Change in Online Taxi Drivers' Labor Supply: Experience or Price Effect?

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Outline

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- Snapp/Tapsi are different from Uber/Lyft in the way they operate.
- My focus $\rightarrow$ two unique features in supply side of matching in Tapsi

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  2. driver incurs no penalties if rejects the ride.
- Drivers are not indifferent between rides with similar prices. Destinations also matter.

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- Contributions:
  - Introducing a new channel for labor supply at the *intensive margin* for taxi drivers. (mechanism adopted by Uber just recently)
  - Decomposing effect of exogenous price shocks to labor supply into two components:
    1. *pure* price effect,
    2. experience effect.

Stance in Literature

- Classic utilities Vs. reference-dependence utilities [Camerer et al. (1997)]
- Flexibility in work hours / Value of time [Buchholz et al. (2020), Chen et al. (2020)]
- Information disclosure (?)

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- Drivers behave strategically.
- Result: low acceptance rates, high waiting times

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- Tapsi uses *Surge Pricing Mechanism*:
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- Drivers know if surge is applied, <u>but don't know its magnitude</u>.
- About 2/3 of rides have surge multiplier $\neq$1.

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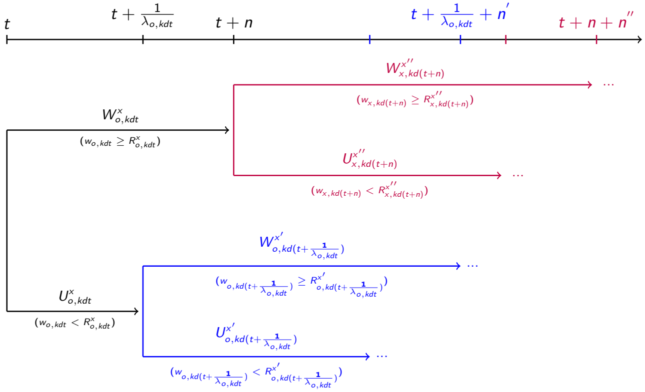
Timing of Driver's Problem

- Drivers face a tradeoff when responding to ride offers.

Figure 1: Timeline of decision making for driver



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  - Reservation wage R, a cutoff strategy solving $W(R) = U$:
    - $w > R$: accept
    - $w < R$: reject

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In context of Tapsi drivers:

1. Working shift continues: drivers receive offers after arriving at current offer's destination
2. Locations matter: distribution of offers is location-dependent
3. Drivers don't know the *actual* distribution: "learn" it as they receive offers

Model: Ride Proposals

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- Tuple $(w_{o,kdt}, n, x)$ is a ride proposal.

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  and updates it after every ride offer price $w_{o,kdt}$.
- Thus, learning is only limited to surge multiplier.

Model: Ride Acceptance

- Flow value of ride rejection:

$$\delta U(\hat{\mu}_{o,kdt}) = \underbrace{c}_{\text{cost of waiting/resting benefit}} + \lambda_{o,kdt} \times \underbrace{\mathbb{E}_y \left[\int_{R^y_{o,kdt}}^{\infty} (1 - F_{\hat{\mu}_{o,kdt}}(\tilde{w}) d\tilde{w}) \right]}_{\text{driver's expected value of next offer in current location}},$$

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- Flow value of ride acceptance for ride proposal $(w_{o,kdt}, n, x)$:

$$\delta W(w_{o,kdt}, n, \hat{\mu}_{x,kd(t+n)}) = \underbrace{\delta n w_{o,kdt}}_{\text{instantaneous earning from ride completion}}$$
$$+ \underbrace{c + \lambda_{x,kd(t+n)} \times \mathbb{E}_y \left[\int_{R^y_{x,kd(t+n)}}^{\infty} (1 - F_{\hat{\mu}_{x,kd(t+n)}}(\tilde{w}) d\tilde{w}) \right]}_{\text{expected value of receiving offer in current offer's destination at time of arrival}}.$$

Model: Reservation Wage

- $R^x_{o,kdt}$ reservation wage of driver at o, kdt for proposal with duration n and destination x:

$$R^x_{o,kdt} = \frac{1}{\delta n}\Bigg[\underbrace{\lambda_{o,kdt}\,\mathbb{E}_y\left[\int_{R^y_{o,kdt}}^{\infty}(1 - F_{\hat{\mu}_{o,kdt}}(\tilde{w})d\tilde{w})\right]}_{\text{expected earning opportunities in origin}}$$

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Proposition

We have: $\dfrac{\partial R^x_{o,kdt}}{\partial \hat{\mu}_{o,kdt}} > 0$ *and* $\dfrac{\partial R^x_{o,kdt}}{\partial \hat{\mu}_{x,kd(t+n)}} < 0.$

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Main takeaway: Beliefs must be accounted for. Model captures this. Data allows to quantify it.

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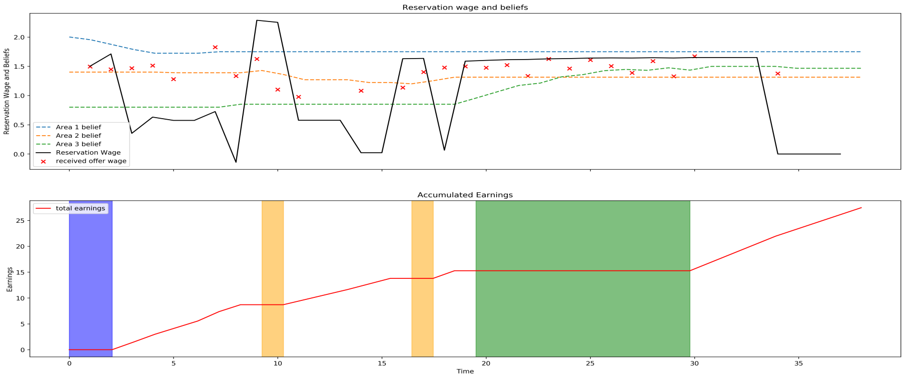
Simulation of Reservation Wage

- Three regions with same *actual* distribution, driver has different belief about each region.
- Prices randomly drawn and assigned to random destinations.

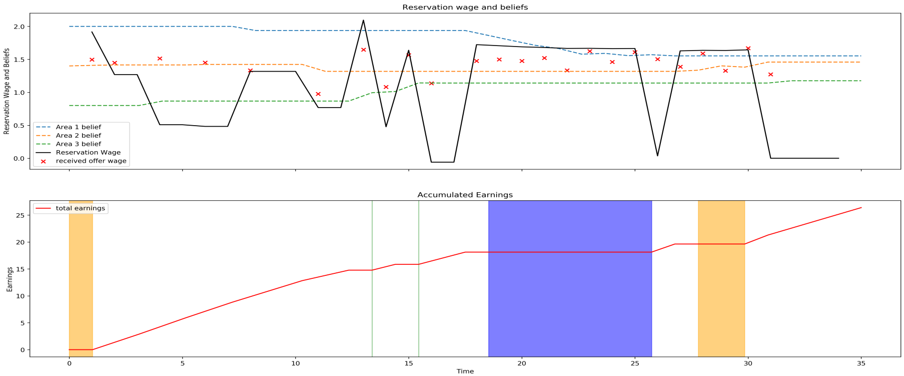
Figure 2: Reservation wage process - driver initially at region 1



Simulation of Reservation Wage

- Now, suppose driver starts from region 2.
- Same beliefs + prices but different destinations $\rightarrow$ different reservation wage!

Figure 3: Reservation wage process - driver initially at region 2



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Answer:

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2. Different surge multipliers at the borders of surge regions $\rightarrow$ RD
3. Exploit accidents as exogenous shocks to driver's belief!

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- Next steps:
  - Take the model to data.
  - Simulation $\rightarrow$ compare acceptance rate and earnings against a benchmark of no learning
  - With minor changes also answer:
    - how fast do drivers adjust their beliefs over time?
    - how would drivers react if Tapsi's rejection policy changes? (counterfactual analysis)
    - design a pricing policy that prevents drivers to extract rent from experience.