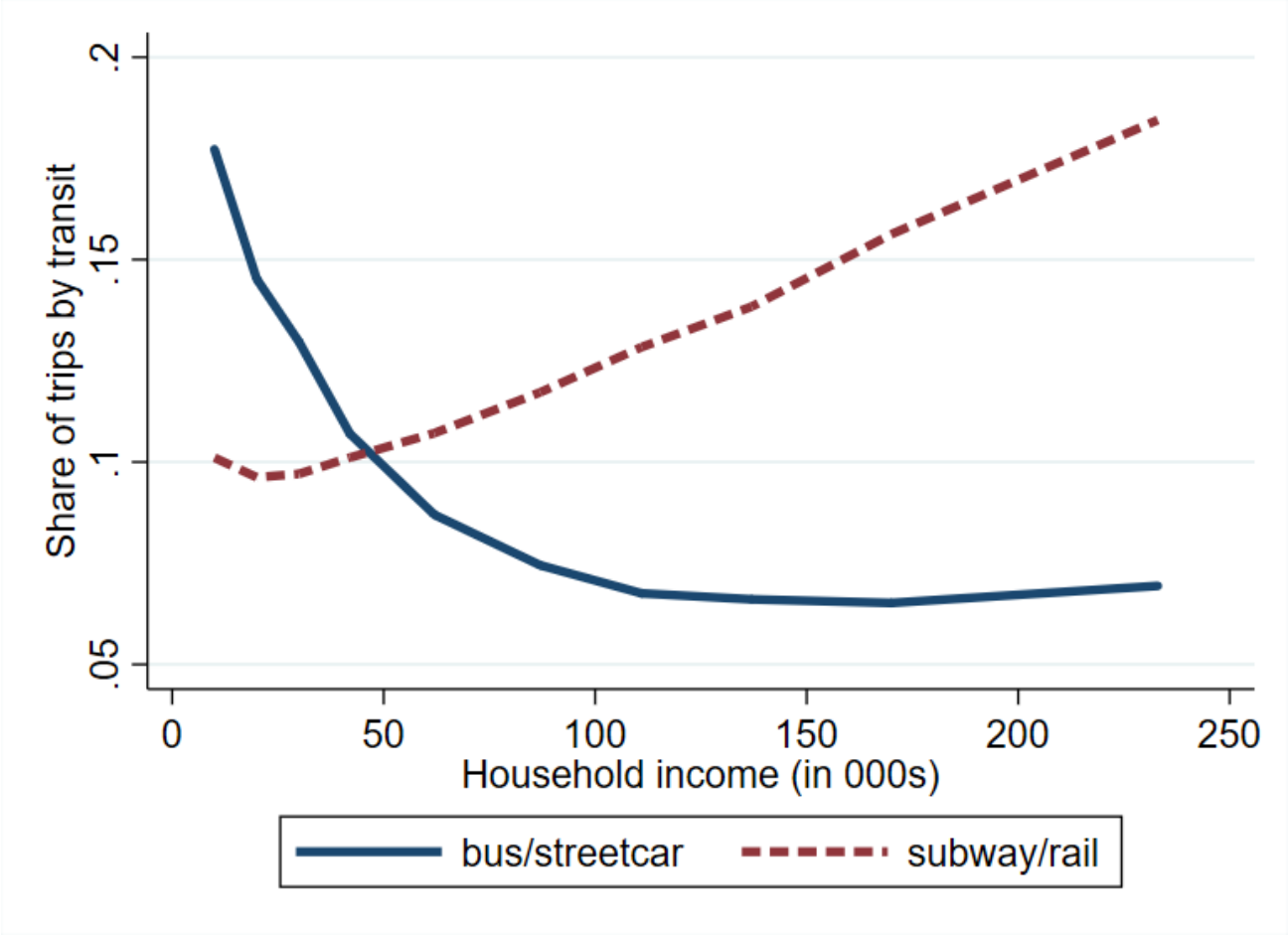
Targeted public transit

- Attracting more ridership / revenue often requires price discrimination
  - Not just in terms of fares

- Profitable transit operations in US cities serve:
  - Bus routes through mostly high-density areas with low-income people and short trip lengths (Cervero, 1990), OR
  - Commuter rail, rapid transit, and express buses from affluent suburbs to large employment centers

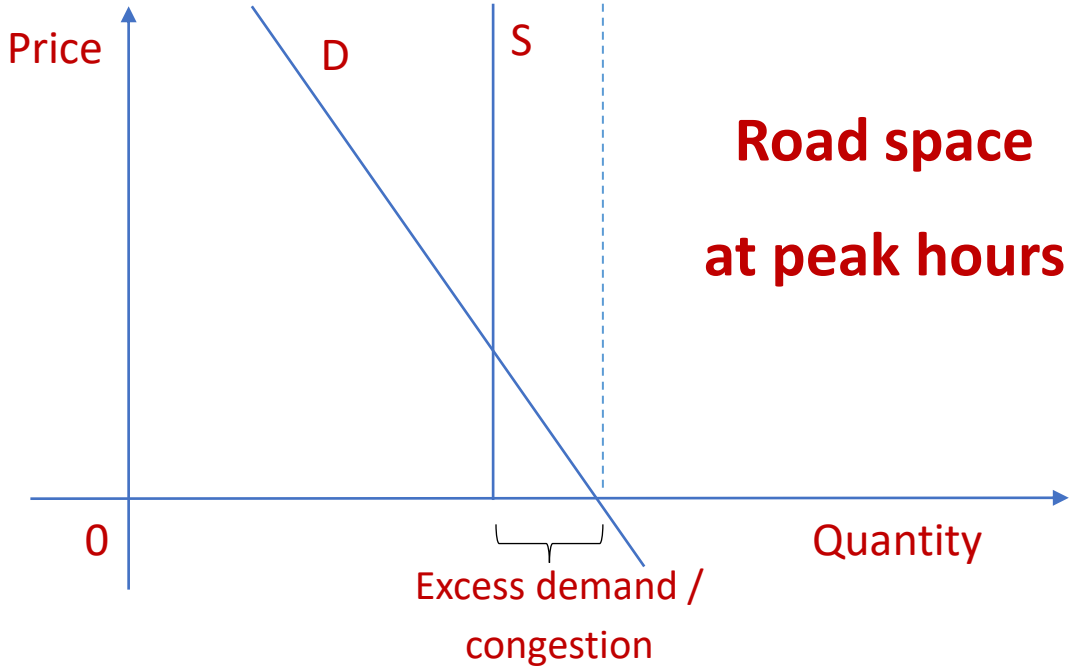


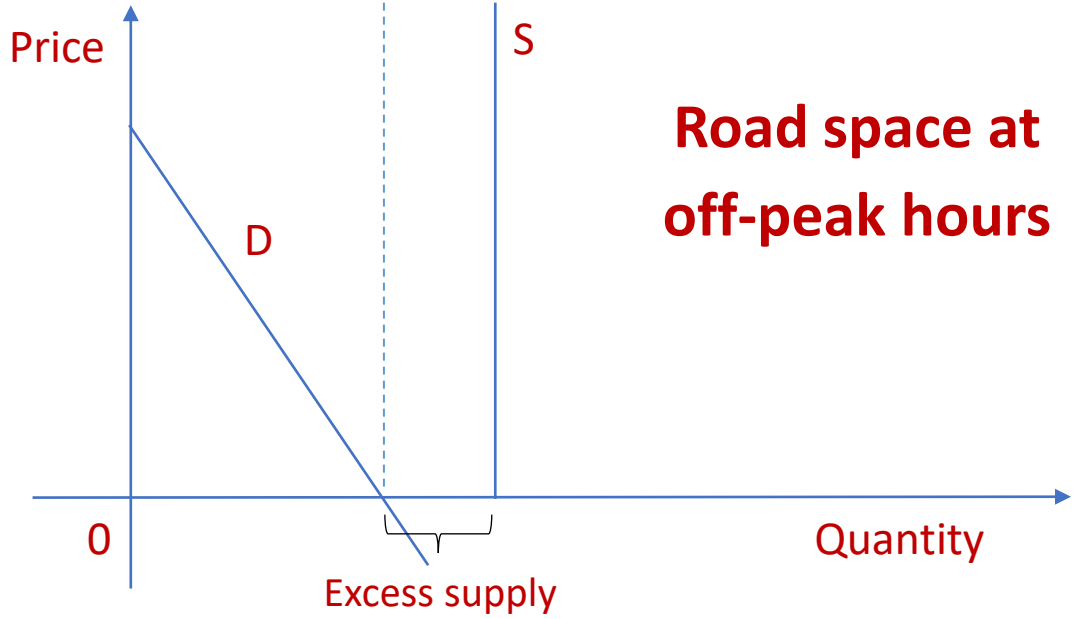
Road pricing (review+)

- Demand for road space varies over time and space. Instead of taxing cars, directly price roads to be able to price discriminate

- Let markets set road prices?
  - Competition among road suppliers could lead to optimal pricing.
  - Public may be more accepting of privately funded roads (rather than taxpayer-funded)
- Also needs government intervention
  - Lack of competition may lead to over-pricing
  - Private suppliers may ignore other externalities of road usage (pollution, land use, …)

- Public-private partnerships are not uncommon

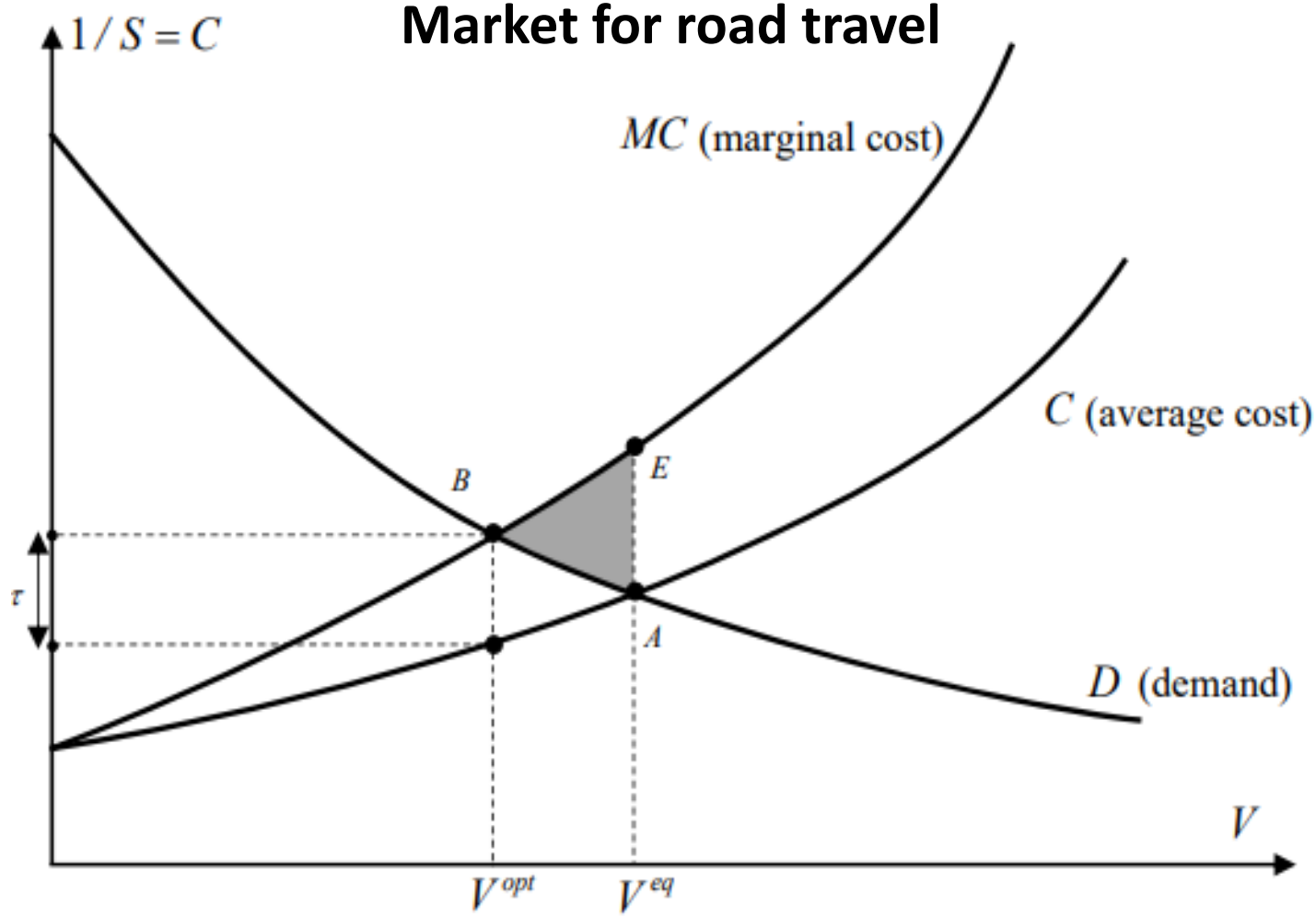




Congestion pricing (review)

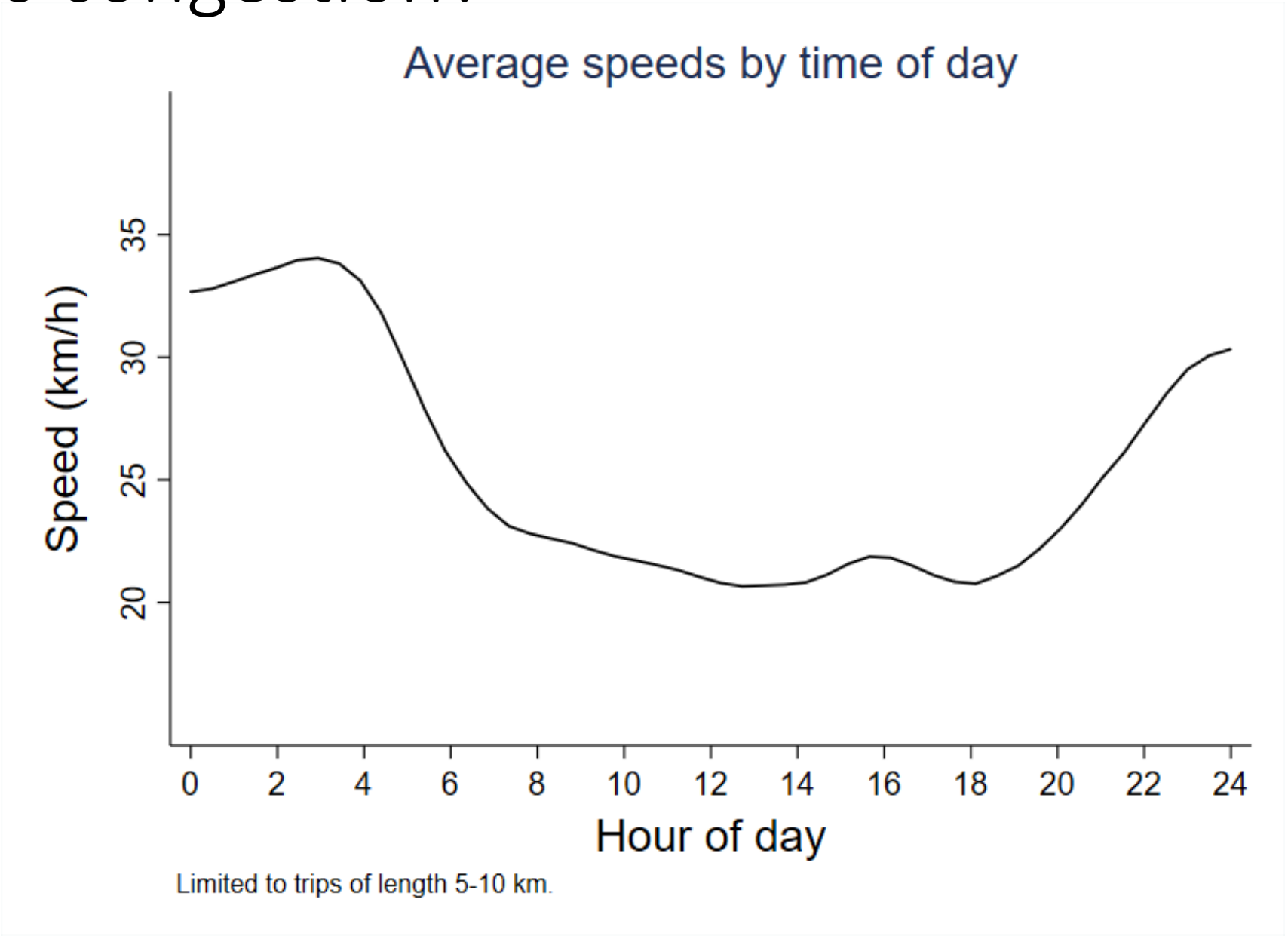
- Price = inverse travel speed (1/S)
- Quantity = travel volume (V)

- Average traveler faces the Average Cost
- The cost them being on the road imposes on everyone's travel is the Marginal Cost
- In equilibrium: more travel than optimal (DWL in gray)

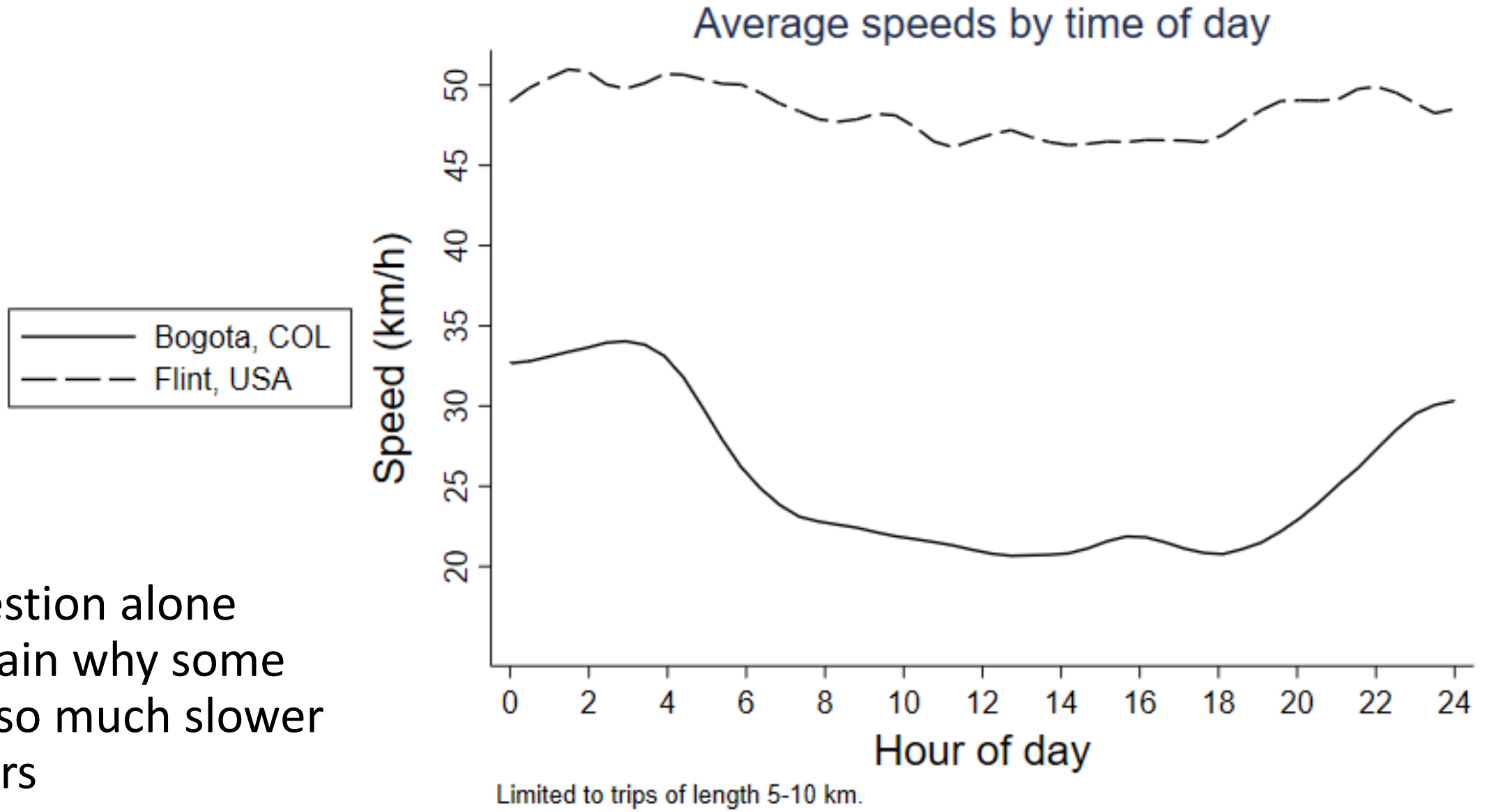


How important is congestion?

Lower speeds during peak hours of travel

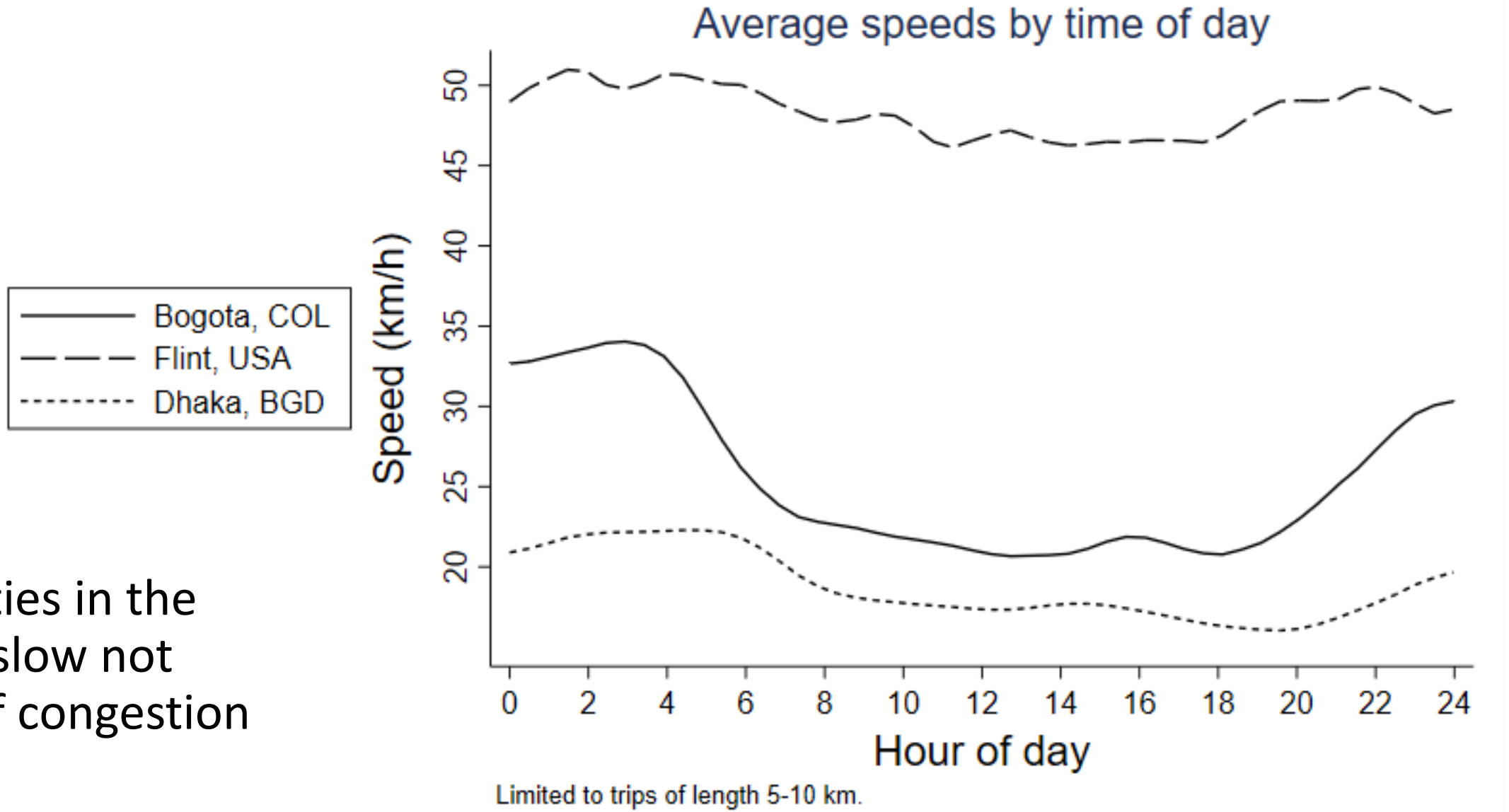


How important is congestion?



But congestion alone can't explain why some cities are so much slower than others

How important is congestion?

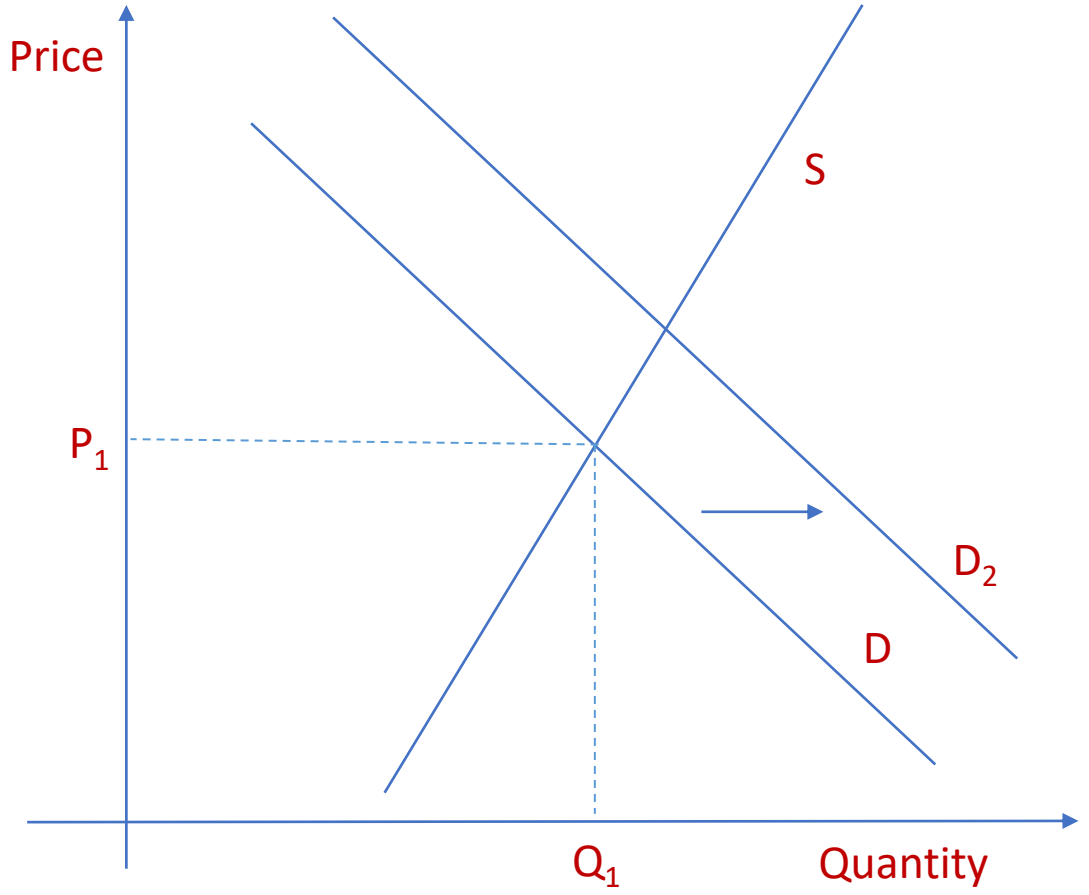


Slowest cities in the world are slow not because of congestion

Public transit access and housing market (review+)

- New subway station may increase demand for housing in the neighborhood
  - And increase housing prices
  - But not necessarily! (e.g., if more people don't want the subway access than people who do)

- Govt. intervention in housing market?
  - Rent controls?
    - Excess demand, deadweight loss
    - Benefits people who live there, but fewer people with access to subway
  - Shift housing supply?
    - E.g., subsidy to developers?
  - Relax restrictions on housing density / zoning laws?
    - More elastic housing supply: smaller price increase, greater access for more people
  - Encourage price discrimination?
    - Affordable housing units, etc.



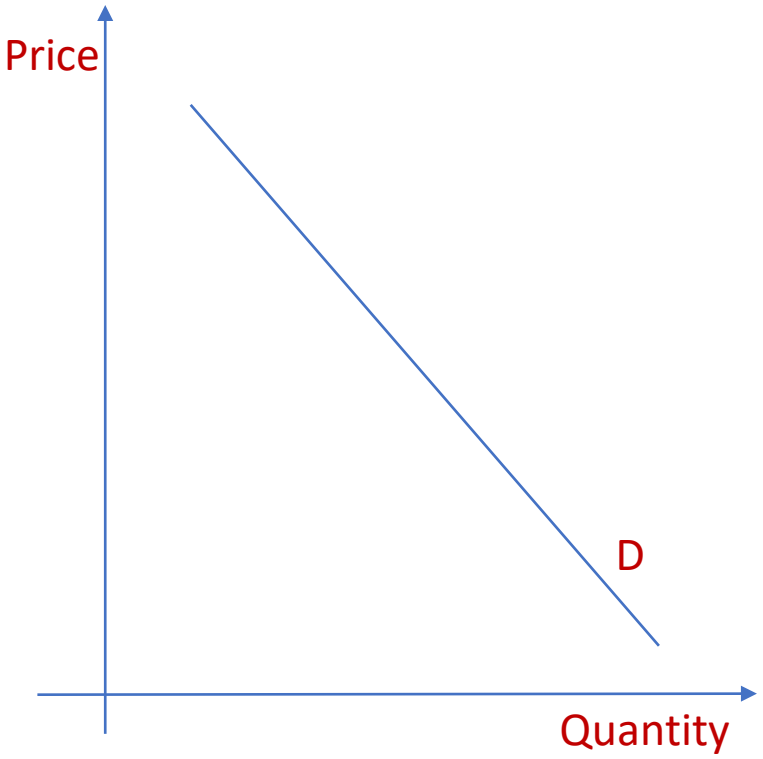
How to quantify costs and benefits?

- What are the size of externalities?
  - And the size of government interventions?
- How responsive are demanders and suppliers to these interventions?
  - Elasticities relative to price, income, prices of related goods/services, …

- **Rest of the course:** how to learn from data?

- Utility: The usefulness or enjoyment that individuals get from their choices of goods/services
  - Our willingness/ability to pay for an item is meant to maximize our utility (across all our choices)

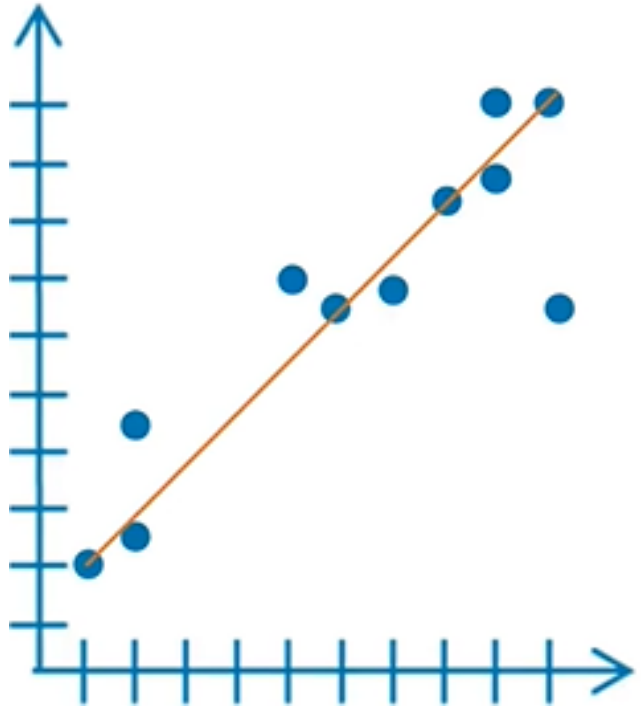
- How to predict (before choosing) what utility will be?
  - Based on existing observations (data)
  - Model extrapolations



Linear regression

Demand/supply, Y, for a service is dependent on:

$$Y = \beta_0 + \beta_1 (\text{Price}) + \beta_2 X_2 + \beta_3 X_3 + \ldots + \varepsilon$$



- Explanatory variables: Price, X_2 , X_3, …
  - That we observe
- Coefficients: β_0, β_1, β_2, …
  - Unknown parameters of interest
- Random error term ε
  - that are unobservable/“unpredictable” to us
- If we have data on the dependent and explanatory variables, we can “estimate” the coefficients that would best “fit” the data
  - i.e., choose coefficients to minimize distance between actual data points and prediction
  - Once coefficients are estimated, we can predict what Y would look like under a different price, different market characteristics, etc.

Linear regression

To estimate price-elasticity, regress Ln(quantity) on Ln(price):

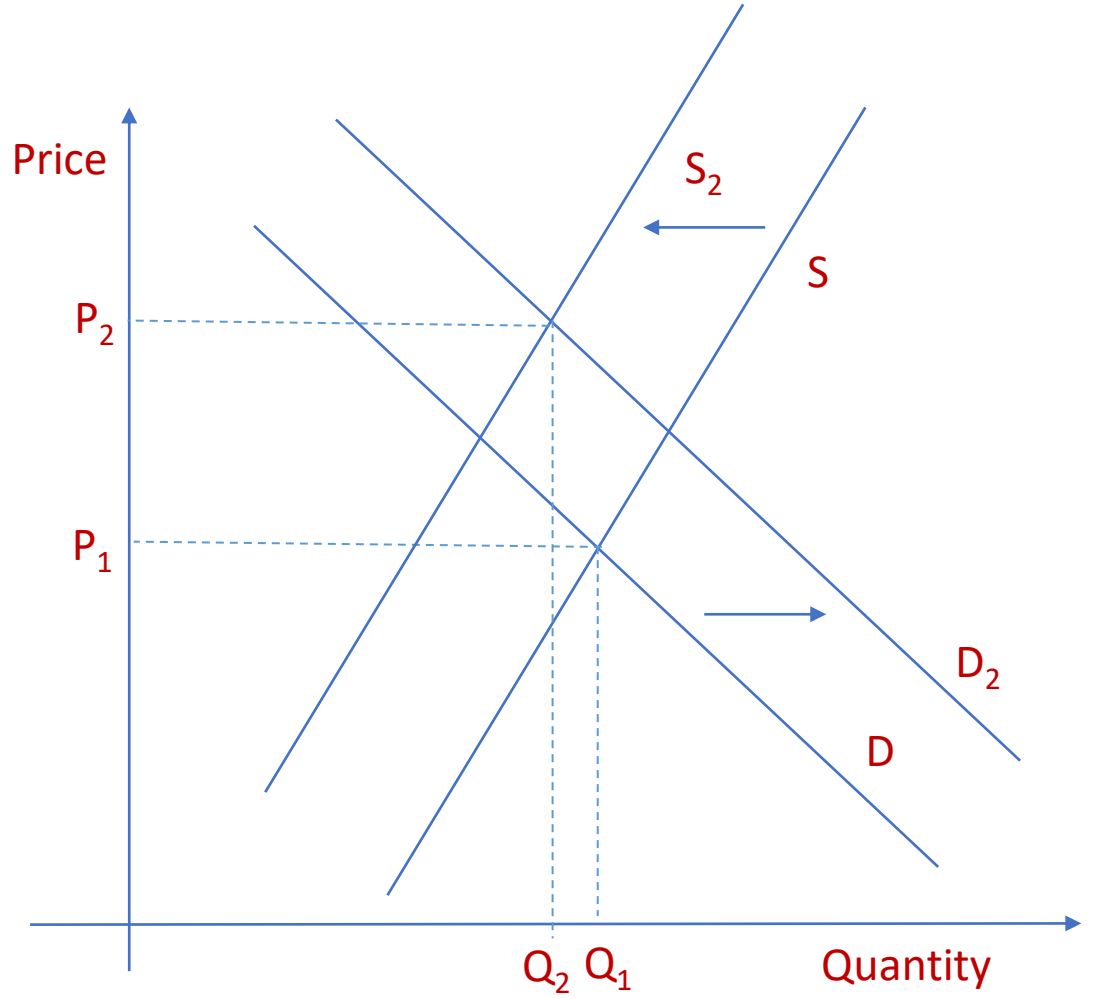
$$\text{Ln(Quantity)} = \beta_0 + \beta_1 \text{ Ln(Price)} + \beta_2 X_2 + \beta_3 X_3 + \ldots + \varepsilon$$

Price	Quantity
…	…
…	…
…	…

- β_1 is the price elasticity: % change in quantity due to 1% change in price
- Say we observe prices and quantities of a service over a period of time
  - Can we regress Price on Quantity to estimate the Supply curve? (+ve β_1)
  - Or regress Quantity on Price to estimate the Demand curve? (-ve β_1)
- Most of the time, we only observe equilibrium prices and quantities.

Linear regression

- Most of the time, we only observe equilibrium prices and quantities.
  - But many things may have changed between two equilibria



- To estimate the supply curve, we need a shift in demand **only**.
- To estimate the demand curve, we need a shift in supply **only**.
- Or "condition out" one of the shifts
  - e.g., if supply shift is caused by X_2, can use effect of demand curve shift to estimate price elasticity of supply:

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