MIT 14.661
Fall 2024

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Due: Friday, October 25

Labor Economics Problem Set 2

1 A Last Look at Labor Supply

1. Rideshare economics
   (a) Derive Rideshare drivers' opt-in rule for Taxi contracts (eq. 3 in Angrist, Caldwell, and Hall 2021). Assuming, as seems reasonable, that preferences vary across drivers, for what sort of driver is the gap between the opt-in farebox and breakeven farebox likely to be largest?
   (b) (more challenging) Use the expression for compensating variation (CV) given by eq. 4 in the paper to interpret the Taxi opt-in rule in terms of the surplus that Rideshare drivers reap from higher fee-free wages when driving under a Taxi contract. Specifically, prove the statement on p. 279 that: *The surplus generated by higher Taxi wages is .5 times the product of the proportional Taxi wage advantage,* $\frac{t_0}{1-t_0}$*, the substitution elasticity (*δ*), and Rideshare fees,* $t_0 w h_0$*. This product approximates the area under the driver's supply curve between net-of-fee Rideshare and Taxi wages.* Hints: the ISE approximates the *percent change* in hours with respect to a percent change in wages. When using this, measure base-level wage rates as the Rideshare wage, $(1-t)w$.
2. A subset of the Angrist, Caldwell, and Hall (2021; ACH21) data is posted on canvas (please don't share this). The data set includes observations on the 1,031 drivers who consented to be in the Taxi experiment, that is, they agreed to receive randomly offered combinations of a virtual taxi lease, L, and a discounted Uber fee, t. The Taxi experiment ran twice; the data set includes treatment offered in each Taxi week, treatment opt-in, drivers hours worked (meaning Uber app on), farebox ("payout"), experimental strata, treatment parameters (lease and fee), and a few covariates like a dummy for female drivers and an indicator for older model-year vehicles (which cannot drive for Lyft).
   - Use these data to replicate the ISE estimates from the First Stage, 2SLS, and OLS models in columns (4)-(6) of Table A7 in ACH21. Note that the main results in Table 5 contain a parallel set of estimates with additional covariates that are unavailable for this problem set.
   - Panel B in Figure 7 reports results of using Taxi offers as instruments for the effect of Taxi *participation* on labor supply. What's the LATE interpretation of this parameter? Replicate the estimated participation effects plotted in Figure 7 at t=0 for (1) log(hours) and (2) an indicator for any Uber activity, denoted as "active" in Figure 7. Include controls for the strata used for random assignment. The point estimates and standard errors won't match the figure perfectly but it should match the estimates in appendix table A5 panel A cols 7-12.
   - Replicate one set of parametric estimates of the probit participation model reported in Table 7. For this, it's helpful to know that the variable called `predictedearnings_taxi` is a measure of $\hat{w}_i$ defined in equation (18) in the paper. It includes lags for three periods in the set of predictors. Explore the sensitivity of the opt-in probit estimates to choice of ISE by re-estimating the model for ISE values of 0 and 3. (Hint: $\hat{w}_i$ is a function of $\hat{\sigma}(t_i)$ defined using footnote 16. This, in turn, is a function of the ISE, δ^f.) Don't worry about bootstrapping standard errors; the usual clustered standard errors will do.

2 CES Production

Consider the constant elasticity of substitution (CES) production function:

$$F(K,L) = (\alpha K^\rho + (1-\alpha)L^\rho)^{\frac{1}{\rho}}\ ;\ \rho \in (-\infty, 1], \alpha \in (0,1)$$

1. Show that CES is a constant returns to scale production function
2. Derive CES conditional factor demands (K^c and L^c) and the associated cost function
3. Derive the elasticity of technical substitution for CES production. For what values of ρ does CES become Linear, Leontief, and Cobb-Douglas production? Prove this.

3 Fast-Food Labor Demand

Suppose that N fast food establishments produce according to $f(L) = \log L$, with fixed capital. The product price is fixed at 1. Aggregate labor supply is given by w^{ε} for $\varepsilon > 0$.

1. Assume establishments are price-takers in the factor market (in other words, the labor market is competitive). Derive an individual firm's demand curve. Use this to derive the aggregate demand curve (i.e., the sum of labor demand for the N establishments).

2. Derive the competitive equilibrium wage and aggregate employment level as a function of the labor supply elasticity.

3. Suppose that the ghost of Ray Kroc (that's Kroc with a K!) buys these N establishments and operates them as one firm. Assume the retail fast food market remains competitive (since there are good substitutes for Ray's product), but monopsonist Kroc is a large employer and therefore has market power in his factor market. Derive the new equilibrium wage and aggregate employment levels. Compare these to wages and aggregate employment levels when fast food establishments compete for workers.

4. Explain how Lina Khan or another similarly wise and beneficent policy-maker can use a minimum wage to generate the competitive employment level as an equilibrium outcome in spite of Kroc's market power. What must Ms. Kahn know to accomplish this feat?

5. Before feeling the Wrath of Kahn, ghost Ray was heard bemoaning a shortage of workers. Explain why a minimum wage should help Ray rest in peace.

4 Immigration Effects:Theory

1. Many skilled immigrants come to Silicon Valley to work as code warriors (we know this from the eponymous TV series). Suppose there are n_1 native programmers and the aggregate labor supply function of native programmers is $n_1 S_1(w_1)$, where $S_1(w_1)$ is the labor supply function of an individual programmer. The demand function for native labor is $D(w_1)$, with $D'(w_1) < 0$.

   (a) Suppose that immigrant and native programmers have identical labor supply functions, are paid the same, and that employers treat immigrant and native programmers as perfect substitutes. Graph the effect of an influx of n_2 immigrants on native programmer wages and employment.

   (b) Suppose now that immigrant labor supply functions differ from natives'. As in Johnson (1980), derive comparative statics formulas for the elasticity of equilibrium native wages and employment with respect to immigration (for example, $\frac{d \ln w_1}{d \ln n_2}$). For what configuration of supply elasticities is immigrant displacement of native programmers largest? Is this plausible?

5 Human Capitalism

1. Suppose that *potential* log earnings for a worker with s years of schooling are given by:

$$g_i(s) = \alpha + \rho_1 s - \rho_2 s^2$$

and that *potential* schooling values $[S_{0i}, S_{1i}]$ indexed against a Bernoulli instrument, Z_i, determine actual schooling according to:

$$S_i = S_{0i} + (S_{1i} - S_{0i}) Z_i.$$

Show that under the usual IV assumptions, the Wald estimand using Z_i to instrument S_i equals the average derivative $E\left[\omega_i g_i'(S_i^*)\right]$, where:

$$\omega_i = \frac{S_{1i} - S_{0i}}{E\left[S_{1i} - S_{0i}\right]}; S_i^* = \frac{S_{0i} + S_{1i}}{2}$$

In other words, IV captures a weighted average return to schooling with weights proportional to a normalized individual-specific first stage, ω_i.

2. Lang (1993) proposes an economic explanation of the fact that IV estimates of schooling returns often exceed the corresponding OLS estimates. Use the weighting formula to explain this argument, called "discount rate bias." (Hint: see Section 2.3.4 of Angrist and Krueger, 1999 and Card, 2001).

3. Card (2001) summarizes the evidence for discount rate bias. Propose at least two alternative explanations for the pattern of empirical findings summarized in the Card paper. What sort of evidence might help you distinguish between these explanations?

6 *(Extra Credit)* Empirical Analysis of Impacts of Immigration on the Labor Market

1. Replicate Table III in Borjas (2003) using your own 1960-2000 samples from IPUMS. Borjas used 1999-2001 CPS data rather than the 2000 Census, as the latter wasn't yet available when he was writing. For this and other reasons, your replication won't be exact; try to come as close as you can by following the sample selection, variable definition, and model specification descriptions in the paper.

2. Explore the robustness of your findings to the possible presence of schooling- and experience-specific linear trends. Why is this issue worth exploring?

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