Lecture 11: Transportation: modal choice

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1 Introduction

1. Finish congestion
2. Modal choice

2 Review

1. Equilibrium in congested transport market satisifies

$$\begin{array}{cc} n_h = N\left(1 - \frac{c_h}{100}\right) & \text{Demand curve} \\ c_h = C\left(n_h\right) & \text{Supply curve} \end{array}$$

which can also be written as

$$\begin{array}{ccc} C\left(n_h\right) & = & 100\left(1 - \frac{n_h}{N}\right) \\ \text{marginal private cost} & = & \text{marginal private benefit} \end{array}.$$

2. An efficient outcome in a congested transport market satisfies

$$\begin{array}{ccccc} C\left(n_h\right) & + & n_h \frac{\partial C(n_h)}{\partial n_h} & = & 100\left(\frac{N - n_h}{N}\right) \\ \text{private cost} & & \text{external cost} & & \text{marginal social benefit} \end{array}$$

3. A tax equal to the external cost can result in an efficient outcome.
4. Tradeable quotas with total supply equal to efficient n can produce efficient outcome and distribute benefits.
   (a) Explain.

3 Complications

1. The cost of administering a tax system, a toll system, or a road permit system are positive. This reduces the benefit of the system. In the extreme case, if these costs are very high, creating a road use tax system or road permit system would reduce social welfare. Germany has instituted an electronic system to charge trucks for road use aimed at improving the efficiency of road use. However, the costs of developing the system have proved to be large and the system is still experiencing many problems.

2. The solution above assumes that the government can easily calculate the optimal tax or the optimal number of permits. This requires the government to know $C(n)$ and the distribution of costs c_i. In reality, both of these are unknown and vary by time of day and by location. They must be estimated and it may not be possible to calculate exactly the optimal congestion tax or the optimal number of road permits.

3. Interactions with other modes of travel have been ignored. Imposing a tax to reduce congestion on road A may make congestion on road B worse. The analysis above ignores the possibility of multiple roads. If there are multiple roads, the efficient solution may have to consider the interactions between demand for the different roads.

4. Alternative taxes such as a petrol tax or a parking tax have been used to approximate the optimal toll. The petrol tax does not vary by time of day or location. Also, neither of these taxes is designed to address equity concerns.

5. Alternatively, instead of taxing road transport, a government can subsidize alternatives like public transit. However, to do this properly one must consider the more general problem of how to price both highways and alternatives like public transit to obtain efficient use of each resource.

4 Modal choice

1. Up to now, we have focused on the costs of providing transport services: infrastructure costs, operating and time costs, and pollution and other

external costs. We have considered some ways to improve efficiency when there is congestion.

2. The study of congestion brought in some demand considerations. In the congestion model, the consumers attempt to minimise travel costs by choosing between two modes of transport. The analysis assumed that we know the demand functions for travel by each mode. The spatial equilibrium models we studied in the first part of the course assumed demand for transportation was inelastic. In those models, every consumer commuted and that was that.

3. How do we develop a more complete model of transport mode choice?

4. Modal choice: why is this interesting?

    (a) Study modal choice for two reasons.

        i. Predict transport demand responses to changes in prices or other features of the transport network.

            A. e.g. need to predict demand responses in order to determine optimal congestion charge.

        ii. Measure welfare effects of government policies towards transport.

5. Model of transport mode choice.

    (a) Utility from transport mode depends on:

        i. Observable characteristics of mode (z_j). These typically are things like: time of day, trip duration, travel cost, etc.

        ii. Observable characteristics of people (x_i). These typically are things like: income/wage, location, (possibly) job location, car ownership, etc.

        iii. Unobservable characteristics of both transport modes and people (ε_{ij}). These typically are things like: the degree of comfort or safety of a mode, "tastes" for driving or traveling by train, residential location, or job location.

        iv. All characteristics are observed by consumers. Some are not observed by economists. What is observed may differ depending on the dataset and the application.

6. Utility for person i on transport mode j is

$$U_{ij} = f\left(x_i, z_j, \varepsilon_{ij}\right).$$

An example is

$$U_{ij} = \left(\beta_1 + \beta_2 w_i\right) t_{ij} + \beta_3 p_{ij} + \beta_4 c_j + \varepsilon_{ij}.$$

(a) w_i is the wage or income of person i.

(b) t_{ij} is the time (duration) of travel for person i on mode j.

(c) p_{ij} is the price or fare on monetary cost to person i on mode j.

(d) c_j measures the degree of comfort on transport mode j.

(e) ε_{ij} captures all other features that affect utility of person i on mode j.

(f) We would expect $(\beta_1 + \beta_2 w_i) < 0$, $\beta_3 < 0$, and $\beta_4 > 0$. Why?