Uber vs. Taxi: A Driver's Eye View

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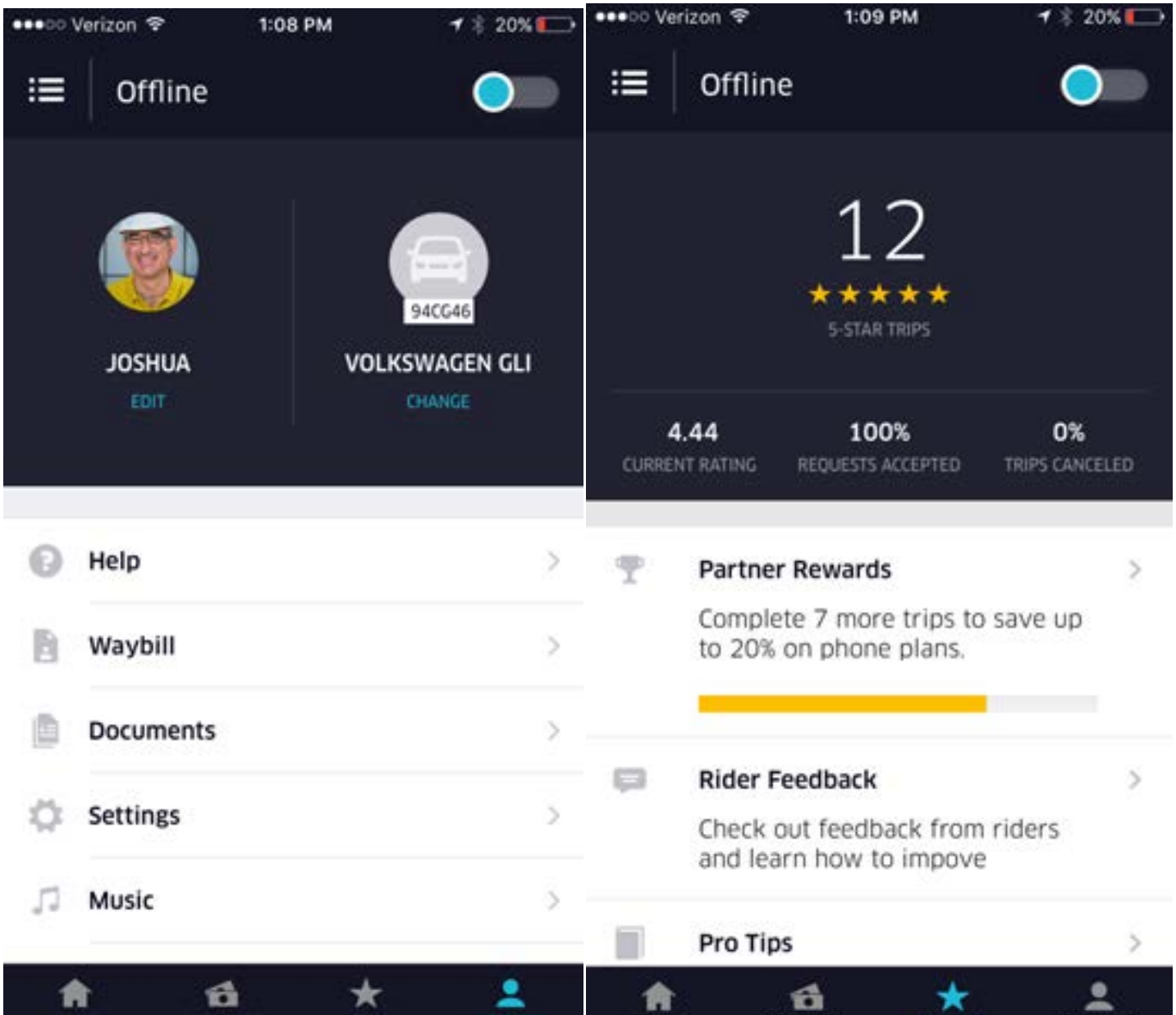
Angrist, Caldwell, and Hall (2021)

- Combines key elements of our labor supply agenda

- Life-cycle labor supply–theory and metrics
- Structural participation analysis ala Ashenfelter (1983)
- Home production
- Incorporates a Fehr and Goette (2007)-type behavioral channel in the form of lease aversion

- And I had great fun doing it!

Portrait of an Uber Driver



It's All About that Lease

- Drivers drive h hours/week, generating wh in farebox (revenue) and earnings y
- **Uber drivers** pay a proportional fee; **Taxi drivers** pay a fixed lease
  - Uber contract:

    $$y_0 = (1 - t)wh_0$$

    where $t \in [.2, .25]$ is the fee
  - Taxi contract:

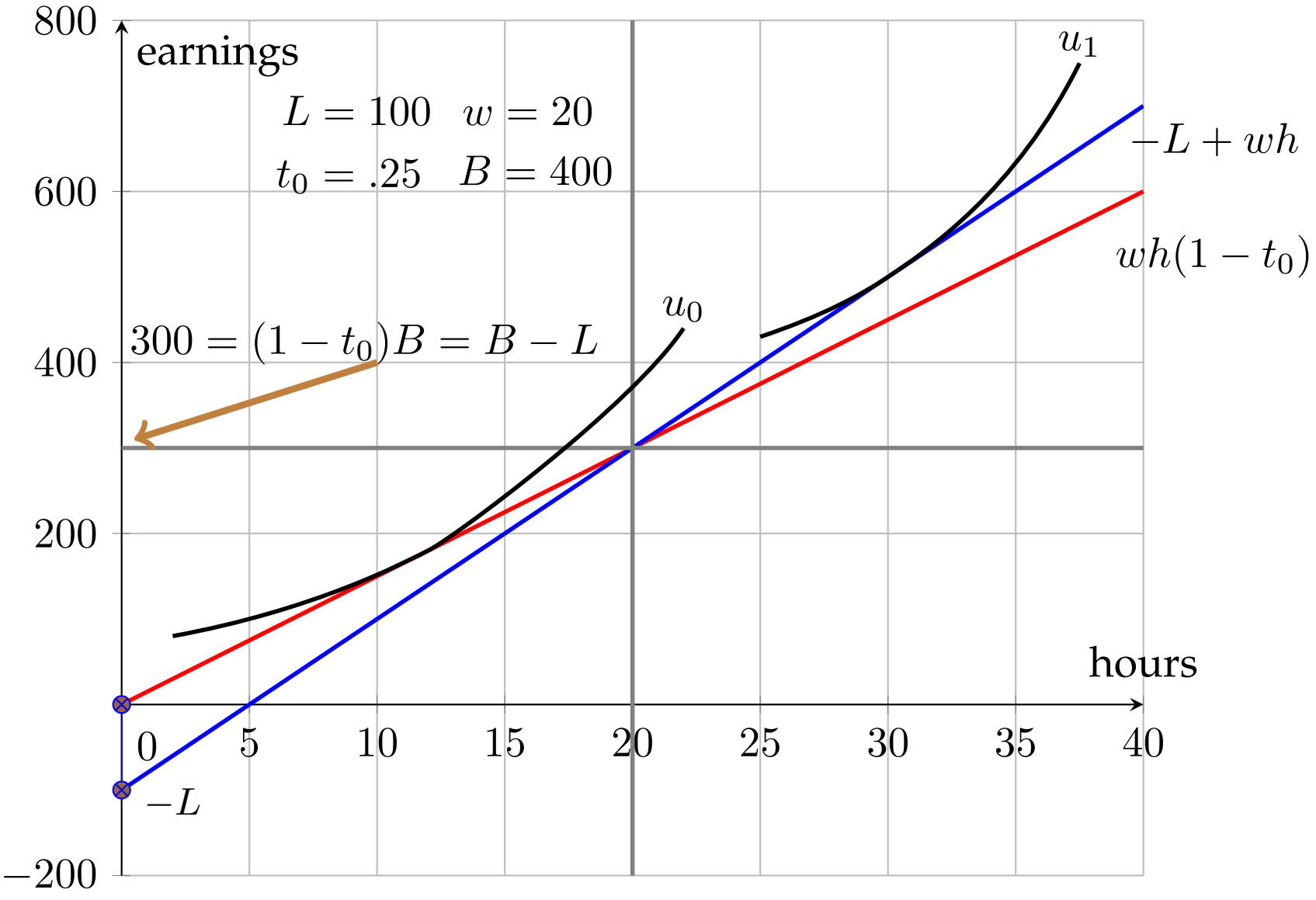
    $$y_1 = wh_1 - L$$

    where L is the weekly lease rate
- These lines cross at the Taxi *breakeven*

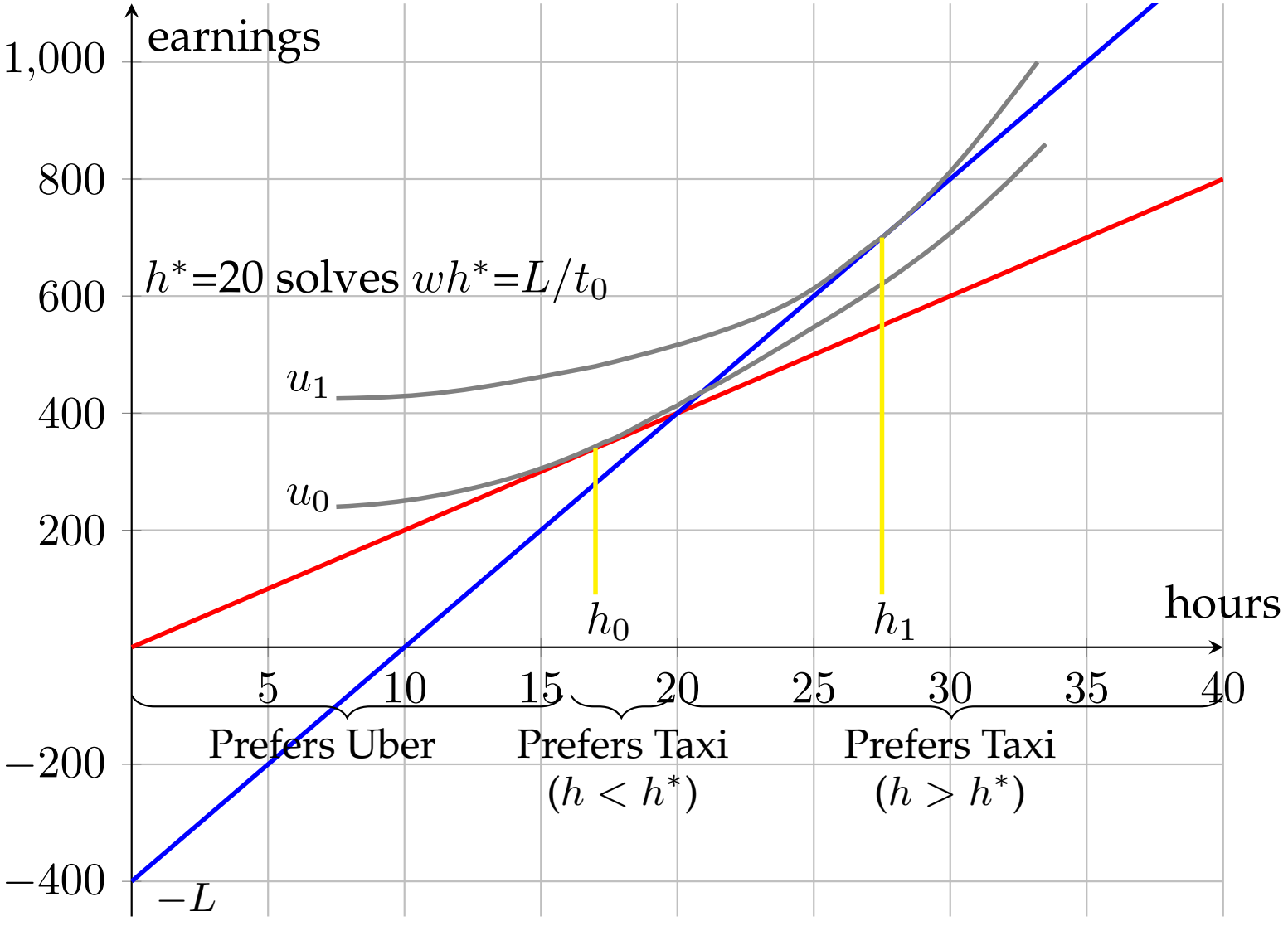
$$\frac{L}{t} = B$$

- When $wh_0 > B$, Taxi drivers earn more; some elastic drivers with $wh_0 < B$ may prefer Taxi too

Budget Lines



Driven and Elastic Drivers Opt to Take Taxi



Taxi Participation and Compensating Variation

- Excess expenditure:

$$s(w, \bar{u}) \equiv e(p, w, \bar{u}) - wT = px^c - wh^c$$

Cash to hit $\bar{u}$ when driving under a scheme with L and t:

$$f(w, \bar{u}; t, L) = (px^c + L) - w(1-t)h^c = s(w[1-t], \bar{u}) + L.$$

Compensation for Taxi (over no-lease Uber fee) is given by:

$$CV = \underbrace{f(w, u_0; 0, L)}_{\text{Taxi}} - \underbrace{f(w, u_0; t, 0)}_{\text{Uber}} = [s(w, u_0) + L] - s(w[1-t], u_0)$$

- Uber drivers opt for Taxi when $CV < 0$
  - Like Ashenfelter (1983), expand $s(w, u_0)$ around $s(w[1-t], u_0)$ and simplify to derive Taxi opt-in rule:

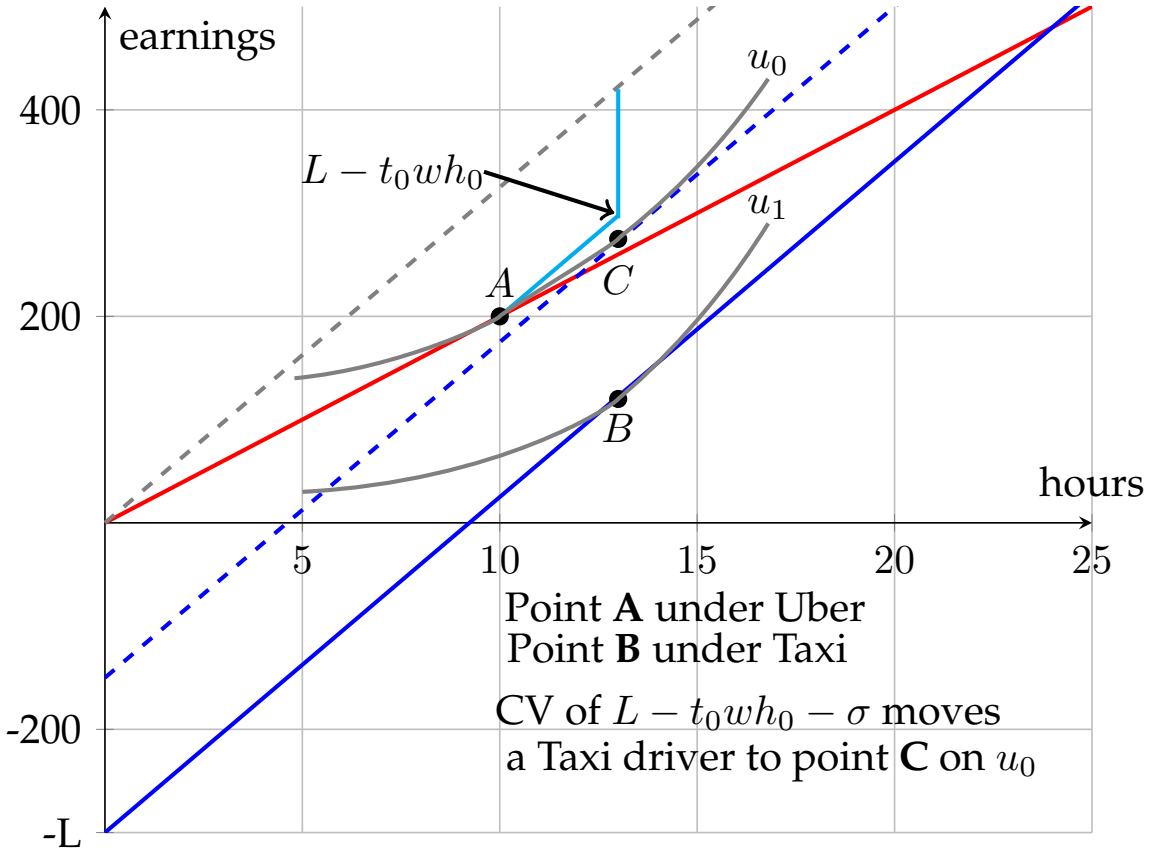
$$\underbrace{wh_0}_{\text{Uber farebox}} > \frac{L}{t}\left(1 + \frac{\delta}{2}\frac{t_0}{1-t_0}\right)^{-1}, \quad (1)$$

where δ is a substitution elasticity

Uber Driver

- We used two randomized trials to estimate the economic value of Rideshare contracts to Boston drivers
- Our *Uber Driver* story plays out in three acts:
  - Randomization of t establishes that driver effort responds sharply to pay; this favors Taxi
  - Our "Taxi experiment" offering different packages of $[L, t]$ shows that drivers are "lease averse"; this favors Rideshare
  - Findings from the first two acts are used to compute Rideshare vs Taxi Compensating variation: Rideshare wins!

CV Pictured: From $A \to B \to C$



- $CV \cong (L - t_0 wh_0) - \sigma(t, wh_0)$ where $\sigma(t, wh_0) = t_0 wh_0 \left(\frac{\delta}{2} \frac{t_0}{1 - t_0} \right)$ is driver surplus from higher Taxi wage (use opt-in expansion to show this)
- Conclude: CV is a function of $L, t, \delta; wh_0$

CV and Opt-in: Optional Features

- Compensation that moves me from $B \rightarrow C$ pays my ...
  - Taxi lease, net of fees I would have paid Uber
  - Minus extra driver surplus from higher wage ($\sigma(t, wh_0)$ is area under driver supply curve from $w[1 - t_0]$ to w, increasing in δ)
- In a static model, δ is the usual substitution elasticity
- In a lifecycle framework where Taxi contracts are offered weekly, δ is the ISE (adapting Browning, Deaton, and Irish 1985)
- Many Rideshare drivers drive part-time and/or multi-platform
  - Suppose (as in Gronau 1977) alternative earnings opportunities are a concave function of alternative hours: $e(a)$ where $l = T - h - a$
  - CV and opt–in formulas are unchanged, with the proviso that δ is the elasticity of a driver's labor supply to the firm offering Taxi contracts, higher than the elasticity of labor supply to the market

Experimental Design

Our experiment–branded *The Earnings Accelerator*—unfolded in 3 phases:

1. Identification of eligible drivers
   - Made at least 4 trips in July 2016 ("Boston active")
   - Drove an average of 5-25 hours/week in July ("Boston eligible")
   - We sampled eligibles for opt-in week from **two hours strata**
     - High hours: averaged 16-25 hours/week in July
     - Low hours: averaged 5-15 hours/week in July
2. **Opt-In week**: offering fee-free driving to eligibles $[L = 0, t_1 = 0]$
3. **Taxi treatments**: selling virtual medallions in the form of fee reductions $[L > 0, t_1 \leq 0]$

- Goals: to identify parameters determining CV and taxi participation, using these to estimate CV for Taxi

Phase 2: Opt-In Weeks ("fee-free driving")

Goals of Free Week:

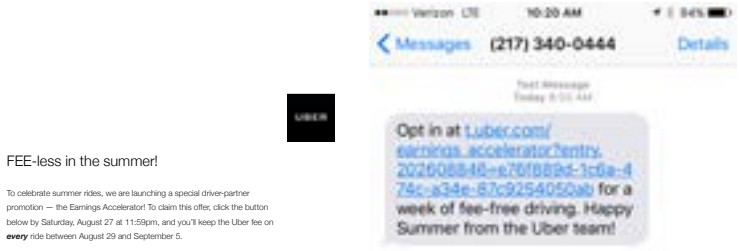
1. estimate the δ to be used when designing Taxi treatments
2. screen out inattentive drivers
3. obtain consent for data use and Taxi offers

Design:

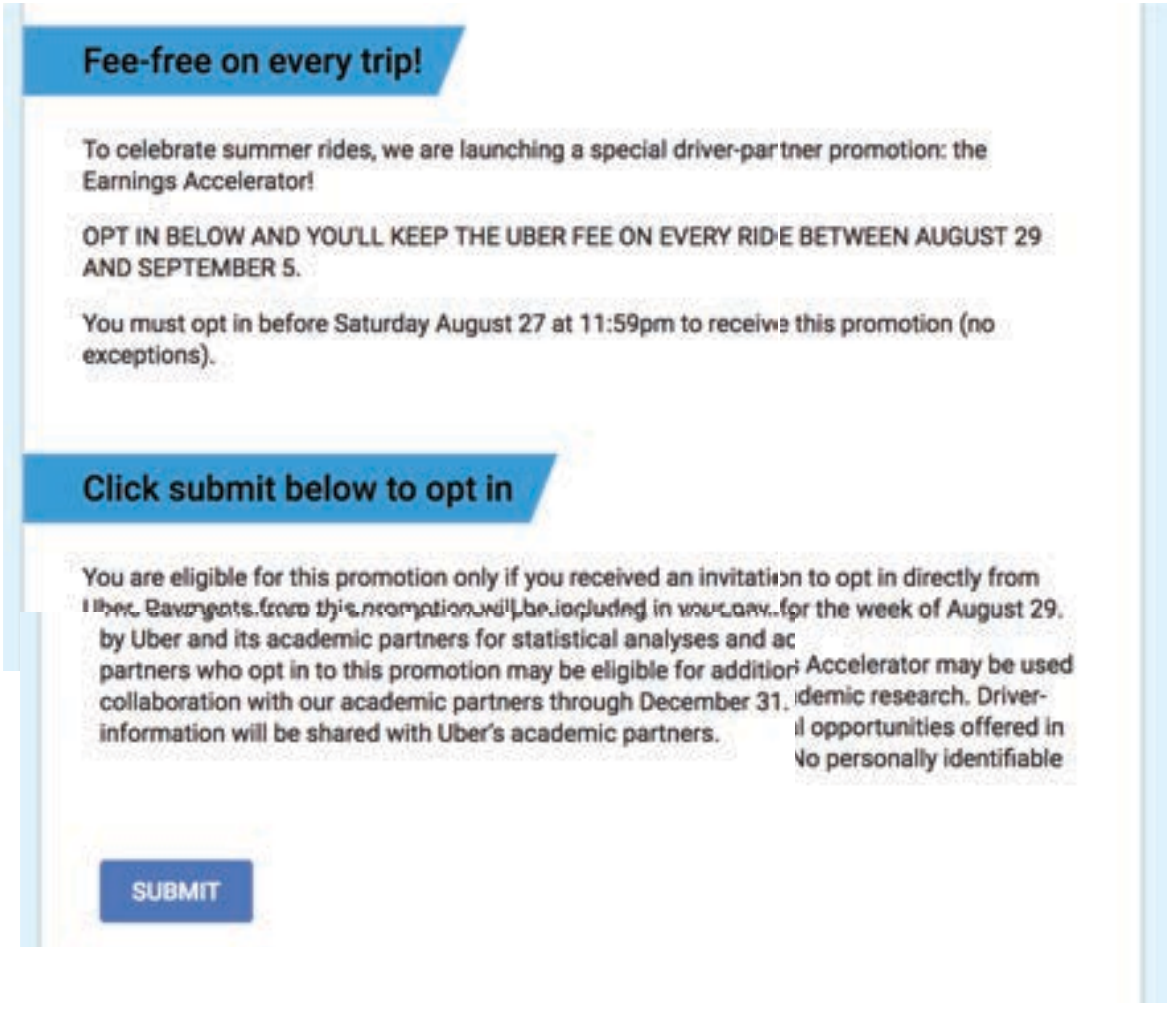
- 1600 eligible drivers were offered the opportunity to drive with no Uber fee for one week
- 800 offered fee-free driving in the first week, 800 the next (by random assignment)

Implementation:

- Drivers assigned to treatment were notified repeatedly via e-mail, text, in-app; 1 week to opt-in

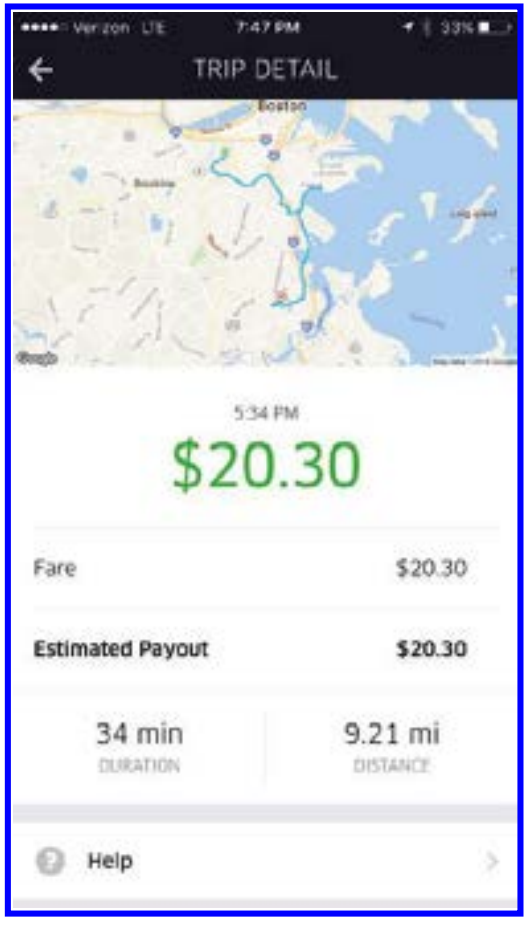


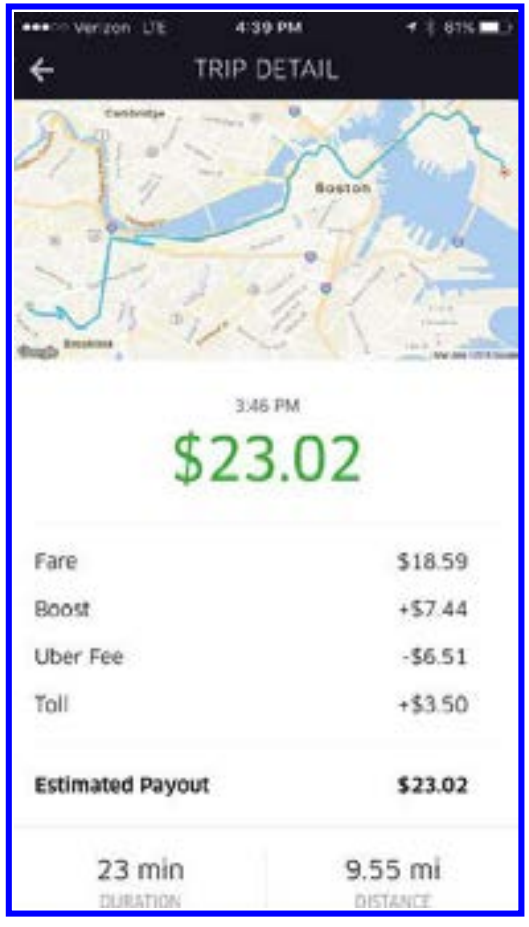
Opt-In Week: Click-thru Detail



This is what many Uber promotions look like!

Opt-In Week: Trip Receipts





Opt-In Week Take-up

- 64% of drivers (1031/1600) accepted our offer of fee-free driving
  - 71% in wave 1, 58% in wave 2
- Why not everyone?
  - Drivers are swamped with messaging
  - Some ignore Uber promotions even when these are no-lose propositions
- Free week opt-in rates were better than expected
  - And more than we budgeted for!

Phase 3: Taxi

- In Taxi Week 1, we randomly assigned 60% of the 1031 drivers who opted in to free week the chance to buy one week decreases in the Uber fee
- In Taxi Week 2, we offered 30% of 1031 the chance to buy Taxi contracts
  - Treatment contract offers were assigned within strata defined by average hours and commission (fee) rates of 20% or 25%
  - 8 treatment groups each week (2 different offers, 4 strata)

- Each Taxi treatment is characterized by two parameters:
  1. (Virtual) Lease costs (L) ranging from \$15 to \$165
  2. Fee changes ($t_1 - t_0$) ranging from 10 to 37.5 pp

Taxi Treatment Parameters

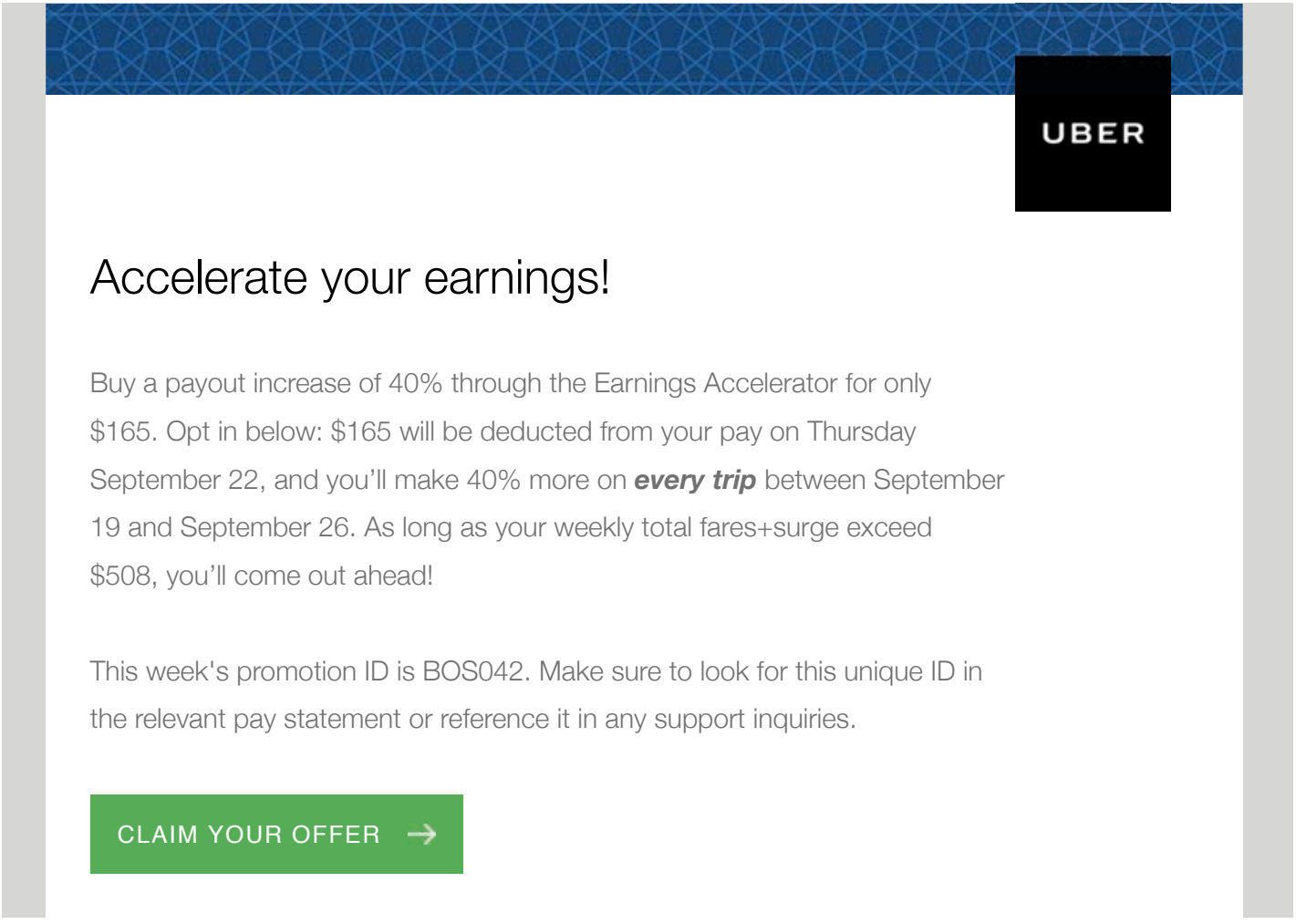
TABLE 4—EARNINGS ACCELERATOR TAXI PARAMETERS AND TAKE-UP

Strata			Treatment			Offers and Opt Ins	
Hours Group	Fee	Number in group	Lease	New fee	Breakeven	Offer rate	Opt-in rate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Week 1							
High	0.20	180	$110	0	$550	0.4	0.42
			$165	−0.125	$508	0.2	0.53
High	0.25	349	$110	0	$440	0.4	0.28
			$165	−0.125	$440	0.2	0.33
Low	0.2	177	$45	0	$225	0.4	0.58
			$75	−0.125	$231	0.2	0.51
Low	0.25	325	$45	0	$180	0.4	0.48
			$75	−0.125	$200	0.2	0.34
Week 2							
High	0.20	180	$60	0	$300	0.3	0.50
			$25	0.10	$250	0.3	0.46
High	0.25	349	$55	0	$220	0.3	0.41
			$35	0.125	$280	0.3	0.54
Low	0.2	177	$40	0	$200	0.3	0.43
			$15	0.10	$150	0.3	0.58
Low	0.25	324	$35	0	$140	0.3	0.43
			$15	0.125	$120	0.3	0.58

Notes: This table describes the Taxi phase of the experiment in which drivers could purchase a virtual lease giving them a week of fee-free driving. During each of two Taxi weeks, drivers within each stratum (listed in columns 1–3) were randomly assigned to one of two lease treatments (60 percent) or to the control group (40 percent). Columns 4 and 5 describe these treatments. Column 6 reports the breakeven associated with each treatment. Opt-in rates in column 8 are reported as a proportion of drivers offered. Lease prices were chosen so as to be attractive to roughly 60 percent of the drivers in each stratum.

The Taxi Treatment Hails Drivers

- Taxi comms show relevant breakeven, with click-thru to examples and an individualized earnings calculator



Experimental 2SLS for the ISE

- We use data from opt-in and Taxi weeks to estimate

$$\ln h_{it} = \alpha \ln w_{it} + \beta X_{it} + \eta_{it} \quad (2)$$

$$\ln w_{it} = \gamma Z_{it} + \lambda X_{it} + \upsilon_{it} \quad (3)$$

  where $\ln w_{it}$ is driver i's average hourly earnings
- Z_{it} (the instrument) indicates offer of a week of fee-free driving (opt-in weeks) or a Taxi contract
  - Life-cycle logic: income effects from leasing should be negligible
  - Modest offer effects on $h_{it} > 0$ mean logs should be ok

- Proportional wage increase generated by the Earnings Accelerator is:

$$\frac{E[w_{it}|Z_{it}=1,t_0,t_1] - E[w_{it}|Z_{it}=0,t_0,t_1]}{E[w_{it}|Z_{it}=0,t_0,t_1]} = \frac{(t_0 - t_1)}{1 - t_0} P[D_{it} = 1|Z_{it} = 1].$$

ISE Estimates

TABLE 5—ESTIMATED ISEs

	Opt-in weeks			Taxi weeks		
	Pooled (1)	High hours (2)	Low hours (3)	Pooled (4)	High hours (5)	Low hours (6)
Panel A. 2SLS estimates						
First stage	0.20	0.19	0.21	0.13	0.11	0.15
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
2SLS	1.16	1.12	1.21	1.81	2.18	1.49
	(0.12)	(0.16)	(0.19)	(0.37)	(0.66)	(0.44)
Over-identified model	1.17	1.12	1.23	1.48	1.46	1.54
	(0.12)	(0.16)	(0.19)	(0.27)	(0.40)	(0.39)
Panel B. OLS estimates						
OLS	0.21	0.13	0.29	0.03	-0.05	0.13
	(0.06)	(0.08)	(0.09)	(0.08)	(0.09)	(0.14)
Drivers	1,176	649	527	822	445	377
Observations	2,214	1,242	972	1,422	775	647

Notes: This table reports 2SLS estimates of the intertemporal substitution elasticity (ISE). The endogenous variable is log wages, instrumented with dummies indicating treatment offers. The overidentified estimates reported in columns 1–3 were computed using separate treatment indicators for each week, fee class, and hours group. Overidentified estimates in columns 4–6 uses separate treatment indicators for each taxi offer. All models control

Lease Aversion

Taxi Take-up Under Farebox Certainty

- Logging inequality (1), drivers who predict a Rideshare farebox of wh_0 should take Taxi if

$$\ln wh_0 > \ln \frac{L}{t} - \sigma(t)$$

where $\sigma(t) = \ln\left[1 + \frac{\delta t}{2(1-t)}\right]$ is the log (proportional) participation threshhold reduction due to higher Taxi wages

  - We first assume opt-in week farebox plays the role of wh_0

- Predicting participation from the Taxi opt-in week log farebox distribution for controls (denoted F_0) yields

$$q_0(L,t) = 1 - F_0(\ln \frac{L}{t} - \sigma(t))$$

- Fig. 8 compares $q_0(L,t)$ with empirical opt-in, $p(L,t)$, for the 16 Taxi treatment groups

Taxi Under-subscription

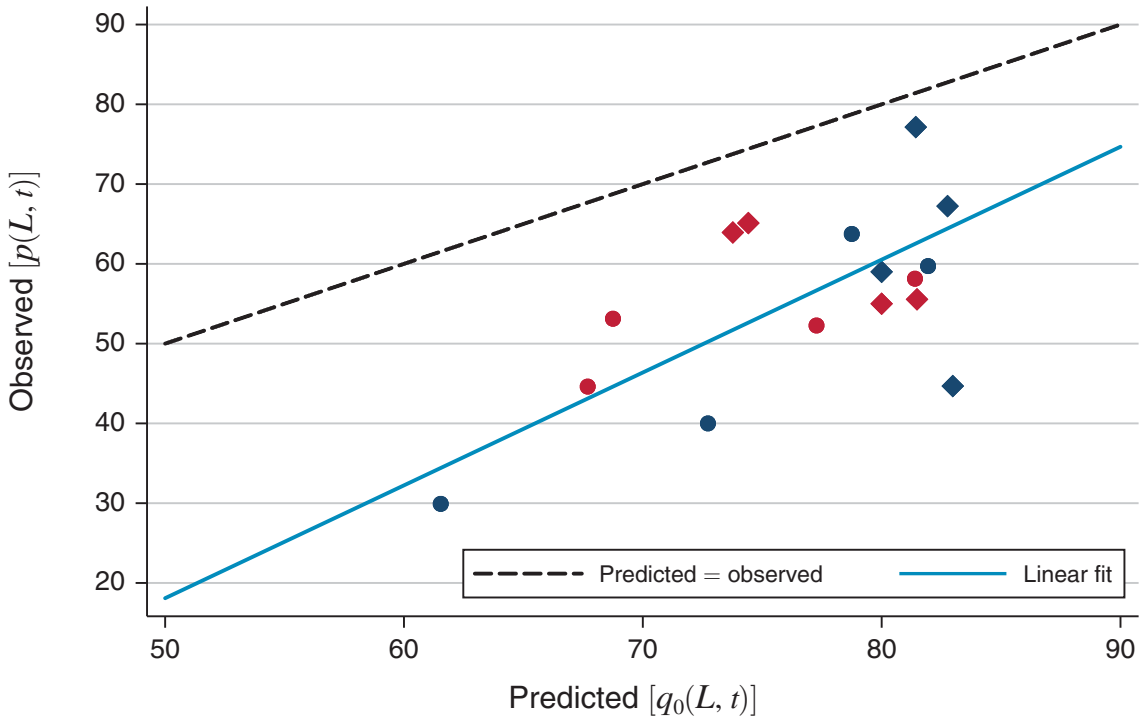


FIGURE 8. TAXI UNDERSUBSCRIPTION

Notes: For each of 16 strata defined by preexperimental hours driven, treatment week, and Taxi treatment offered, this figure plots empirical Taxi participation (lease purchase) rates against the theoretical rate predicted by the treated groups' earning distributions during opt-in week. Diamonds are used for the high hours group and circles are used for the low hours group. Red points are used for the 20 percent commission group and blue points are used for the 25 percent commission group. Drivers in the 20 percent commission group are more experienced than those in the 25 percent commission group. The ISE is set at 1.8. The dashed line indicates the locus of equality for theoretical and empirical take-up rates. Rates are calculated on the sample of drivers who drove during Taxi offer week.

Facing the Take-Up Facts

- Many drivers left money on the table by not opting in!

TABLE 6—GAINS AND LOSSES FROM TAXI

	Offer week earnings		Treatment week earnings	
	Expected		Observed	Expected
	Participated	Did not participate	Participated	Did not participate
	(1)	(2)	(3)	(4)
Panel A. All				
Mean benefit	$92	$66	$85	$64
Percent benefiting	78	56	85	54
Observations	560	679	560	679
Panel B. Conditional on driving during treatment week				
Mean benefit	$103	$106	$97	$115
Percent benefiting	83	78	92	87
Observations	515	423	515	423

Notes: This table reports the mean gains and losses from the Taxi treatment among treated drivers who did and did not buy a taxi contract. Columns 1 and 2 use data from Taxi offer weeks. Columns 3 and 4 use the same data, but adjust driver hours using the experimental wage offer and an ISE of 1.2. Panel A includes data for all treated drivers. Panel B includes data for drivers who drove during treatment week. The first row in each panel presents the mean gain for all workers in the sample. The second row reports the percent of workers benefiting.

Behavioral Taxi Take-Up

- Taxi asks drivers to bet that their post-treatment farebox will exceed B; this gamble may explain lease aversion
- Suppose drivers offered nominal lease L act as if they face lease costs of κL for $\kappa > 1$
  - This can be derived from loss aversion (reference-dependent preferences) as in Koszegi and Rabin (2006); Fehr and Goette (2007) and others
- Risk aversion (concave utility) alone is unlikely to explain under-subscription; we show this by adapting Sydnor (2010)

Lease-Averse Participation Rule

- Allowing for lease aversion, participation rates are:

$$P\left(\ln wh_0 > \ln \frac{\kappa L}{t} - \sigma\right)$$

  where $\frac{\kappa L}{t}$ is the behavioral breakeven
- Assuming farebox is Normal:

$$\ln wh_0 \sim N(X'\beta_0, \tau_0^2),$$

  β_0 is identified by regressing Taxi live week control farebox on X
- The proportion opting for Taxi is then:

$$q_0(L, t; X) = \Phi\left(\frac{1}{\tau_0}\hat{w} - \frac{1}{\tau_0}\ln \kappa\right)$$

  where $\hat{w} = \hat{\sigma}(t, wh_0) + X'\hat{\beta} - \ln \frac{L}{t}$
  - Lease aversion (κ) is identified by a participation Probit

Estimated Lease Aversion

TABLE 7—MODELING TAXI TAKE-UP

	Parametric				Inattention	
	(1)	(2)	(3)	(4)	(5)	(6)
Slope	0.69	0.73	0.81	0.79	0.69	0.68
	(0.10)	(0.09)	(0.09)	(0.09)	(0.10)	(0.10)
Intercept	−0.24	−0.25	−0.28	−0.27	−0.24	−0.17
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)
Implied Kappa	1.41	1.40	1.41	1.41	1.41	1.27
	(0.11)	(0.10)	(0.10)	(0.10)	(0.11)	(0.15)
Implied Tau	1.46	1.36	1.24	1.26	1.46	1.47
	(0.22)	(0.18)	(0.15)	(0.16)	(0.22)	(0.23)
Forecasting regression RMSE	0.71	0.82	0.80	0.79	0.71	0.71
Attentive					1.00	
					(0.00)	
Attentive × low hours						0.91
						(0.06)
Attentive × high hours						1.00
						(0.01)
Number of drivers	954	938	938	938	954	954
Earnings distribution	Predicted offer week	Predicted treatment week	Predicted treatment week	Predicted treatment week	Predicted offer week	Predicted offer week
Number of earnings lags	1	1	2	3	1	1

Notes: Parametric models are fit to micro data on take-up using equation (18) in the text. Standard errors are bootstrapped as described in the online Appendix.

CV at Last

The Cost of a (Peaceful) Taxi Transition

- Table 8 reports CV stats computed using the July (pre-experiment) avg farebox of active Boston drivers
  - Average weekly farebox is about \$372; weekly earnings around \$286
  - Assuming $\delta = 1.2$, for alternate combinations of L and t
  - Positive CV means drivers prefer Uber
- Traditional weekly lease rates (600-800\$) require substantial compensation for wage gaps (fee differential) as large as 50%
- Allowing for lease aversion ($\kappa = 1.4$), even low lease rates mostly require compensation at gaps of 25% or less
  - Median CV is \$165 for a 25% behavioral driver who leases weekly for 200\$, over half of AWE for active Boston drivers
- Most lease-averse drivers will not want to pay more than $\sim$ \$100 for fee elimination (57% prefer Uber with a 25% fee)

Table 8—Compensating Variation

Wage gap (Rideshare fee)	Weekly lease rates: $50 (1)	$100 (2)	$150 (3)	$200 (4)	$400 (5)	$600 (6)	$800 (7)	Max lease (8)
Panel A. Nominal lease								
15 percent	−$40	$10	$60	$110	$310	$510	$710	$90
	−$13	$37	$87	$137	$337	$537	$737	
	42%	66%	80%	89%	99%	100%	100%	
20 percent	−$75	−$25	$25	$75	$275	$475	$675	$125
	−$38	$12	$62	$112	$312	$512	$712	
	33%	55%	69%	79%	97%	100%	100%	
25 percent	−$113	−$63	−$13	$37	$237	$437	$637	$163
	−$65	−$15	$35	$85	$285	$485	$685	
	26%	46%	59%	70%	91%	98%	100%	
50 percent	−$384	−$334	−$284	−$234	−$34	$166	$366	$434
	−$256	−$206	−$156	−$106	$94	$294	$494	
	10%	20%	29%	37%	59%	74%	83%	
Panel B. Behavioral lease								
15 percent	−$20	$50	$120	$190	$470	$750	$1,030	$64
	$7	$77	$147	$217	$497	$777	$1,057	
	54%	78%	90%	96%	100%	100%	100%	
20 percent	−$55	$15	$85	$155	$435	$715	$995	$89
	−$18	$52	$122	$192	$472	$752	$1,032	
	43%	66%	80%	89%	100%	100%	100%	
25 percent	−$93	−$23	$47	$117	$397	$677	$957	$116
	−$45	$25	$95	$165	$445	$725	$1,005	
	35%	57%	71%	81%	98%	100%	100%	
50 percent	−$364	−$294	−$224	−$154	$126	$406	$686	$310
	−$236	−$166	−$96	−$26	$254	$534	$814	
	14%	27%	38%	47%	71%	85%	92%	

Notes: Panel A shows compensating variation (CV, paid to Rideshare drivers to induce them to work under a Taxi contract), computed for the nominal lease rates listed in columns 1–7. Column 8 reports the mean lease price at which drivers are indifferent between Taxi and Rideshare. Panel B evaluates CV using behavioral lease rates computed from Taxi take-up. The behavioral lease is 40 percent greater than the nominal lease. The ISE is set at 1.2. The first row of each cell shows average CV. The second row shows median CV. The third row reports the proportion of drivers with positive CV, meaning they prefer Rideshare. CV is evaluated using weekly earnings and hours data for all Boston Uber drivers working in the month of July 2016 who completed at least four trips. Weeks with zero trips are omitted. The mean farebox conditional on driving is $541.

Summary

- Drivers drive more in response to a reduction in the Uber fee
  - ISEs are ~ 1.2, higher for those who participate in the Earnings Accelerator
- Many drivers likely to benefit from Taxi opted out
  - Our parameterization of lease aversion, motivated by loss aversion, fits experimental data on Taxi take-up well
  - Behavioral lease costs appear to run about 1.4 times nominal
- High perceived lease costs far outweigh Uber drivers' response to higher Taxi wages
  - Rideshare appears to generate considerable surplus for drivers
  - The NYC TLC has been experimenting with proportional Rideshare-style contracts for traditional cab drivers
  - Our results can explain worker aversion to contracts requiring them to 'buy the firm'