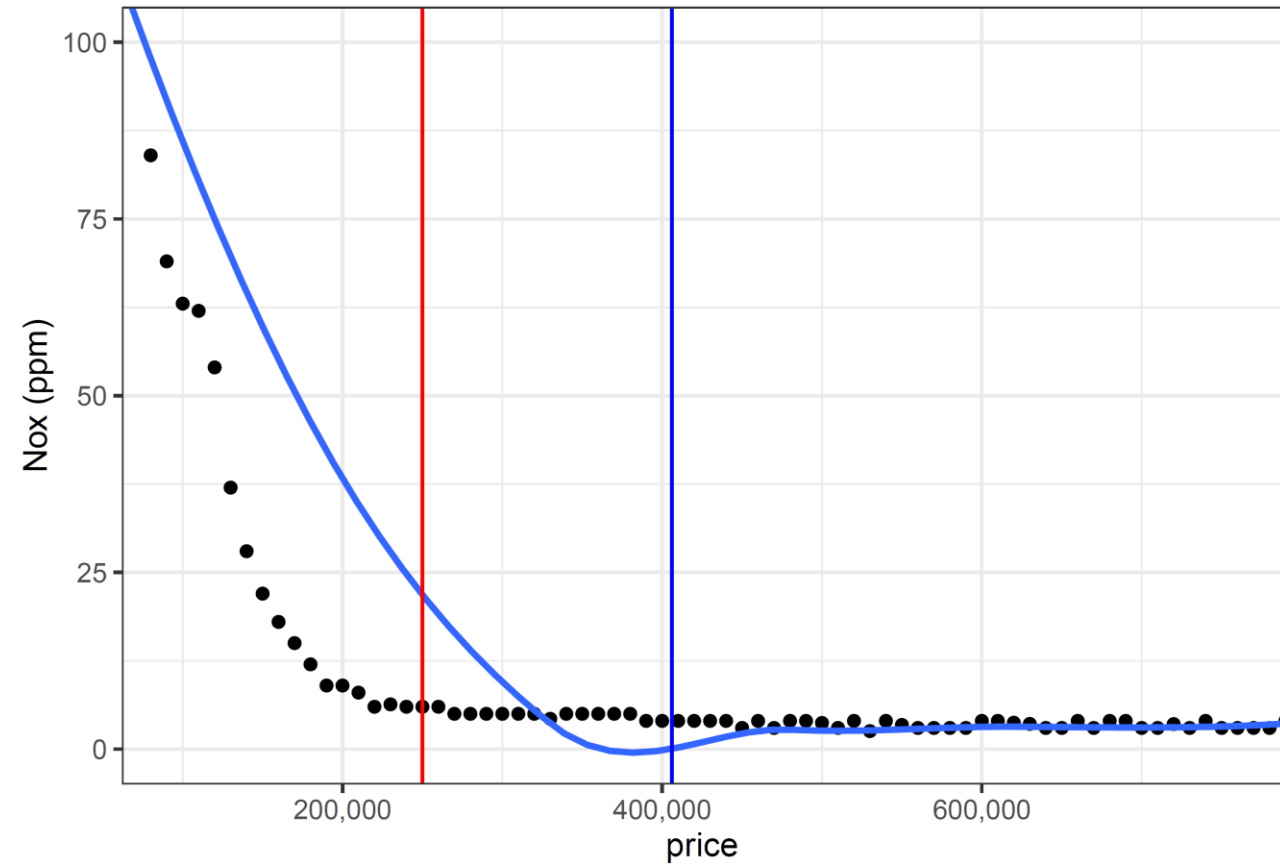
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Cheaper cars have better fuel efficiency



Cheaper cars have worse tailpipe emissions



Findings and conclusion

- Environmental effects are modest when compared to the revenue effect.
- Environmental effect depends on where the cutoff is placed.
- In any case, evasion mitigates the distortionary effects of cutoff policies.

Results between \$190,000 - 270,000			
	Below cutoff	Above cutoff	Weighted average
Fuel efficiency (mpg)			
Current outcome	36.54	33.67	35.73
Increase cheating cost	36.52	33.60	35.74
No exemption and reduce rate	36.09	33.78	35.36
NOX (ppm)			
Current outcome	7.29	5.64	6.82
Increase cheating cost	7.27	5.62	6.83
No exemption and reduce rate	7.43	5.68	6.88
HC (ppm)			
Current outcome	8.45	8.00	8.32
Increase cheating cost	8.44	8.00	8.32
No exemption and reduce rate	8.51	8.00	8.35

Findings and conclusion

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