Crowdsourcing the Last Mile

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Agenda

- The Issue
- A Few Points on Two-Sided Markets
- Crowdsourcing Goods Delivery
- Uberization of Goods Delivery?
- Modeling Delivery Crowdsourcing
- Some Comparative Statics
- Conclusions

The Issue

- National Hub & Spoke companies dominate delivery.
  - Thrive on Density
  - Long-haul transportation (hard to beat in that market)
  - Can they satisfy the growing demand for service quality?
    - Same Day, 2 hr, 1 hr?
    - Local markets, local fulfillment?
- Ridesharing Platforms
  - Two-sided: drivers and riders
  - Moving into same day package delivery
  - Attract enough volume build network?
  - Pricing flexibility
  - Low fixed cost

The Battle

- *UPS can put a driver on every block every day, Uber can put a driver on every block every minute – Ryan Peterson*

- *. . . delivery systems are more likely to succeed with top-down optimization, no matter how badly a sharing economy corporation tries to screw its non-employee employees – Michael Byrne*

A Few Points on Two-Sided Markets

Classic works:

Armstrong (2006)

Rochet and Tirole (2003)

Eisenmann (2005).

Demand on one ‘side’ of a market is highly sensitive to action on the other.

- Uber can attract drivers only if there are enough riders
- Merchants will accept a credit card only if enough people want to use it to pay.

Two-Sided Markets

Pricing Implications: profit max mark-up depends not just on own elasticity but on the reaction on the other side.

EG: Charge shoppers to visit a mall, decline in shoppers, decline in stores (cross-side network effect), reduces value to shoppers, demand falls.

Cross-side effects supercharge some impacts.

Two reasons why prices differ from ordinary markets

- Profit max prices differ because of external effects in equilibrium
- Profit may be sacrificed for growth purposes, leading to subsidies, penetration pricing, etc.

Two-Sided Markets

Related: ‘chicken-and-egg’ problem

No side will join while the other side is missing.

2-Sided Platform - Strong entry barriers after growth – but how do you get there? And who gets there first?

Causes some platforms to subsidize a side or to use penetration pricing, delaying profits until after the network has grown.

Two-Sided Markets

Platform Design: How many sides and how open should they be?

- NHS delivery company: Driver side closed
- Uber: Driver side (mostly) open
  - Bilateral rating system – partial side closure

Kontio (2016) - survey of crowdsourcing goods delivery companies

- Highly varied approach to both pricing and design.
- Either side could be the money side (change over life-cycle)
- Open sides often subsequently closed to improve quality
  - Firm hires its own drivers

Ride Sharing and Goods Delivery

Special characteristics of this integration

Network does not have to be built from scratch

Integration depends on scope economies among ride sharing and
goods delivery

Alternative to Uberization – expansion of Amazon into crowdsourced parcel delivery

Essential requirement: beat NHS company on quality in specific local markets

A Model of Entry by a 2-Sided Platform

Market: local, same-day delivery of packages from retail stores to consumers

Prior to entry, delivery provided by a monopoly NHS company.

- Network built to serve multi-day market
- Not easy to provide the service quality of same-day
- NHS quality is low relative to wtp for rapid delivery.

After entry, the platform provides delivery for a fee.

- ρ = the delivery charge to consumer
- δ = the driver's pay

Explicit External Cross Effect

Perceived quality, $q,$ is a function of delivery time

Delivery time falls as n_d , the number of drivers rises,
so we specify q as a positive but decreasing function of the number of drivers.

$$q = n_d^{\propto}, 0 < \propto < 1.$$

(The impact of an added driver falls as n_d declines.)

Consumers

Consumers differ in their willingness-to-pay for rapid delivery

- Heterogeneous
- Uniformly distributed
- Indexed by $0 < \theta < 1$

$$U(\theta) = N(\theta(q - \underline{q}) - \rho),$$

Where N is the expected orders per consumer and $\underline{q}$ is the quality provided by the NSA delivery company (utility associated with $\underline{q}$ is denoted $\underline{\theta}$).

Consumer joins if $U(\theta) > 0$, i.e., if their added utility outweighs the delivery charge.

Drivers

Earn net income of δ - c_d

Heterogenous in the disutility they experience

Uniformly distributed and indexed by $0 < \gamma < 1$

$$V(\lambda) = N(\delta - c_d - \lambda)\left(\frac{n_c}{n_d}\right),$$

where N is the expected orders per consumer

and $N\frac{n_c}{n_d}$ is expected packages per driver.

Drivers will join if $V(\lambda) > 0$, because net income outweighs disutility and cost.

Critical Values

0 ________$\underline{\theta^*}$__________________________________1

A consumer joins iff $\theta > \theta^*$, so that

$n_c = 1 - \theta^*$, where θ^* = $\theta^* \left(q(n_d)\ \underline{q}, \rho\right)$

0 ___________________________________$\underline{\gamma^*}$____________1

Driver joins iff $\lambda < \lambda^*$, so that

$n_d = \lambda^*$, where λ^*=$\lambda^*(\delta, c_d, N, n_c)$.

The Platform

The platform's profit is

$$\Pi_{\rho,\delta} = Nn_c(\rho - \delta)$$

Optimizing finds profit maximizing ρ and δ.

In lieu of an analytical solution, we examine the model numerically by assigning values and performing three comparative statics exercises.

Baseline Solution

Initial settings

$$\alpha = 0.25$$
$$c_d = 0.10$$
$$\underline{\theta} = 0.05$$

A low value for the service quality of the NHS company needed to support an interior solution ($n_c > 0, n_d > 0$).

With high utility from NHS, positive driver fees and delivery charges that yield positive profits will not exist.

Numerical Analysis

	Baseline Solution
ρ	0.3588
δ	0.2022
θ*	0.4472
λ*	0.1022
Π	0.4338
Nc	0.5528
Nd	0.1022
Nc over Nd	5.4085

Raise Driver Cost

Increase c_d by 50% (0.10 to 0.15)

Leads to large increase in δ to increase n_d.

The delivery charge, ρ, also increases to preserve profit.

Limits to increase in ρ, else n_c falls too far.

Already some fall in n_c. Increase in value of network to consumers swamped by increase in ρ.

Platform *may* be willing to sacrifice profit for growth might dampen further the increase in ρ.

Recall: two reasons for price behavior: external effects in equilibrium and concern to grow the network early on.

Raise Driver Cost

Increasing Cd	
ρ	0.3941
δ	0.2610
θ*	0.4808
λ*	0.1110
Π	0.3069
Nc	0.5192
Nd	0.1110
Nc over Nd	4.6763

Increase NHS Quality

Increase $\underline{\theta}$ by 50%

Platform faces more competition.

Lowers ρ to keep consumers

Small increase δ to increase consumer utility at a given ρ .

Both n_c and profit fall.

Increase NHS Quality

Increasing θ Bar	
ρ	0.3515
δ	0.2066
θ*	0.4828
λ*	0.1066
Π	0.3674
Nc	0.5172
Nd	0.1066
Nc over Nd	4.8503

Strengthen External Cross-side Effect

Increase α by 50%

α is the rate at which increases in drivers increase quality

As the value of the network increases, δ rises to bring on more drivers.

The delivery charge falls very slightly, but not enough to keep profits up.

Strengthen External Cross-side Effect

Increasing α

ρ	0.3422
δ	0.2471
θ*	0.4448
λ*	0.1471
Π	0.1857
Nc	0.5552
Nd	0.1471
Nc over Nd	3.7748

Same-Side Cost Complementarity

Scope economies among driver activities

Formal – Uberization model or

Informal – Amazon Flex

Impact primarily on λ* and c_d

Little added disutility (or cost) if driver is already nearby.

Shift in λ*, directly or thru the impact on c_d increases the number of drivers below the critical disutility value and n_d will rise.

Facilitates entry by the platform.

Beware, however, diseconomies have the opposite effect.
Coordination failure could doom project.

Conclusions and Future Work

Model explores the conditions under which a ride-sharing platform could enter parcel delivery industry

- Essential to compete on service quality
- Strong cross-side effects
- Same-side cost complementarity

Future work would focus on integrating the specific characteristics of the same-side partners into the model

And likely effects over time: growth v profits, platform design

And of course await empirical data that would come from further market experiments.

And so,

Thanks