Transport Economics

Lecture 10

13 February 2023

Prottoy A. Akbar

Today's Agenda

- Challenges to learning from observations
  - to be cognizant of them when making inferences
  - to understand underlying assumptions
  - but not how to solve those challenges as an analyst/researcher (refer to courses on empirical methods and econometrics)

- Applications:
  1. Hall, Palsson, and Price (2018)
     - *Is Uber a substitute or complement for public transit?*
  2. Anderson (2014)
     - *Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion*

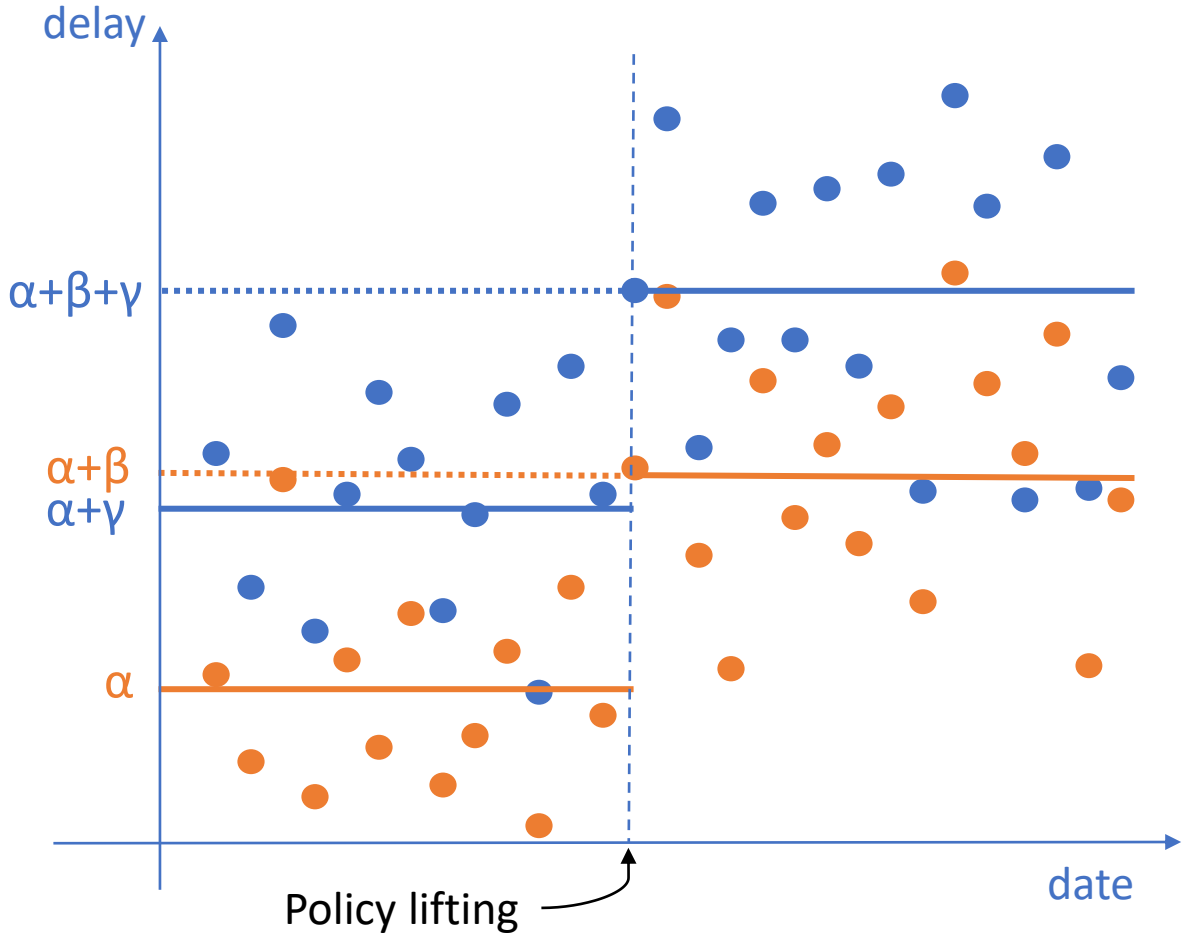
- Final case study

- 5-min break ~11:25
- Iaroslav presents!

Linear regression in event study (review)

$$delay_{idh} = \alpha + \beta \cdot post_d + \gamma \cdot north_i + \varepsilon_{idh}$$

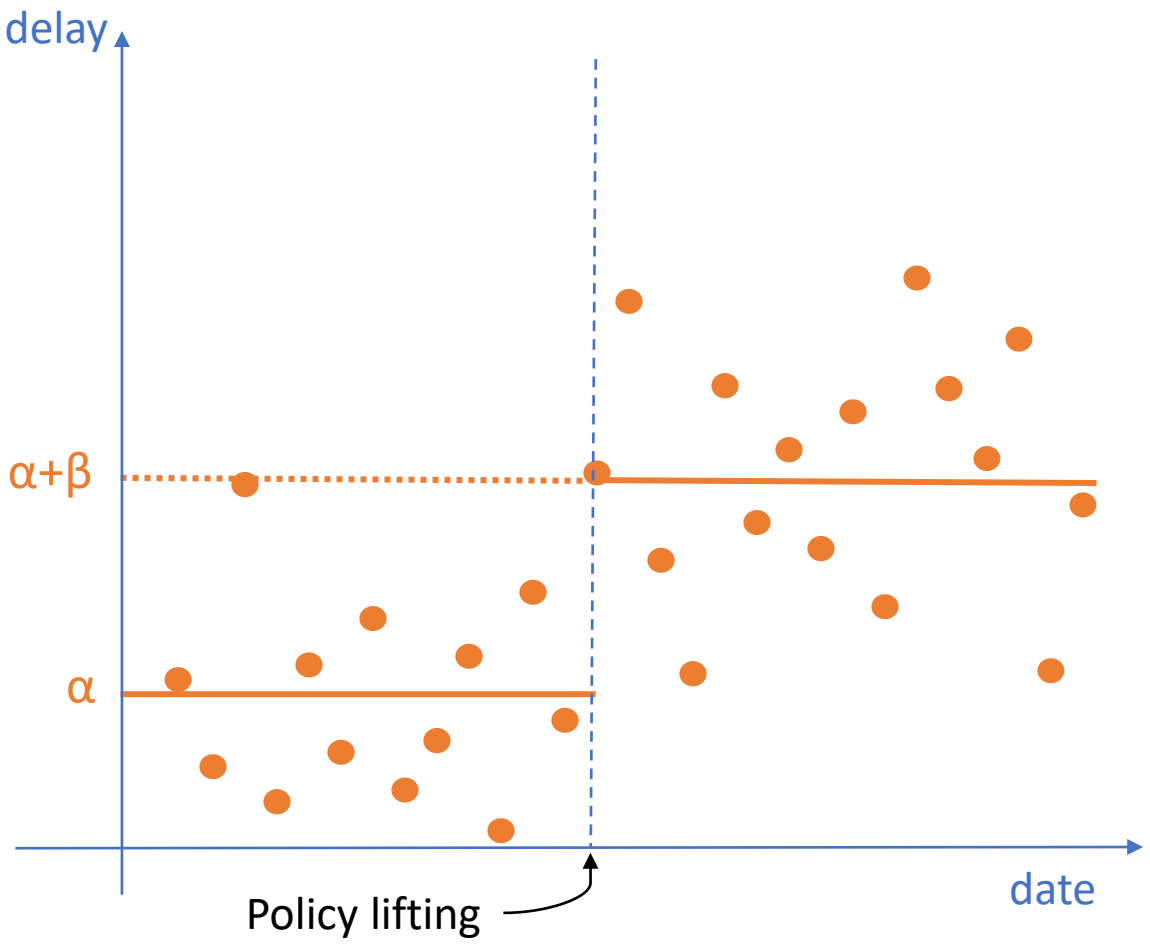
- Dependent/outcome variable: travel delay on segment *i*, on date *d* and departure hour *h*
- Independent/explanatory variable of interest: indicator for whether date *d* is after the policy lifting
  - $post_d$ = 0 before policy lifting ("control" group)
  - $post_d$ = 1 after policy lifting ("treatment" group)
- 'Conditional' on direction
  - north or not
  - $north_i$ = 1 if heading north, and =0 otherwise



Hypothesis testing

$$delay_{idh} = \alpha + \beta \cdot post_d + \gamma \cdot north_i + \varepsilon_{idh}$$

- Is the observed change in travel delay a random coincidence?
- There is always some noise in data that can lead to differences.
- How confident can we be that β is actually positive?
- The more observations we have, the higher the probability that this change in delay is systematic and not random.
- We can quantify this degree of statistical confidence.

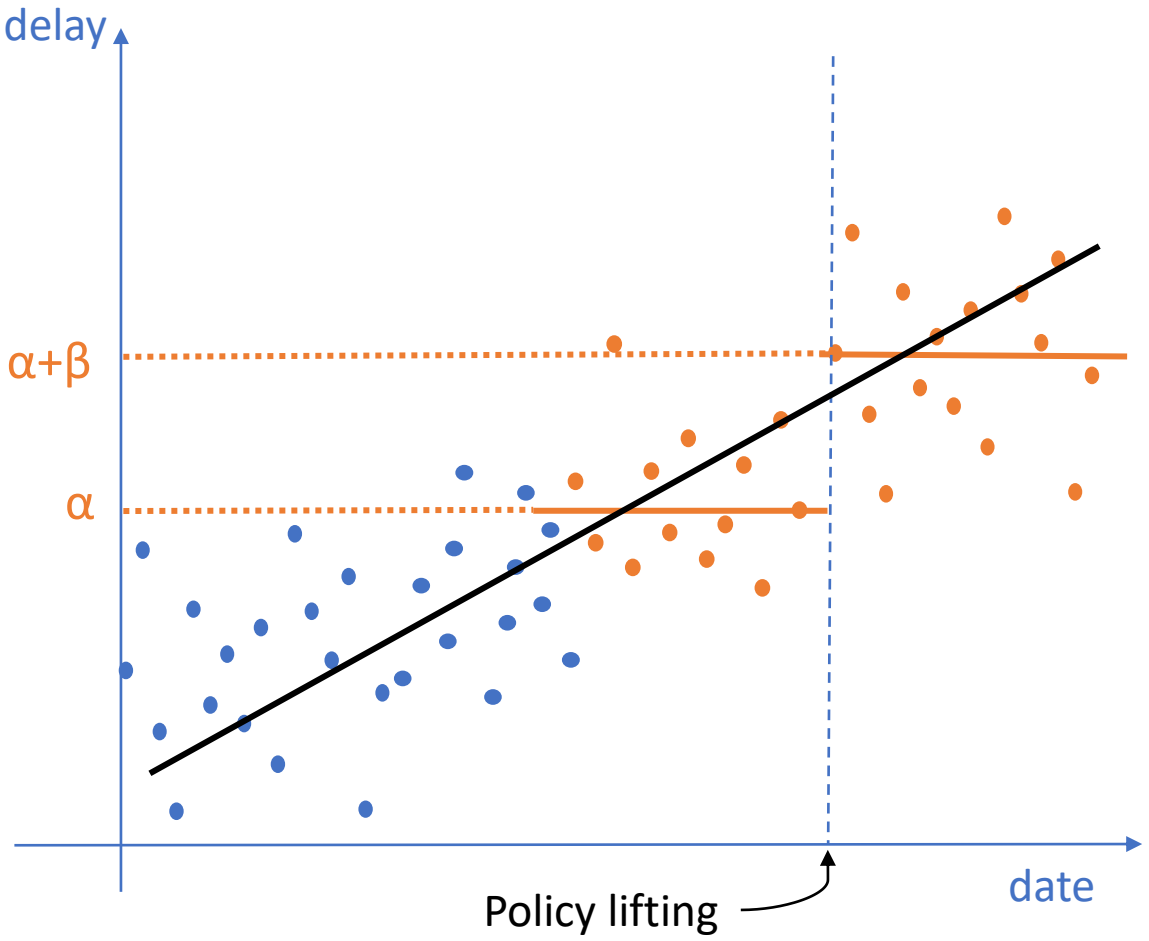


	(1)	(2)
Time interval	6 - 7 a.m.	7 - 10 a.m.
Panel A. Delay on 3-in-1 Road (Jalan Sudirman)		
Policy Lifting	-0.00	0.98***
	(0.05)	(0.07)
Northbound	0.24***	0.12
	(0.01)	(0.12)
Observations	264	792
Control mean	1.92	2.14

Table 1 of Hanna, Kreindler, Olkein (2017): Impact of 3-in-1 policy lifting

‘Identification’ of **causal effect** (review)

- What if the timing of event is intended to coincide with the changes in outcomes?
  - As opposed to the changes being caused by the event?
  - Key assumption of event studies: Event is uncorrelated with (pre-)trends in outcomes
- What would outcomes have looked like in the absence of the policy?
  - Would the average delay have stayed at α?
  - Key assumption: ‘Treated’ observations would resemble ‘control’ observations in the absence of the event



Homework Problem 7

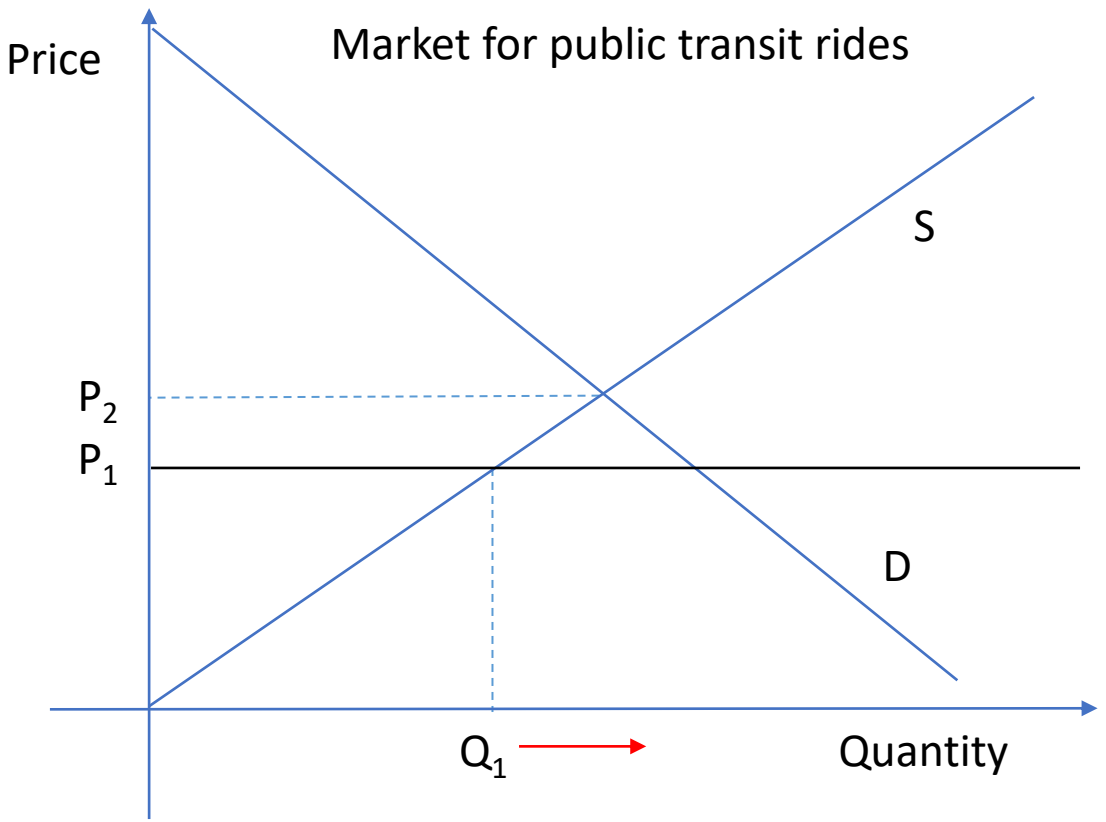
Hall, Jonathan D., Craig Palsson, and Joseph Price, "**Is Uber a substitute or complement for public transit?**", Journal of Urban Economics, 108 (2018): 36-50.

- Event study: Uber entry (different markets at different times)

- Outcome of interest: Demand for public transit rides
  - More of a substitute increases opportunity cost of riding public transit
  - More of a complement makes riding public transit easier / more accessible

Hall, Palsson, and Price (2018)

Conceptually, when does higher public transit ridership imply higher demand for public transit?



Underlying assumption 1:
supply curve didn't shift.

The availability of a substitute/complement would shift the demand curve. Would it affect equilibrium quantities?

Underlying assumption 2:
market is in equilibrium (e.g., through shadow prices)

Hall, Palsson, and Price (2018)

Table 3: Effect of Uber on log transit ridership

	Uber entry				Uber penetration			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
UberX	0.00263	-0.0591**	0.0598**	-0.00190	0.0138***	-0.00483	0.0328***	0.00758
	(0.0143)	(0.0295)	(0.0236)	(0.0364)	(0.00515)	(0.00526)	(0.00652)	(0.00677)
Above median population × UberX		0.0666**		0.0665**		0.0228***		0.0343***
		(0.0294)		(0.0307)		(0.00716)		(0.00796)
Above median ridership × UberX			-0.0811***	-0.0811***			-0.0281***	-0.0323***
			(0.0292)	(0.0292)			(0.00977)	(0.0100)
Observations	71,386	71,386	71,386	71,386	58,015	58,015	58,015	58,015
Clusters	309	309	309	309	227	227	227	227

Hall, Palsson, and Price (2018)

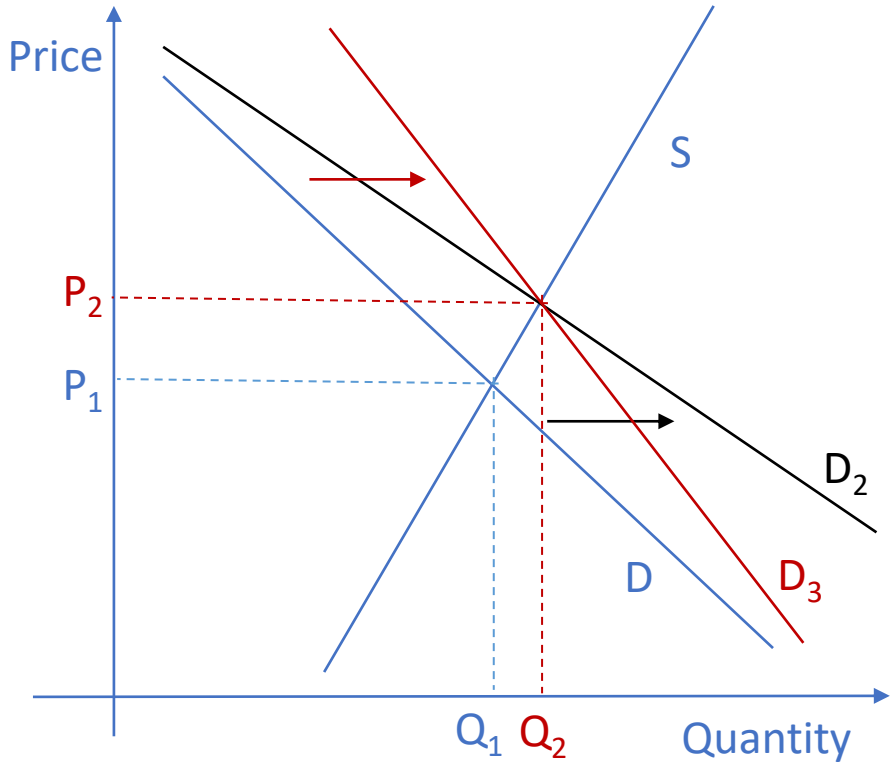
- Causal identification requires Uber's entry choice is unrelated to transit ridership.
- E.g., what if transit ridership change led to Uber entering the city (as opposed to the other way around)?

Table 2: Linear regressions predicting when and whether Uber enters an MSA

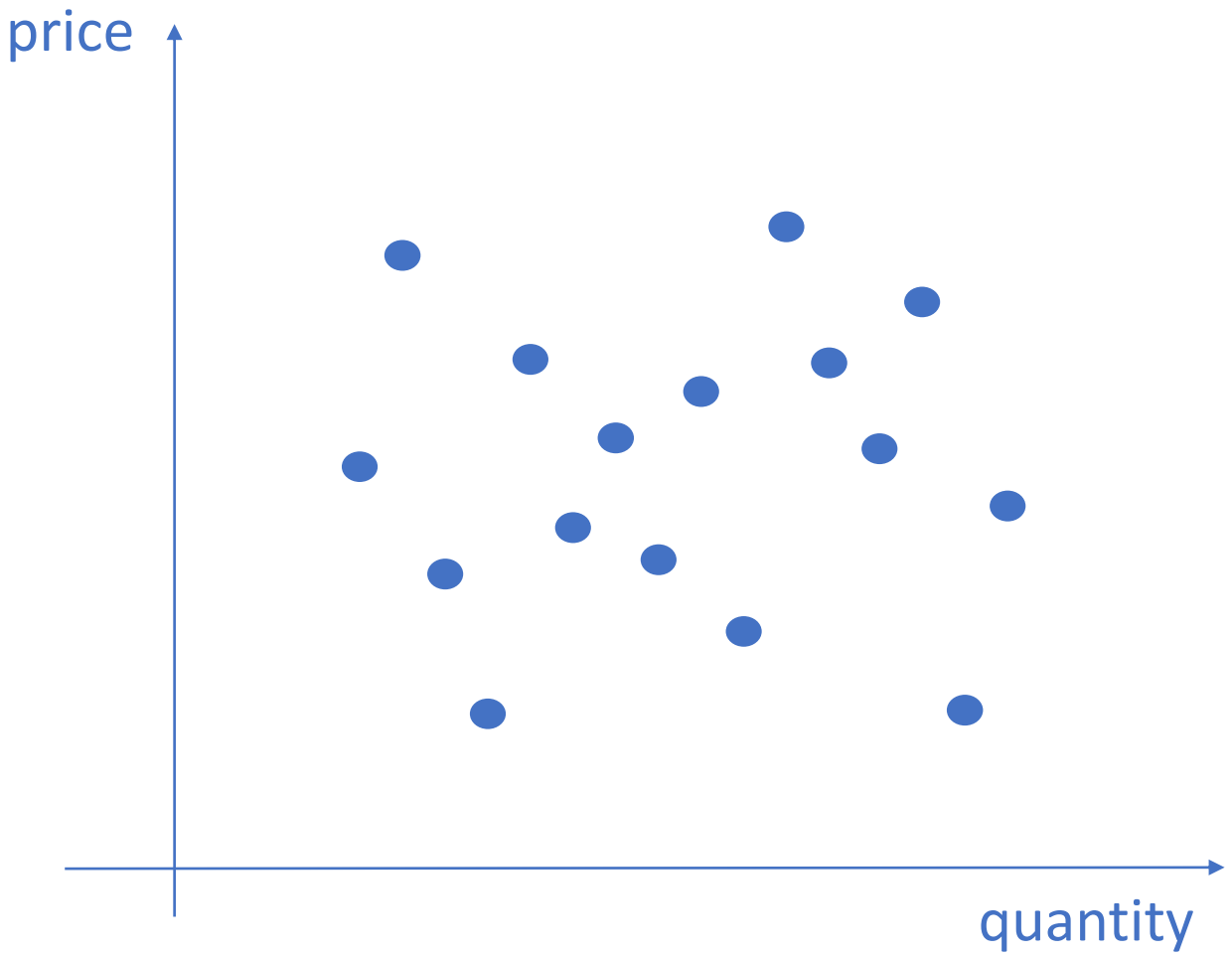
	Date UberX entry (1)	Did UberX enter (2)
Log(population) (σ)	-103.2***	0.256***
	(4.690)	(0.00705)
Percent with bachelor's degree (σ)	-41.77***	0.180***
	(5.108)	(0.00857)
Median age (σ)	30.90***	-0.0518***
	(5.777)	(0.00844)
Median income (σ)	-11.40**	-0.0288***
	(4.905)	(0.00963)
Excess unemployment (σ)	-41.73***	0.0336***
	(4.713)	(0.00789)
Percent work trips transit (σ)	-9.956**	-0.0792***
	(4.968)	(0.00948)
Capital expenditures on public transit (σ)	-4.868	-0.00152
	(4.939)	(0.00698)
Dist from Uber HQ (σ)	11.99***	0.00823
	(4.389)	(0.00662)
Trend in log(population) (σ)	11.46	0.0214*
	(8.225)	(0.0120)
Trend in median income (σ)	1.641	-0.0298
	(13.65)	(0.0204)
Observations	197	386
Adjusted R-squared	0.383	0.394

Quantifying costs/benefits

- Of price changes in a market requires knowing the price elasticities of demand and supply.
- Of any external intervention requires knowing how the demand and supply curves would shift.
- In reality, we mostly only observe equilibrium prices and quantities.
  - Can only observe shifts in points, not entire curves
  - Not enough to characterize changes in welfare or consumer/producer surplus =(



We usually only observe markets in equilibrium

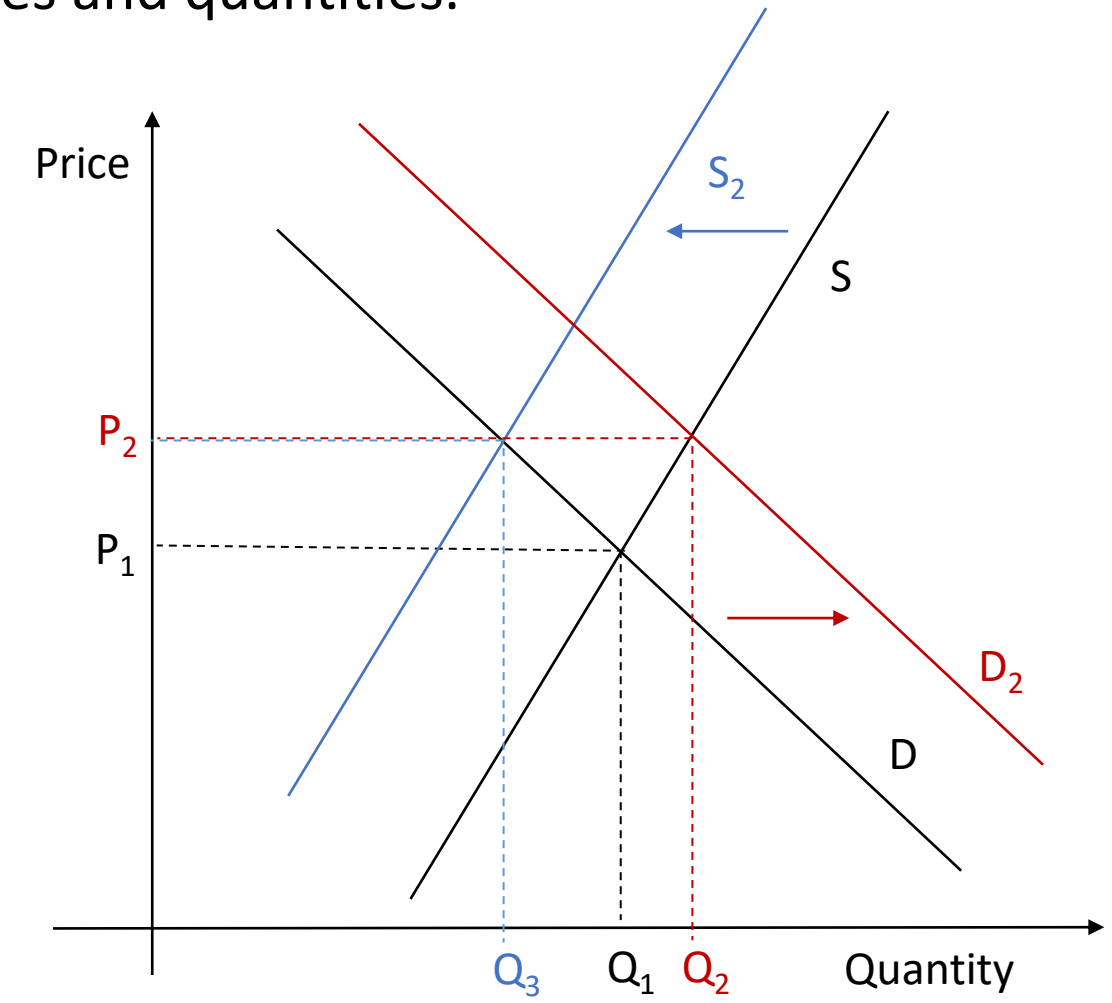


- If we plotted prices and quantities of a service over time, they are unlikely to be either upward or downward sloping.
- Changes in equilibrium prices and quantities can reflect both supplier and demander behavior.

Determining supply/demand elasticities

Most of the time, we only observe equilibrium prices and quantities.

- To identify points along the supply curve, we need a shift in the demand curve **only**.
- To identify points along the demand curve, we need a shift in the supply curve **only**.
- **Or** we need to isolate the effect of one of the shifts to be able to study the other one.



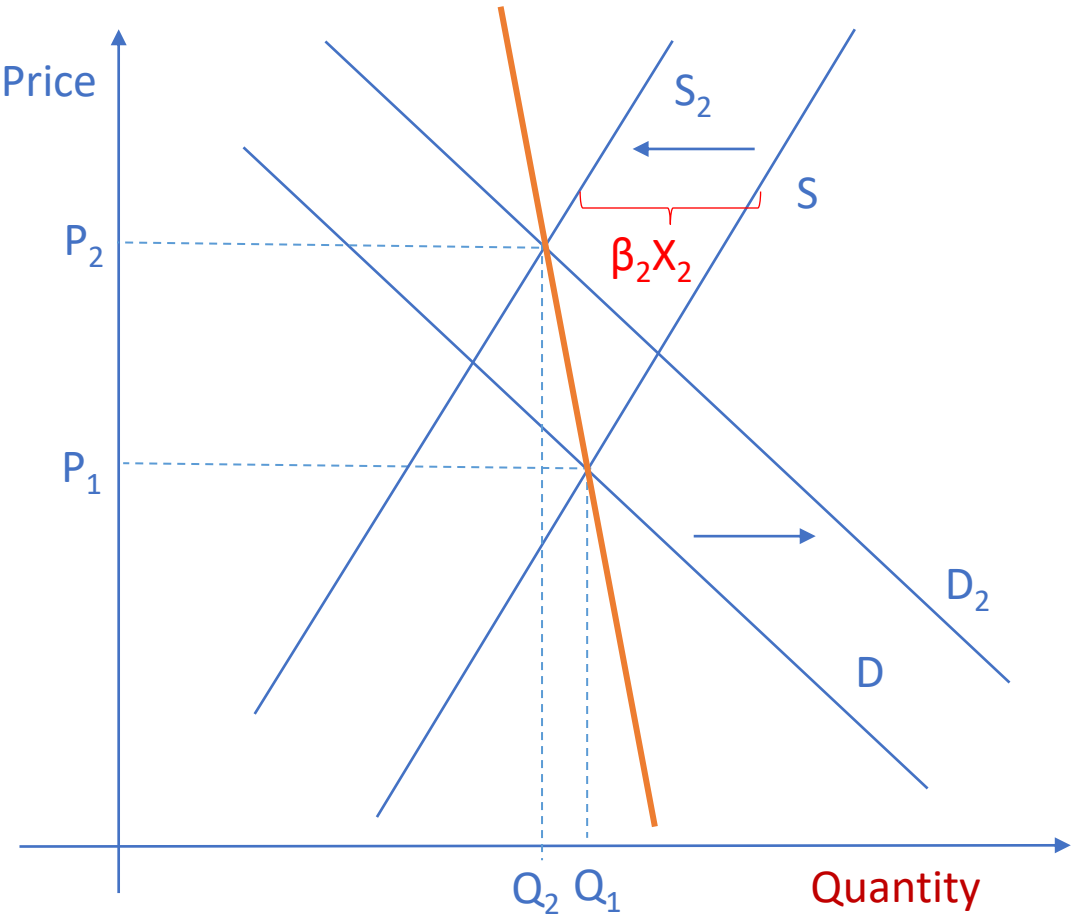
Omitted Variable Bias

- Suppose we want to estimate the price elasticity of supply using observed data
- but the supply curve has shifted!

- If we know shift is caused by some event X_2: conditional on the effect of X_2 on quantity, the relationship between price and quantity lets us estimate the slope of the supply curve:

$$\text{Quantity} = \beta_0 + \beta_1 \text{Price} + \beta_2 X_2 + \varepsilon$$

Not including the variable X_2 in the regression can **bias** our estimate of β_1.



Hall, Palsson, and Price (2018)

Table 3: Effect of Uber on log transit ridership

	Uber entry				Uber penetration			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
UberX	0.00263	-0.0591**	0.0598**	-0.00190	0.0138***	-0.00483	0.0328***	0.00758
	(0.0143)	(0.0295)	(0.0236)	(0.0364)	(0.00515)	(0.00526)	(0.00652)	(0.00677)
Above median population × UberX		0.0666**		0.0665**		0.0228***		0.0343***
		(0.0294)		(0.0307)		(0.00716)		(0.00796)
Above median ridership × UberX			-0.0811***	-0.0811***			-0.0281***	-0.0323***
			(0.0292)	(0.0292)			(0.00977)	(0.0100)
Observations	71,386	71,386	71,386	71,386	58,015	58,015	58,015	58,015
Clusters	309	309	309	309	227	227	227	227

Notes: Controls are the log of the following: average fare, the maximum number of vehicles in service during the month, vehicle-hours of service, vehicle-miles of service, regional gas prices, employment, and population. Includes a linear MSA time-trend and fixed effects for each month-year, transit agency, and transit agency-calendar month pair. Median population is calculated

Courses on empirical methods

- Principles of Empirical Analysis (ECON-A3000)
  - Non-technical intro to micro-econometric methods and research design
- Econometrics I (ECON-C4110)
  - Basics of linear regression, hypothesis testing, instrumental variables
- Econometrics II (ECON-C4210)
  - Difference-in-difference analysis, time-series and panel data analysis

Take a break!

The Impacts of Public Transit on Traffic Congestion

Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

- In the US, only 1-2% of travelled miles via mass transit. Yet, transit subsidies are popular in large driving-heavy cities like Los Angeles.
  - In a 2008 referendum, 67% of LA county voted to allocate $26 billion to transit over 30 years.

- Why? …if few voters are actual transit riders?

- Public transit relieves congestion, so benefits drivers too?

- But only moving a small fraction of drivers off the street!

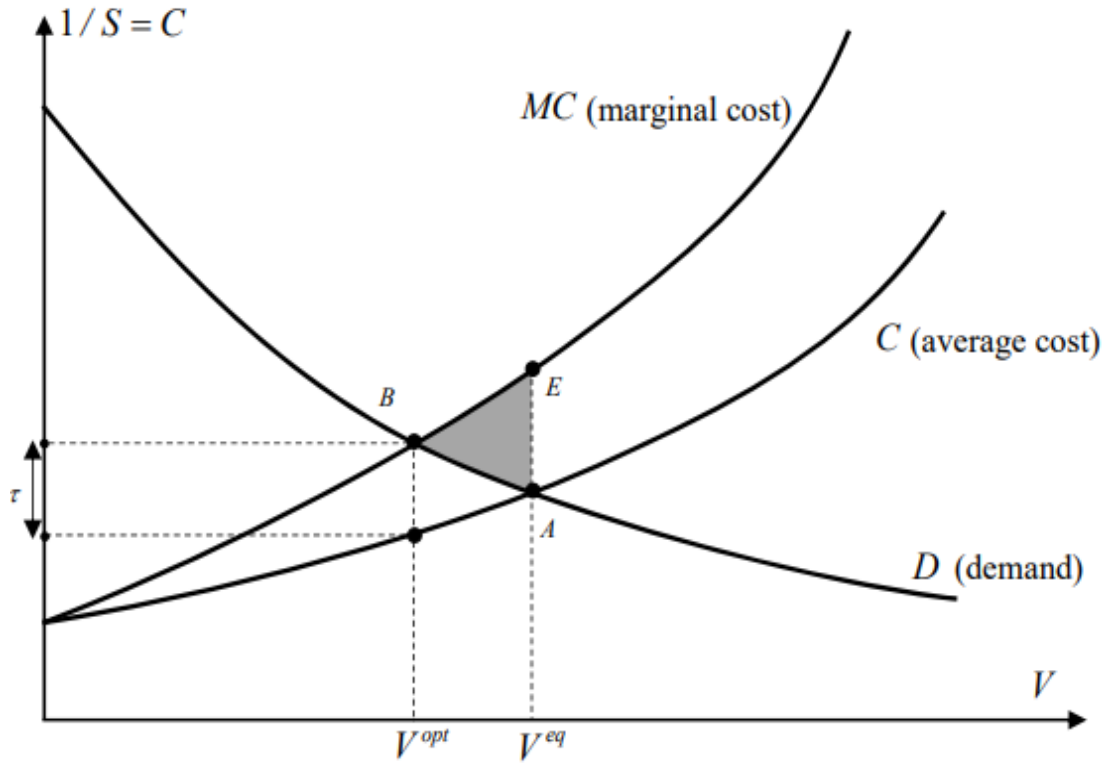
The Impacts of Public Transit on Traffic Congestion

Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

Hypothesis:

- Commuters on different roads and times face different levels of congestion
- Transit attracts commuters who face the worst congestion, who would otherwise drive on the most congested roads at the most congested times.
- Drivers on heavily congested roads have a much higher marginal effect on congestion
- So, transit has a large impact on reducing congestion.

Market for road travel



The Impacts of Public Transit on Traffic Congestion

Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

- **Question:** By how much does LA's public transit relieve congestion?

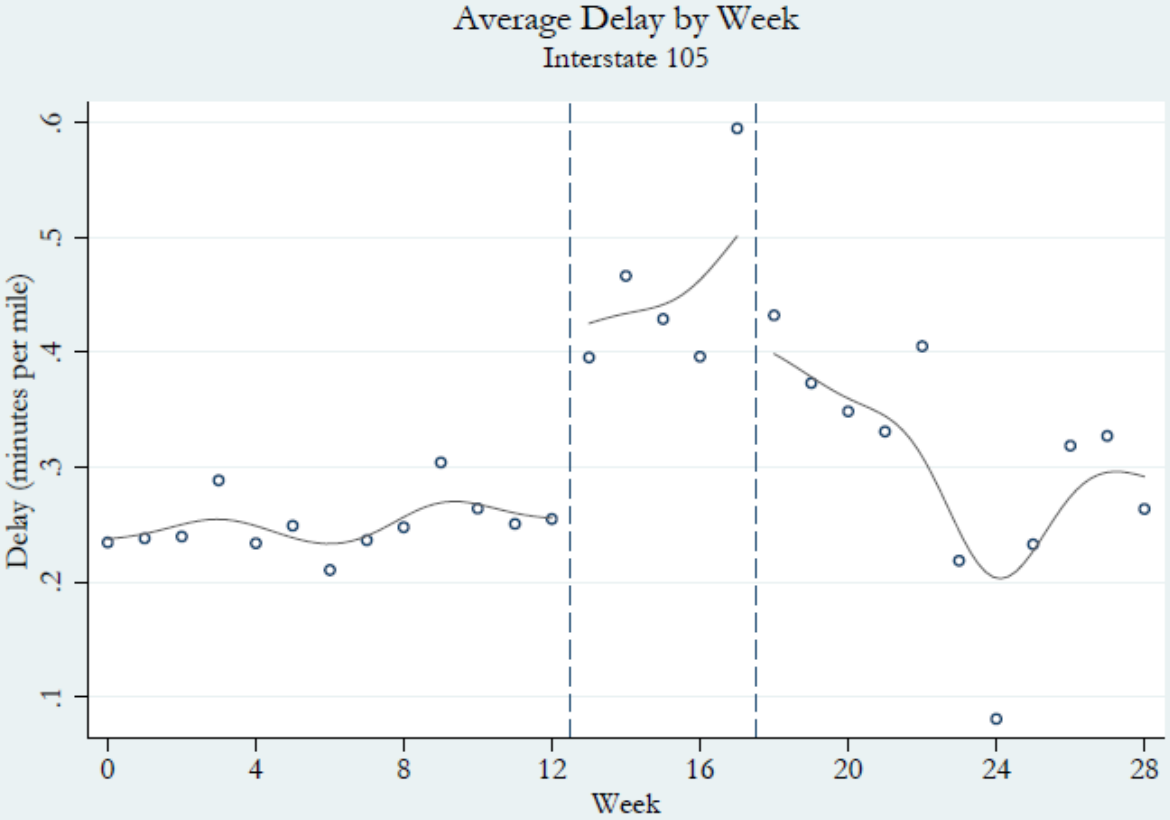
- Exploit a "natural experiment"
  - October 2003: LA public transit workers began a 35-day strike shutting down bus and rail lines
- Look at effect on hourly traffic speeds on major Los Angeles freeways
  - Using a Regression Discontinuity Design (RDD)
- Leads to increase in average travel delays of 47% during peak hours
  - Largest effects on freeways that parallel popular transit lines

Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

Figure 3: Weekly Peak Hr. Delay on Specific L.A. Freeways (7/14/03–1/30/04)

Panel A: Red Line Freeway (US-101)

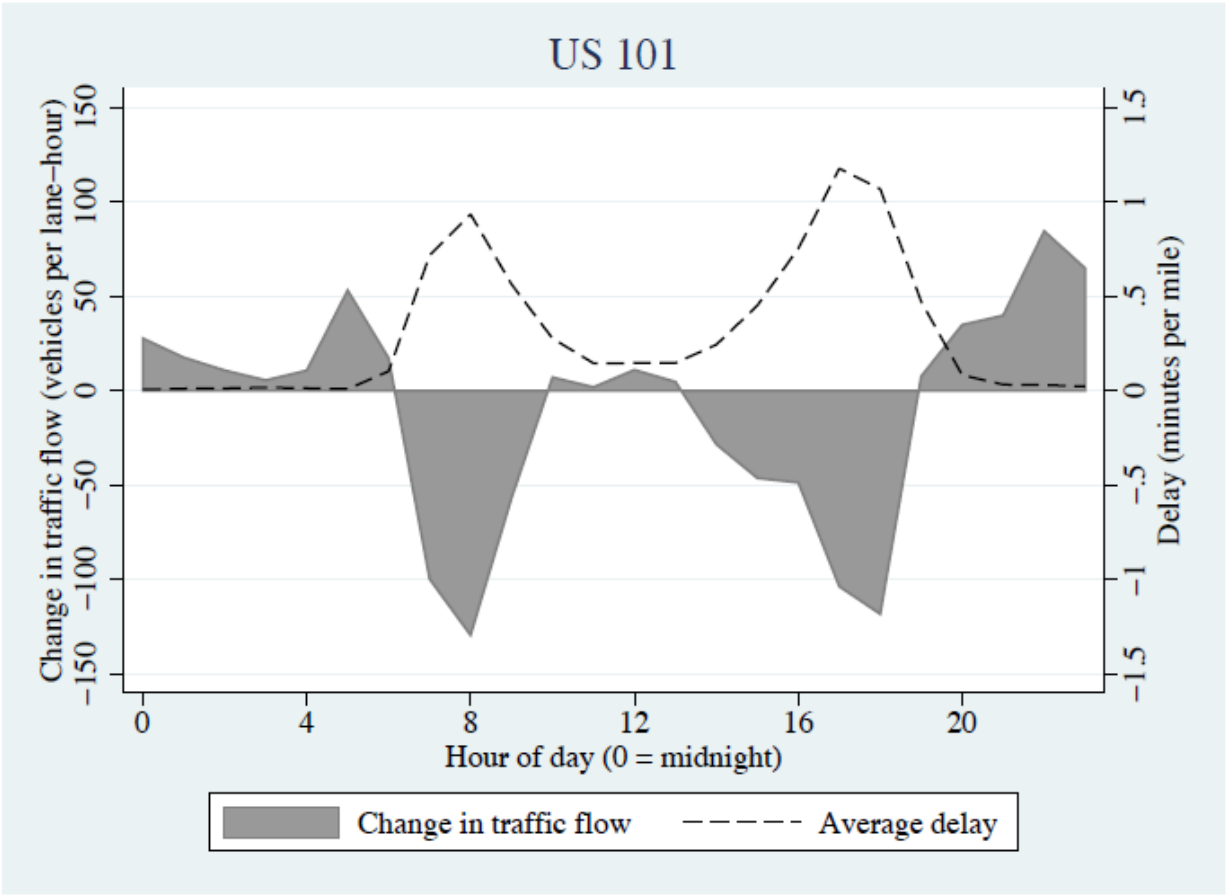
Panel B: Green Line Freeway (I-105)



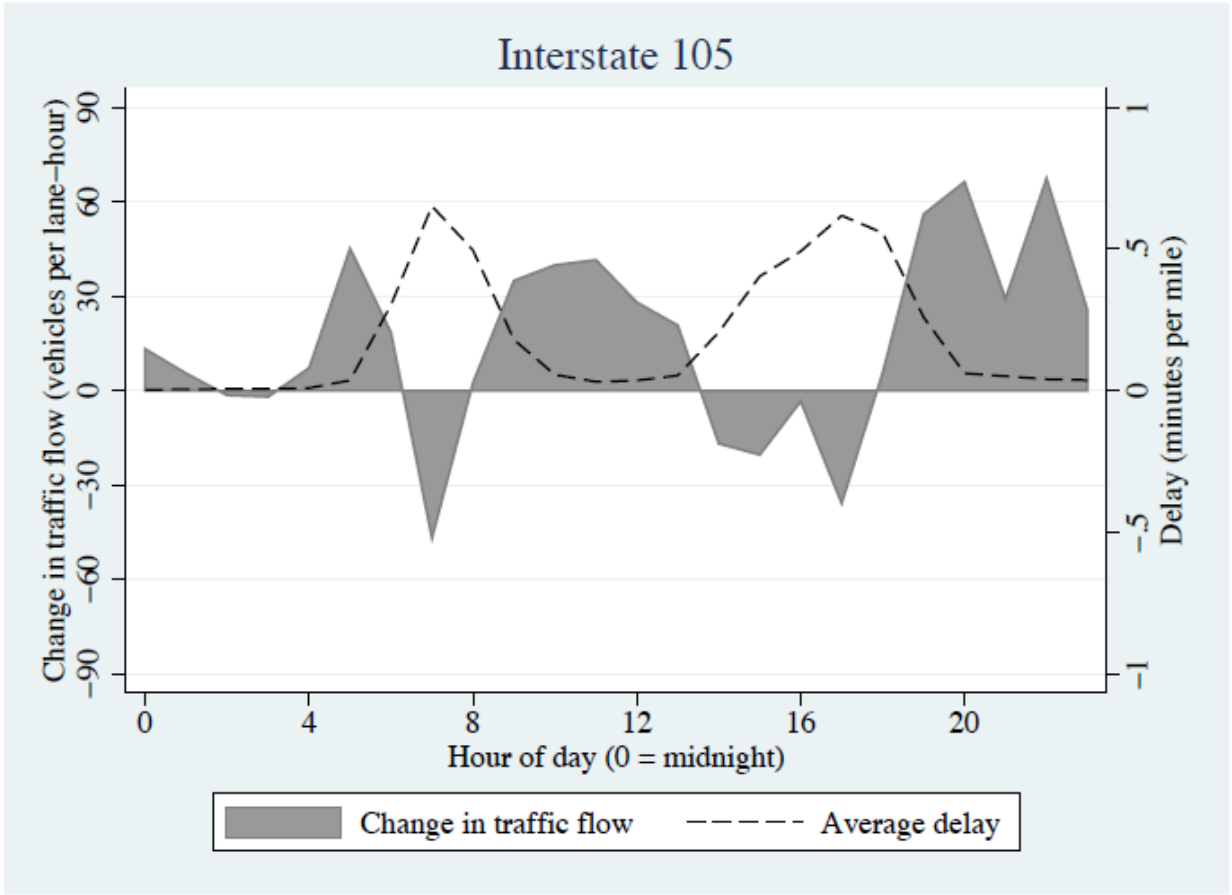
Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

Figure 4: Changes in Traffic Flows by Hour of Day on Specific L.A. Freeways

Panel A: Red Line Freeway (US-101)

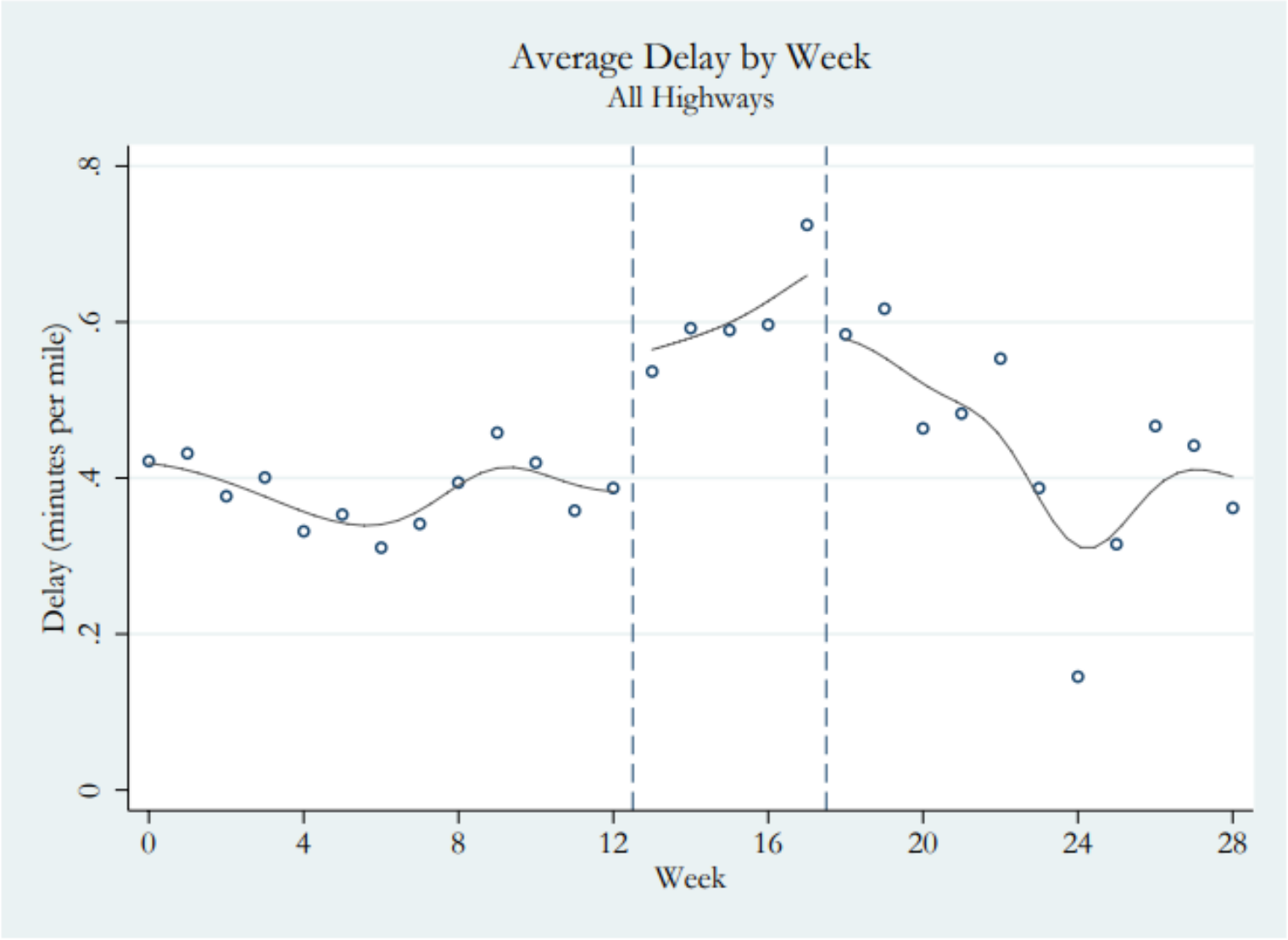


Panel B: Green Line Freeway (I-105)



Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

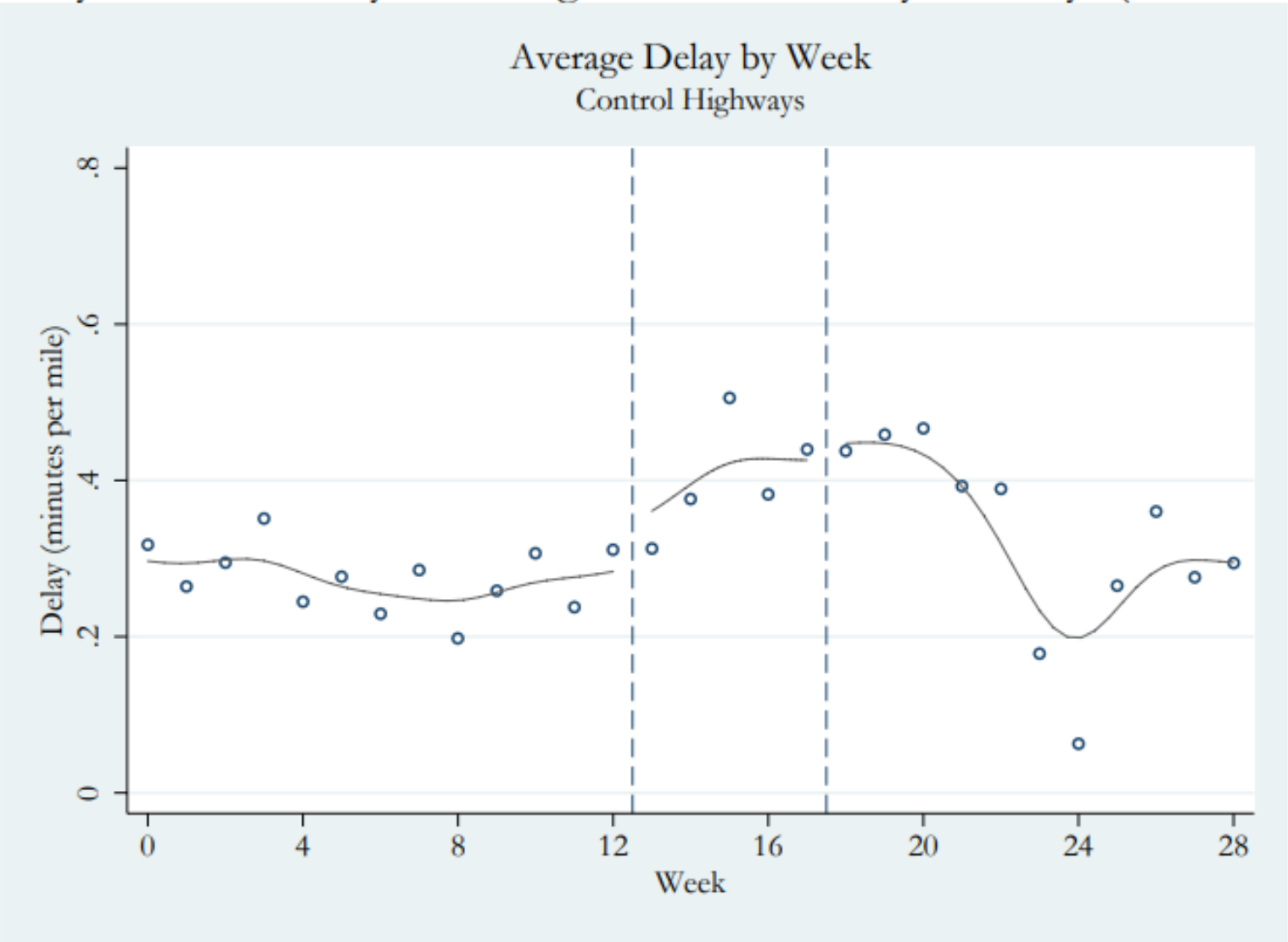
Figure 2: Weekly Peak Hr. Delay on Major L.A. Freeways (7/14/03–1/30/04)



But we need to check for correlated trends!

Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

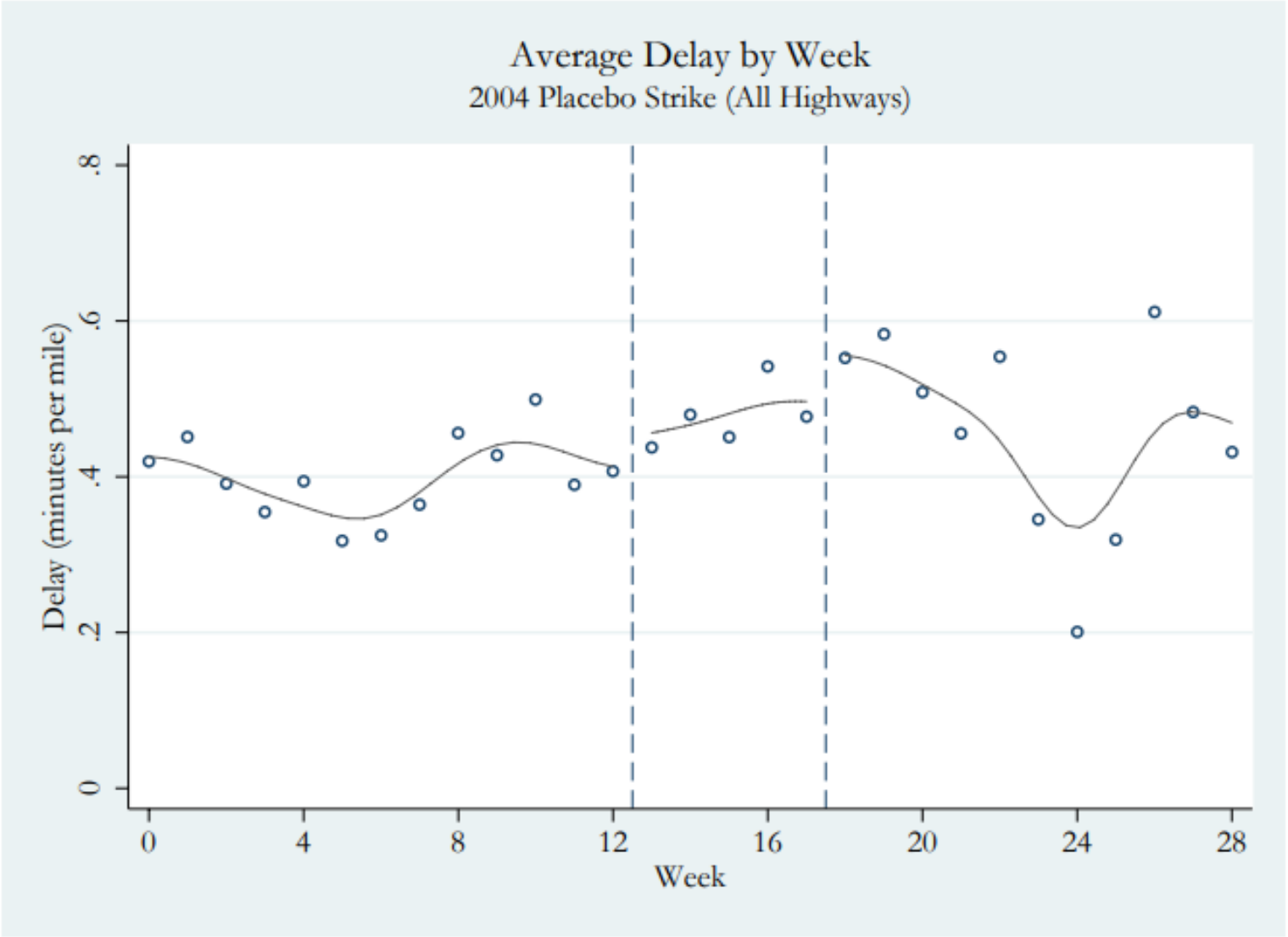
Weekly Peak Hr. Delay on Orange/Ventura County Freeways (7/14/03–1/30/04)



Neighboring counties unaffected

Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

Weekly Peak Hr. Delay on Major L.A. Freeways 1 Year Later (7/14/04–1/30/05)



Delay is not a seasonal effect

Quantifying costs/benefits of the LA Metro

- How do travel time gains translate to gains in individual welfare?
  - Of transit riders? Of drivers?

- Other margins of adjustment possible in the long run, but limited data on individuals.

- Models of individual preferences in order to interpret data.

- Next lecture… (and Worksheet 10)

Case study

- Final course assignment: Evaluate the impact of an external shock to a transport-related market on an outcome of interest.
- Due by **23 February 2023**

- Brief description of your case due by **19 February 2023** (Sunday)

- More details posted on MyCourses

- Some examples next class…

Homework Problem 8

Identify an external intervention (e.g., a government regulation) in a market for transport services (that is not in the textbooks or lectures).

1. Explain how the policy may have shifted the market equilibrium (prices, quantities and net surpluses of producers, consumers, and any external stakeholders) in theory.

2. Describe how you would test your theory above for causality using data that is typically observable. You can assume any data that can be reasonably collected is observable to you.

Bonus: +1 point for sharing with everyone in class.

Final grade on the course

5	90-100%
4	80-90%
3	65-80%
2	50-65%
1	35-50%
0	<35%

References

- Anderson, Michael L. 2014. "Subways, Strikes, and Slowdowns: The Impacts of Public Transit on Traffic Congestion." *American Economic Review*, 104 (9): 2763-96.

- Hall, Jonathan D., Craig Palsson, and Joseph Price, “Is Uber a substitute or complement for public transit?”, *Journal of Urban Economics*, 108 (2018): 36-50.

- Hanna, Rema, Gabriel Kreindler, and Benjamin A. Olken. "Citywide effects of high-occupancy vehicle restrictions: Evidence from “three-in-one” in Jakarta." *Science* 357.6346 (2017): 89-93.