

# Tax incidence in the fuel market: evidence from station-level data

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# Little empirical work on fuel tax incidence

- Most European countries tax road traffic fuels heavily
  - Fiscal and environmental reasons
- Little empirical work has addressed the extent to fuel taxes are passed to consumer prices
  - Poterba (1996), Doyle and Samphantharak (2008), Marion and Muehlegger (2011)
  - Focused solely on using US data
- An increasingly active literature on consumption tax incidence
  - Carbonnier 2007, Kosonen 2015, Benzarti and Carloni 2015, and Rozema 2015
- This paper examines the pass-through of fuel taxes to retail prices in Finland following a substantial tax reform in 2011. Uses a detailed data set of prices at the gas-station level.

# Tax incidence and firms' pricing behavior are central in economic theory

- The literature analyses tax incidence and firms' pricing behavior mostly with a rather simplistic view of firm behavior
  - Elasticities of supply and demand and form of imperfect competition (e.g. Weyl and Fabinger 2013)

$$\frac{dp}{dt} = \frac{\epsilon_D}{\epsilon_S - \epsilon_D}$$

- Empirically a standard way to measure tax incidence is to compare consumer price changes before and after the tax changes to the full tax change
  - Pass-through is

$$\Delta = \frac{p^a - p^b}{p^b} * \frac{100}{FP}$$

- FP is a mechanical full pass-through on prices

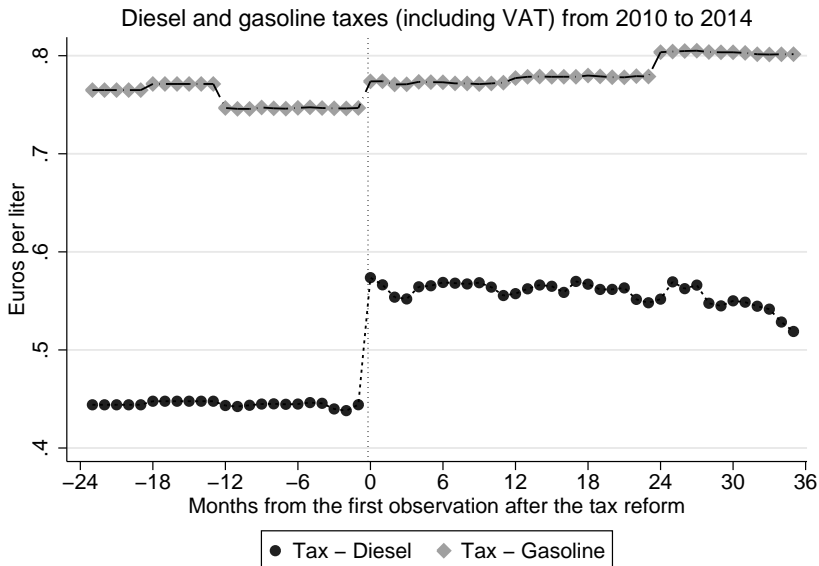
# Previous literature

- The *incidence of taxes on consumers* is estimated to be
  - 75-100% for tax increases in Chouinard and Perloff (2004, 2007), Alm et al. (2009), Doyle and Samphantharak (2008)
  - 100% or even higher in Marion and Muehlegger (2011), below 100% when supply chain constrained
- Huge literature estimating the *price elasticity of demand*
  - Started on 1970s: Finds relatively large responses (-0.25 – -0.75)
  - Hughes et al. (2008) reviews: Inelastic demand (-0.03 – -0.08)
- Recent literature estimating the effects on *car fleet*
  - Finds that increases in fuel taxes increase the fuel efficiency of new cars

# Composition of fuel price

2015	Gasoline (95)	Diesel
Consumer price €/l	1.50	1.30
VAT €/l	0.290	0.252
VAT-exclusive price €/l	1.210	1.048
Fuel tax €/l	0.681	0.506
Tax in total €/l	0.971	0.758
Tax-exclusive price €/l	0.529	0.542
Share of taxes %	64.8	58.3

# 2011 tax reform on diesel fuel tax

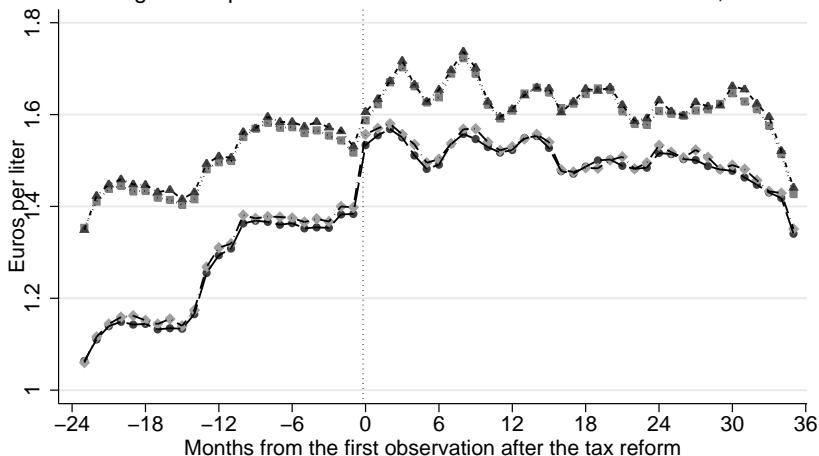


# Price data

- We have gasoline and diesel price data from two website sources: *polttoaine.net* and *tankkaus.com*
  - By stations and time (minutes)
- Individuals report prices to these websites
  - *tankkaus.com* requires registration
- Tankkaus.com data available 2007 onward and polttoaine.net data 2000 onward
  - 700-800 daily-gas-station-level prices, on average
- Possible problem: Individuals report prices wrongly
  - We can compare these data to monthly-level CPI data on fuel prices collected by Statistics Finland

# Micro-level price data vs. CPI-data

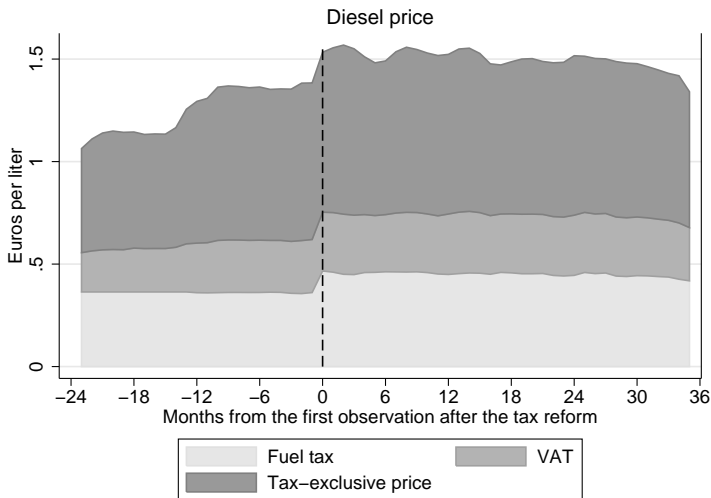
Diesel and gasoline prices: Microdata vs. Statistics Finland data set, 2010–201



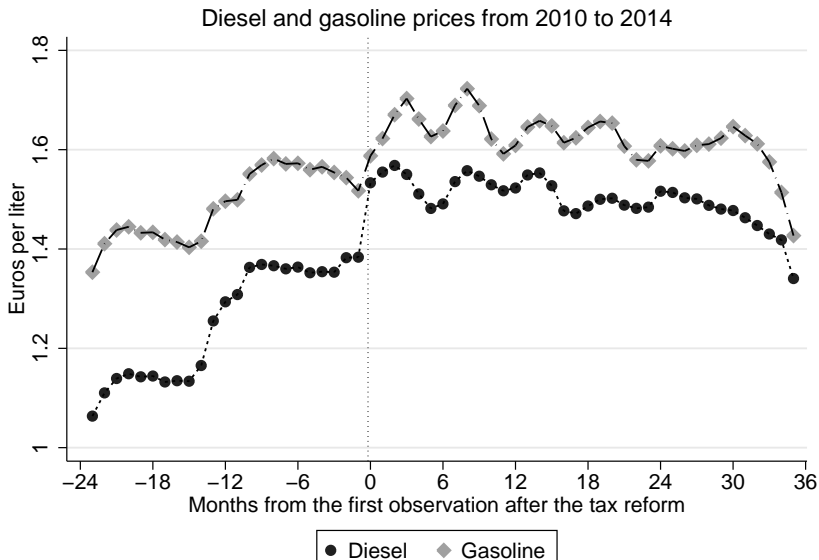
- Diesel: microdata      ◆ Diesel: SF
- Gasoline: microdata    ▲ Gasoline SF



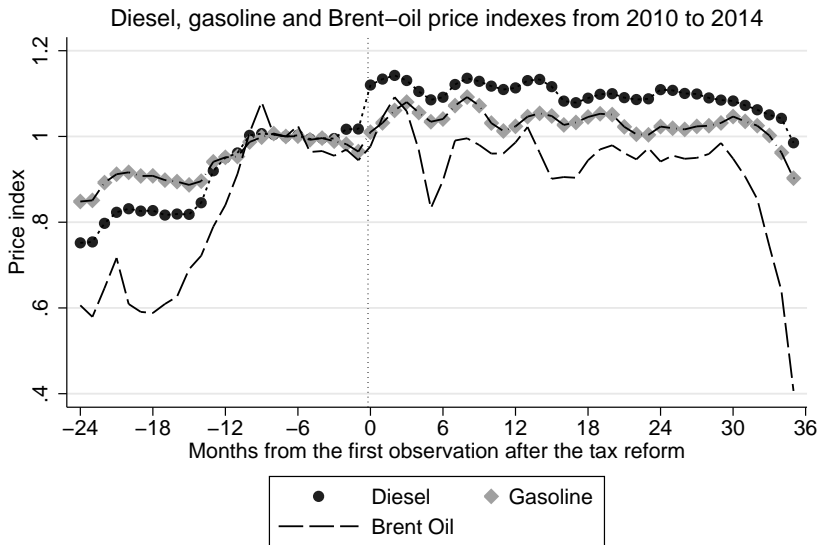
# Composition of diesel price over time



# Development of diesel and gasoline (95) prices



# Index values: diesel, gasoline and Brent-oil



Note: All prices indexed to get value 1 in June 2011

# Methods

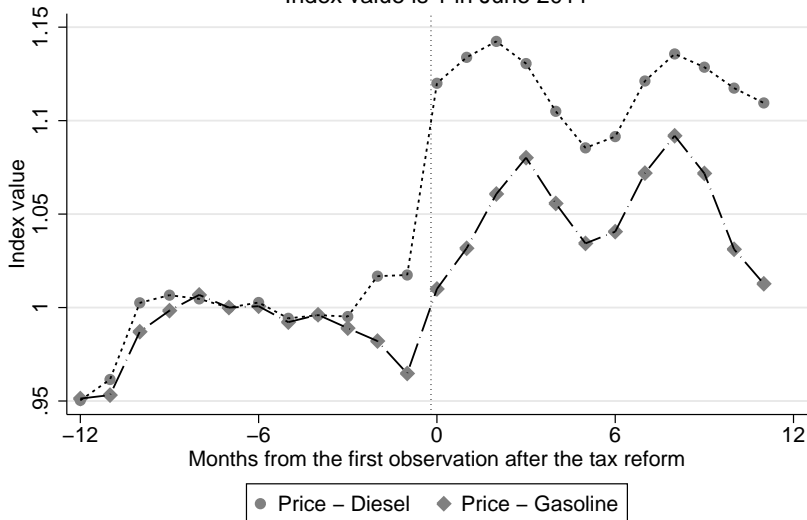
- Our goal: Estimate the tax-incidence of fuel prices using the diesel tax reform of 2012
- We use differences-in-differences method
  - We compare diesel prices (treatment) to gasoline prices (control) over time (before and after the reform)

$$Price_{st} = \alpha_0 + \alpha_1 1(Diesel)_s + \alpha_2 1(Post)_t + \alpha_3 1(Diesel)_s * (Post)_t \quad (1) \\ + \alpha_4 Brent - Oil_t + \alpha_5 X + e_{st}$$

- Parallel time trends assumption: Before the reform prices of gasoline and diesel should develop similarly

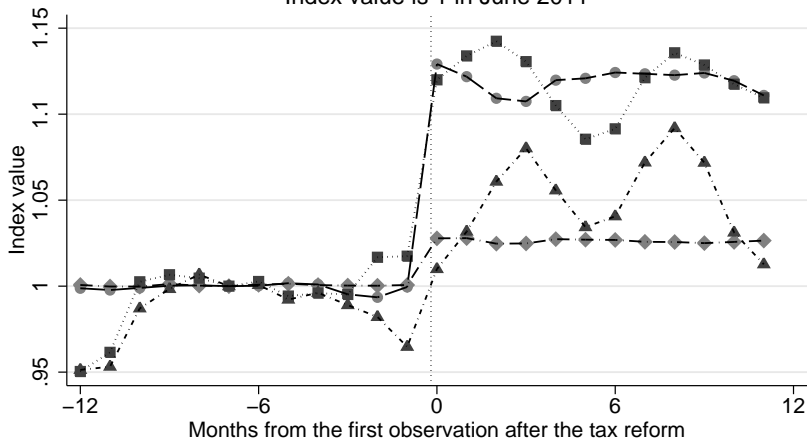
# Index values for consumer prices and fuel taxes

Diesel and gasoline prices from 2011 to 2012  
Index value is 1 in June 2011



# Index values for consumer prices and fuel taxes

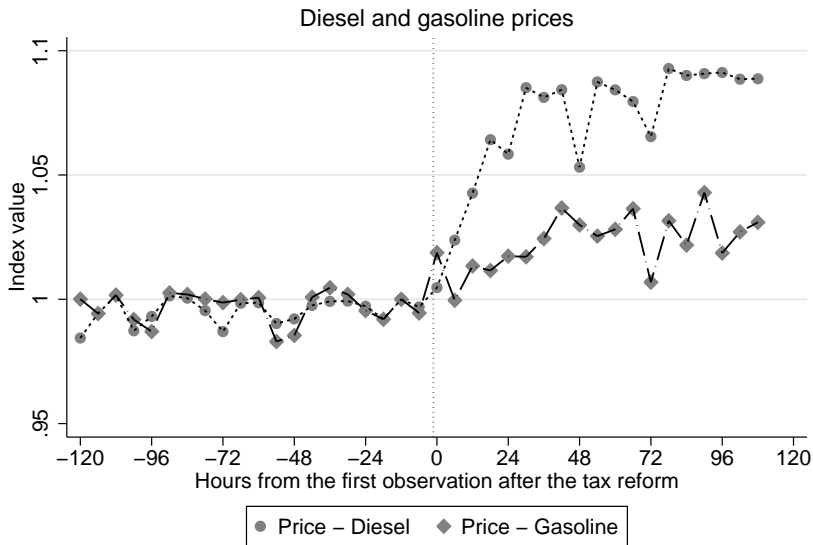
Diesel and gasoline prices and taxes from 2011 to 2012  
Index value is 1 in June 2011



## Tax incidence

OLS	Tax Fuel + VAT	12 mo. Price	12 mo.: -3 mo. Price	12 mo. Price
<i>Diesel</i>	-0.306	-0.207*** (0.009)	-0.170*** (0.003)	-0.257*** (0.071)
<i>After</i>	0.0263	0.101*** (0.002)	0.115*** (0.003)	0.049*** (0.019)
<b>DD</b>	<b>0.0975</b>	<b>0.0737***</b> <b>(0.003)</b>	<b>0.0668***</b> <b>(0.004)</b>	<b>0.0711***</b> <b>(0.004)</b>
<i>Brent oil price</i>		0.003*** ( $< 0.001$ )	0.003*** ( $< 0.001$ )	0.0013*** ( $< 0.001$ )
<i>Constant</i>	0.746	1.257*** (0.004)	1.182*** (0.002)	0.356*** (0.064)
<i>N</i>		613,418	455,380	851,078
<i>R2</i>		0.781	0.804	0.841
<b><i>Pass-through</i></b>		<b>0.756</b>	<b>0.685</b>	<b>0.732</b>

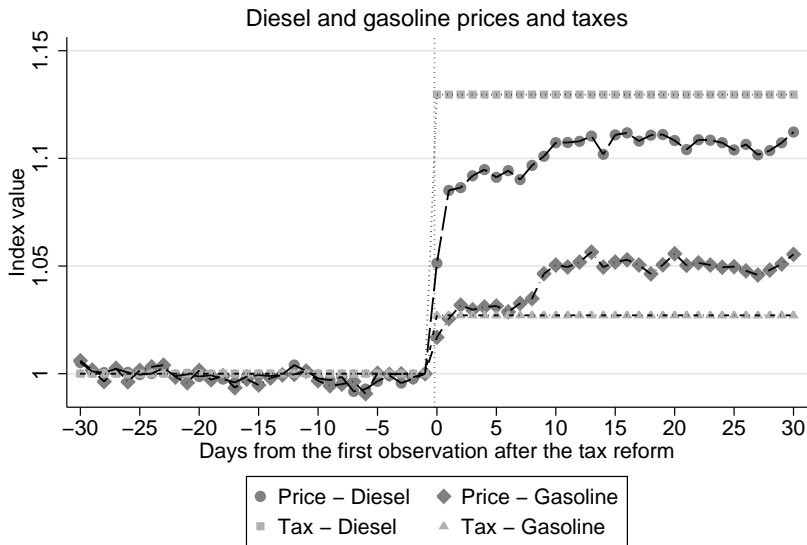
# Short-term effects: Hours after the reform



Index value is one 12 hours before the turn of the year 2011



# Short-term effects: Days after the reform



Index value is one day before the turn of the year 2011

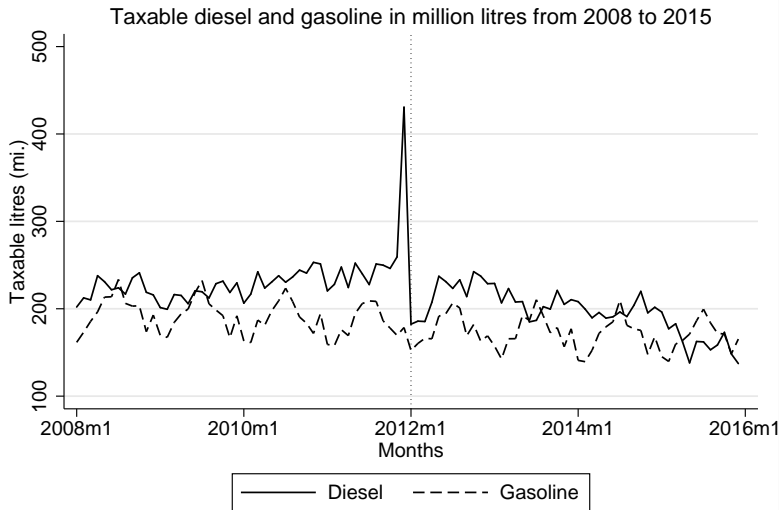
# Conclusions

- We find approx. 70% pass-through on fuel prices
  - Very fast short-term response, implies no adjustment with the use of old storages
- Results are well in line with the previous literature from the US
  - Previous literature find approx. 70-80% pass-through (Doyle & Samphantharak (2008) ja Marion & Muehlegger (2011))
- Pass-through similar although the level of fuel taxes much higher here than in the US!

# Future work

- Heterogeneity in incidence
  - Area
    - Demand differences in different areas: Rural (inelastic) vs. cities (elastic) - larger pass-through in rural areas?
  - Characteristics of gas stations
    - Station brands
    - Service station (e.g. ABC with grocery store) vs. filling station
- Competition
  - Gas station density within municipality
  - Distance between gas-stations
- Interactions? Ideas?

# Taxable amount of diesel and gasoline over time



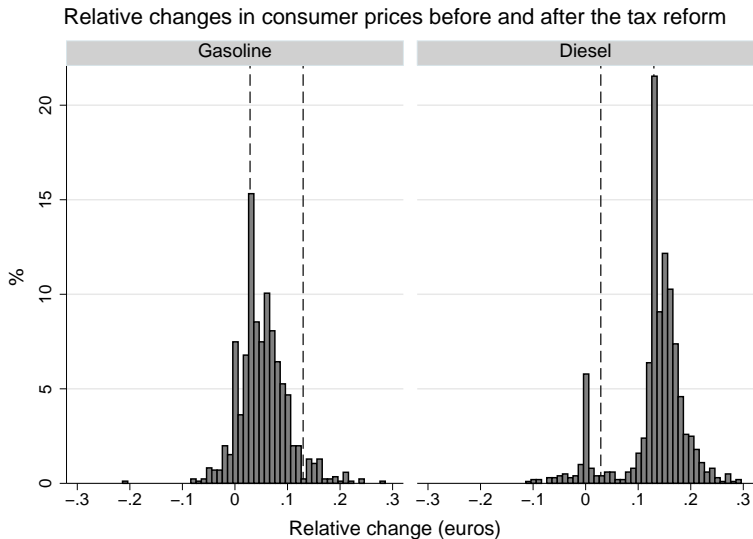
Source: Finnish Customs

# Traffic taxes in Finland

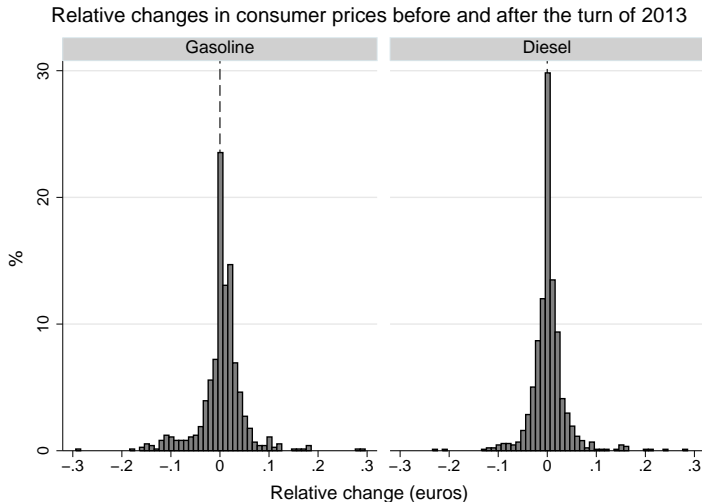
Million euros	2007	2008	2009	2010	2011	2012	2013	2014
Car tax	1 217	1 016	687	941	1 067	1 007	933	918
Vehicle tax	612	637	654	691	758	758	866	878
Fuel taxes	2 264	2 202	2 198	2 179	2 390	2 662	2 654	2 745
VAT on fuels	1 051	1 082	1 009	1 185	1 352	1 455	1 479	1 437
Tax on insurance payments	272	260	269	285	300	318	343	378
VAT on new vehicles	1 219	1 272	1 262	1 339	1 410	1 410	1 535	1 552
<b>Total</b>	<b>6 635</b>	<b>6 469</b>	<b>6 079</b>	<b>6 619</b>	<b>7 276</b>	<b>7 609</b>	<b>7 809</b>	<b>7 908</b>

**Taulukko:** Road traffic taxes in Finland (Source: Finnish Information Centre of Automobile Sector)

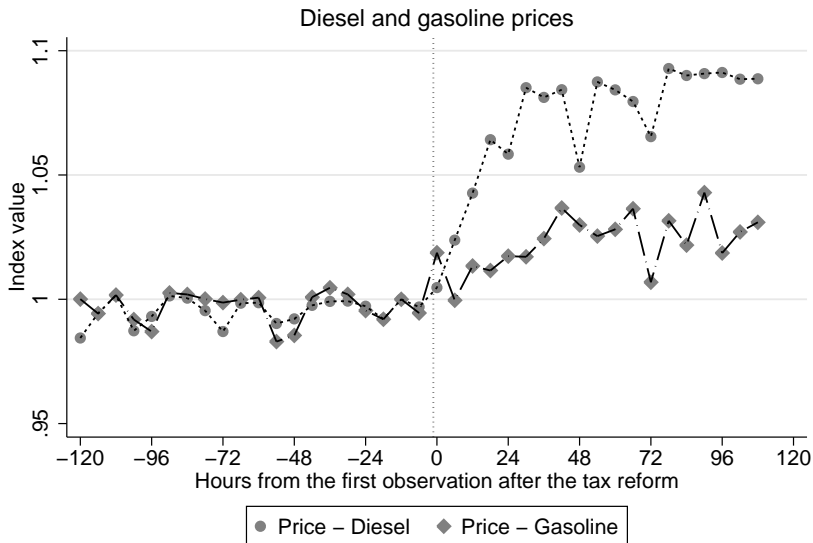
# Relative changes in diesel and gasoline prices: 2012



# Relative changes in diesel and gasoline prices: 2013



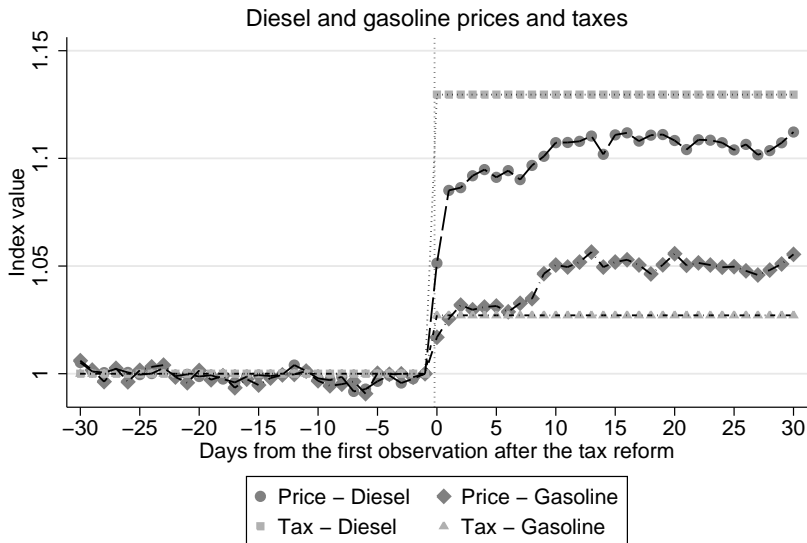
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# Placebo

OLS	2010-2011	2012-2013
	Price	Price
<i>Diesel</i>	-0.310*** (0.001)	-0.0918*** (0.001)
<i>After</i>	0.0364*** (0.002)	-0.027*** (0.004)
<b>Placebo dd</b>	<b>0.008</b> <b>(0.015)</b>	<b>-0.004</b> <b>(0.021)</b>
<i>Constant</i>	1.421*** (0.0005)	1.430*** (0.0202)
<i>N</i>	794,881	592,778
<i>R2</i>	0.942	0.626