

Labor Platforms for On-Demand Services

Implications for Labor Welfare and Consumer Surplus

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Platforms for on-demand services



Transportation



Grocery deliveries

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- Shopping
- Event Help
- House Chores
- Delivery
- Office Help
- Moving Help
- Virtual Assistance
- Skilled

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Everyday tasks

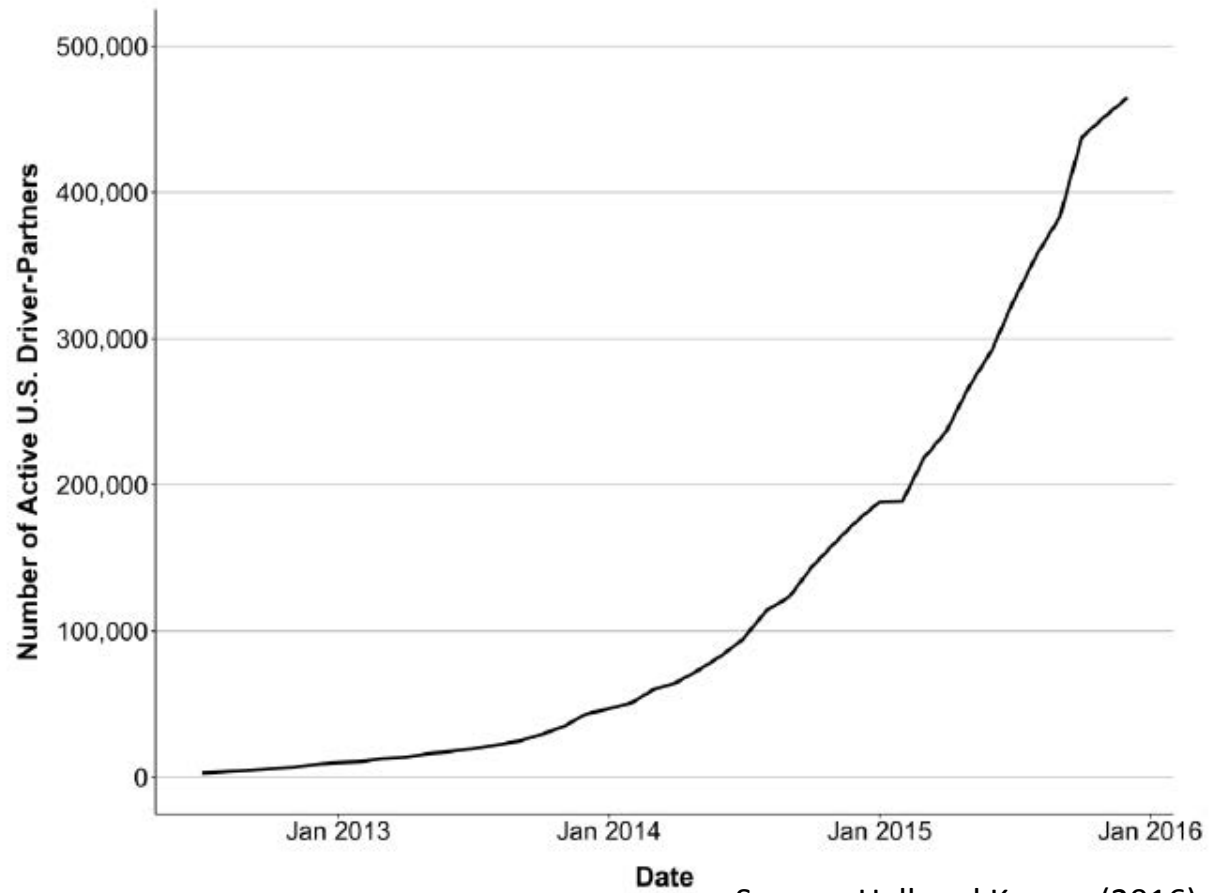


Food deliveries

and many more...



Number of Uber active drivers in the United States



Source: Hall and Kruger (2016)

Ongoing debate



Quotes from a recent article & editorial in the New Times (April 2, 2017):

“Faster pickup times mean more idle drivers.”

“Having more drivers on the road benefits ride-share companies, but **drivers profit from surge pricing and scarcity** in their ranks.”

“Drivers prefer some scarcity in their ranks to keep them busier and push up earnings. For its part, **Uber is desperate to avoid shortages**, seeking instead to serve every customer quickly, ideally in five minutes or less.”

“Uber’s interests and those of drivers are at odds on some level.”

Research questions

- Is it true that more workers on the platform hurt workers?
- Is it true that more worker mean more idle workers?

Some additional questions

- Do improvements in the **efficiency** with which the platform matches supply and demand hurt or benefit workers?
- How do the characteristics of workers (e.g., **opportunistic versus non-opportunistic**) impact the welfare of workers and that of the platform?

Agenda for the talk

- Some related literature
- An equilibrium model of labor platforms for on-demand services
- Preliminary results regarding the impact of platforms on labor welfare

Some related literature

- **Economics of labor supply**

Camerer et al. (1997); Chen & Sheldon (2015); Cullen & Faronnato (2014); Hall and Krueger (2016); Cramer and Kruger (2016)

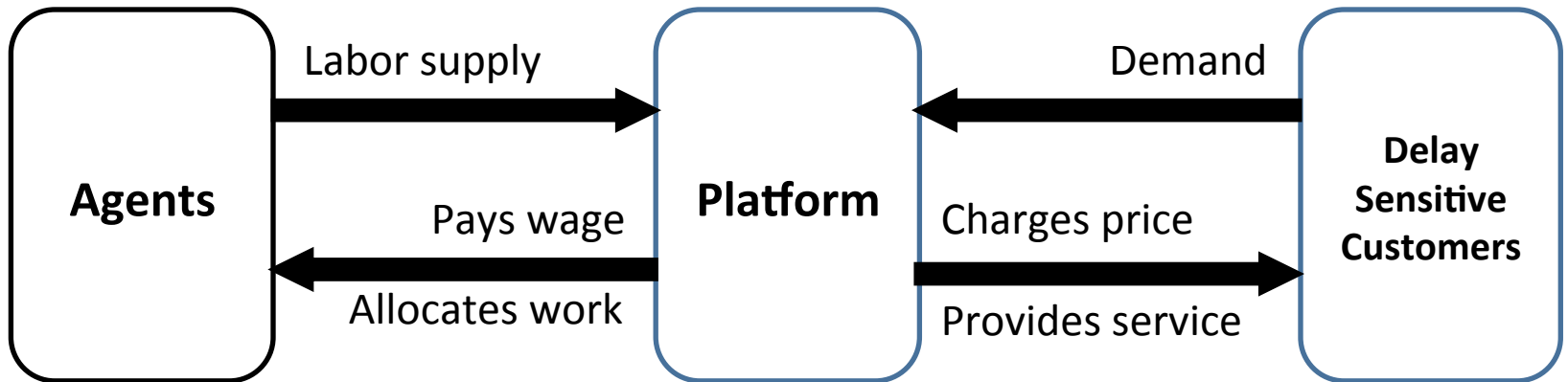
- **On demand service platforms**

Cachon, Daniels, Lobel (2017); Gurvich, Lariviere & Moreno (2016); Banerjee et al. (2015); Hu and Zhu (2017); Bimpikis et al. (2016); Taylor (2016); Bai et al. (2016)

- **Queueing systems with endogenous demand**

Mendelson (1985); Hassin & Haviv (2003); Chen & Frank (2004); Kumar and Randhawa (2010); Hassin (2016)

Problem description



Features

Agents

- Agents decide when to work and how much to work
- Agents vary in their opportunity cost

Customers

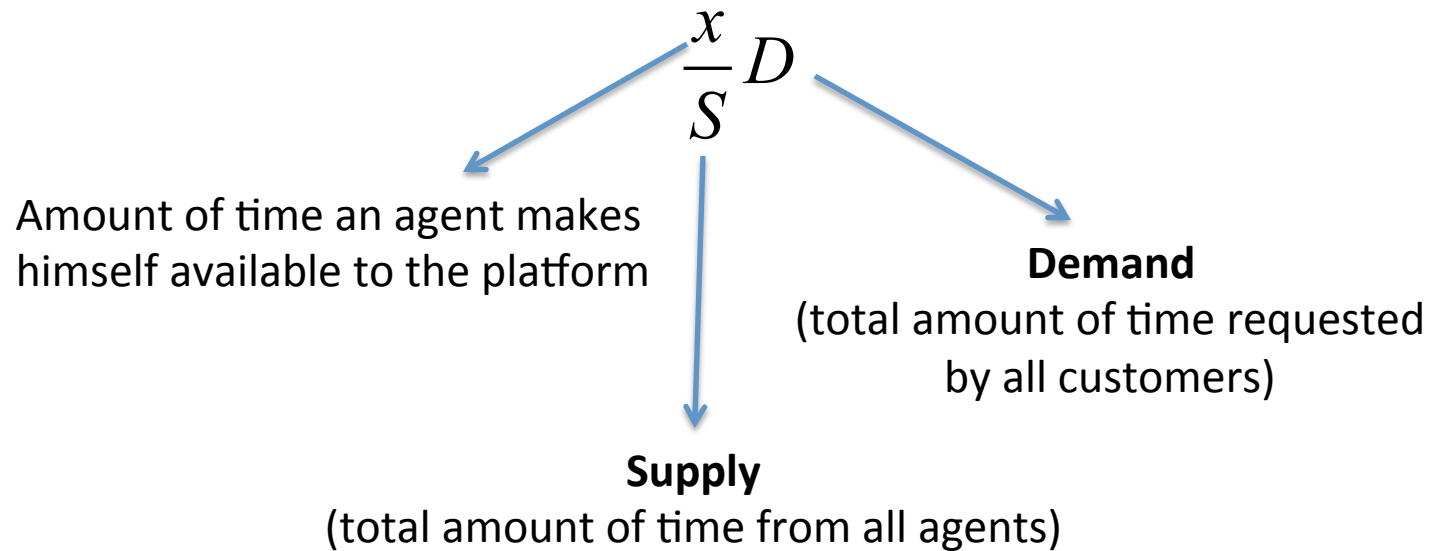
- Customers are sensitive to both price and delay
- Customers vary in their valuation of the service

Platform

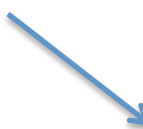
- Matches customers with agents
- Decides on wages and prices

Wages and work allocation

- The platform pays a wage w per unit of work carried out
- The platform allocates a fraction of total demand (D) to each agent that is increasing in their availability and decreasing in the overall supply of availability (S) from all the agents who participate

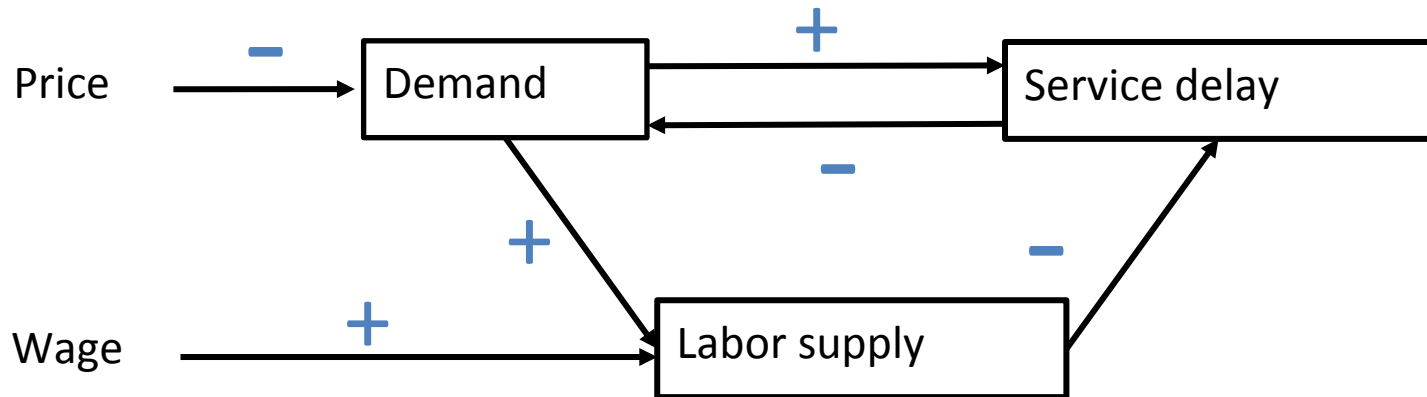


This means that **effective wage rate** per unit of time the agent makes himself available to the platform is

$$w \frac{D}{S}$$


D/S is the **agent workload** – the percentage of time an agent is busy doing work

System dynamics



A feature that arises from these dynamics is that the **cost of supply depends on demand** and the **realized demand depends on supply**.

Given these dynamics, is it necessarily the case that (in equilibrium)

- **Lower wage rates** are accompanied with **lower labor supply**?

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- **Higher delay sensitivity** is accompanied with **more agent idleness**?

Given these dynamics, is it necessarily the case that (in equilibrium)

- **Lower wage rates** are accompanied with **lower labor supply**?
- **Lower wage rates** are accompanied with **lower income** and **lower labor welfare**?
- **Higher labor supply** is accompanied with **more agent idleness**?
- **Platform growth** is accompanied with either **lower labor welfare** or **lower consumer surplus**?

An equilibrium model of a labor platform

- The platform charges customers (per instance of service) price p , pays wage w to agents per unit of work carried out and incurs variable cost r
- The objective of the platform is to maximize its profit by choosing p and w

$$\max_{p,w} \left\{ (p - w - r)\lambda \right\}$$

subject to

$$\lambda = \lambda_0 (1 - G(p + hW))$$

$$W = \frac{\lambda / S}{S - \lambda}$$

$$S = N_0 \int_{a_1}^{a_2} \frac{w\lambda}{2aS} dF(a)$$

$$0 \leq \lambda \leq S$$

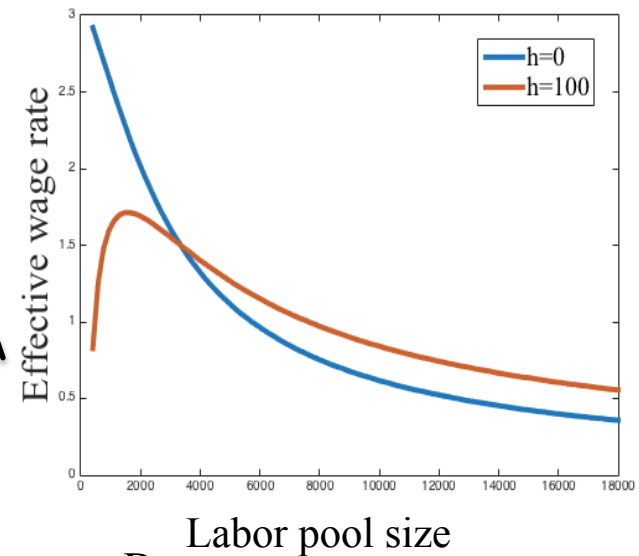
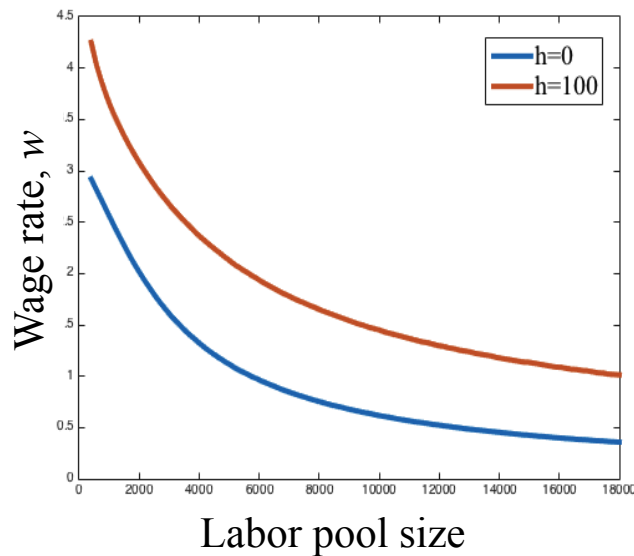
$$p, w \geq 0$$

Two benchmarks

- A system with **delay-insensitive customers** ($h = 0$)
- A “**traditional**” firm that relies on a fixed number of agents who work a **fixed amount of time** and are guaranteed a **fixed wage per unit of time** regardless of whether or not they are engaged in serving customers

Impact of labor pool size

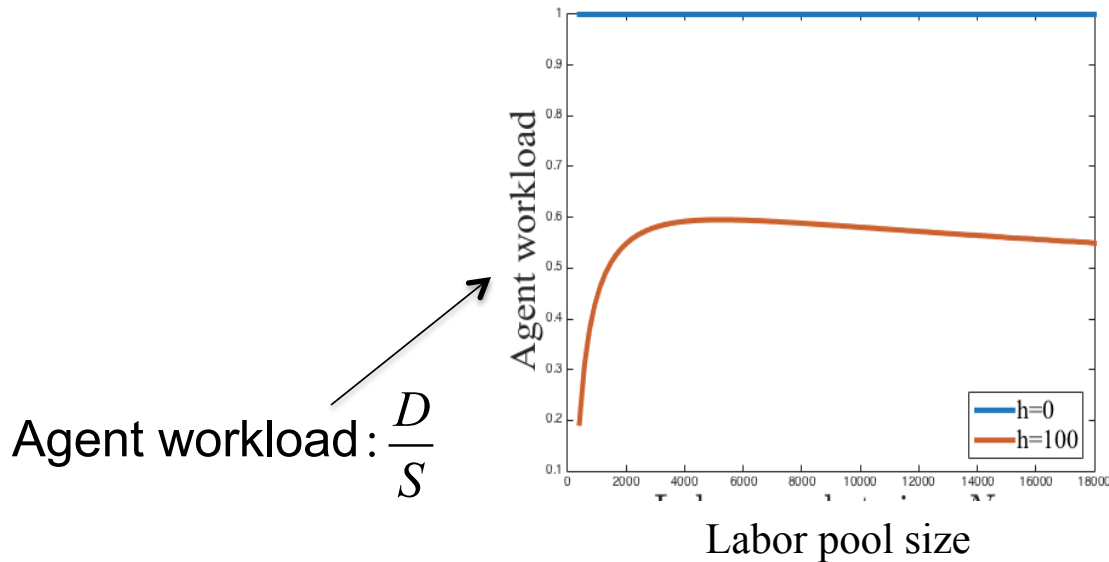
The effective wage first increases and then decreases in the labor pool size.



Effective wage: $w \frac{D}{S}$

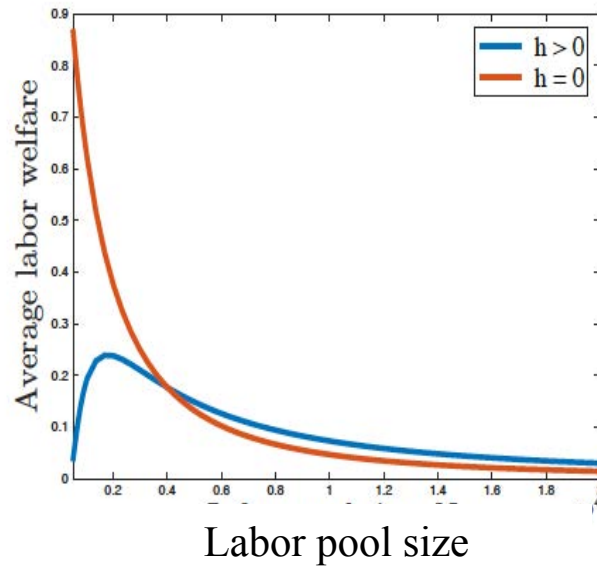
Impact of labor pool size

Agent workload first increases and then decreases in the labor pool size



Impact of labor pool size

... and so does labor welfare



- When the labor pool size is small, agents are complements as more labor supply induces more demand
- When the labor pool size is large, workers are substitutes (they compete) and more labor supply no longer induces more demand.
- An increase in the labor pool size does not necessarily lead to more idle agents

Impact of platform efficiency

- Initial increases in platform efficiency improves labor welfare (because it induces more demand which, in turn, leads to more labor supply and higher effective wages).
- However, eventually, higher efficiency leads to lower labor welfare as the platform is able to get away with less supply

Impact of opportunistic agents

- More opportunistic agents (agents whose opportunity cost varies day to day) results in more labor supply on average.
- Initial increases in the fraction of opportunistic agents increases labor welfare (an effect similar to that of labor pool size. However, further increases decrease labor welfare.

Extensions and Ongoing Work

- Systems with **peak** and **off peak demand** (and corresponding peak and off peak prices and wages)
- Systems with **labor friction** (fixed hiring and training costs, differences in labor efficiency)

Summary

- A modeling framework for understanding equilibrium outcomes (regarding prices, wages, labor welfare, and consumer surplus) under on-demand platforms
- The importance of accounting for congestion (the sensitivity to delay leads to important differences in outcomes from standard markets)
- Labor benefits from a moderate amount of congestion; enabling agents to extract a wage premium from the platform
- Regulating labor platforms needs to account for the specificity of the operating environment

Questions, Comments, Suggestions?

