



The Impact of Behavioral and Economic Drivers on Gig Economy Workers

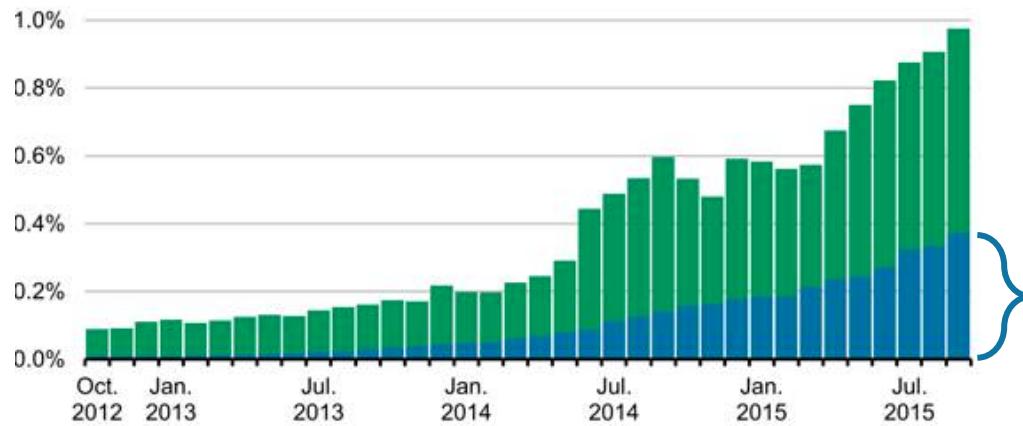
STAT 590 Spring 2019



Park Sinchaisri
Operations, Information, and Decisions
Wharton

Gig Economy

Share of US adults earning income in a given month via online platforms

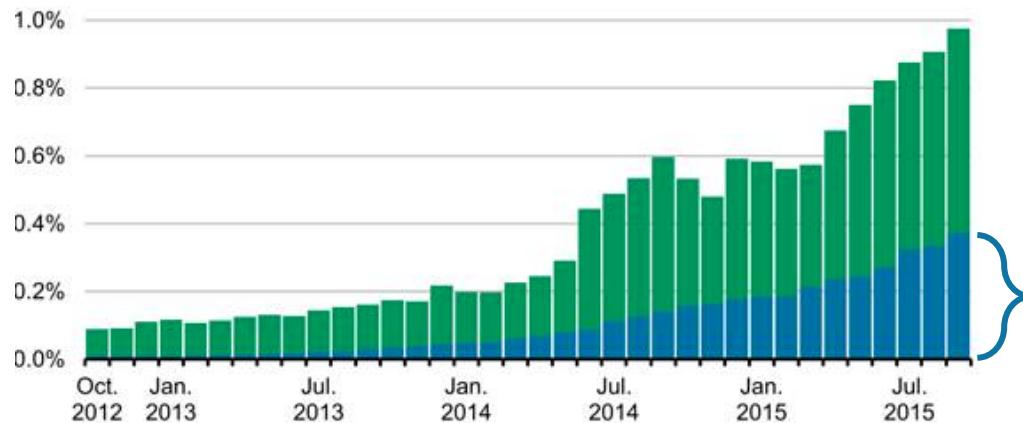


2015

44M people
in the US took on gig work (34%)

Gig Economy

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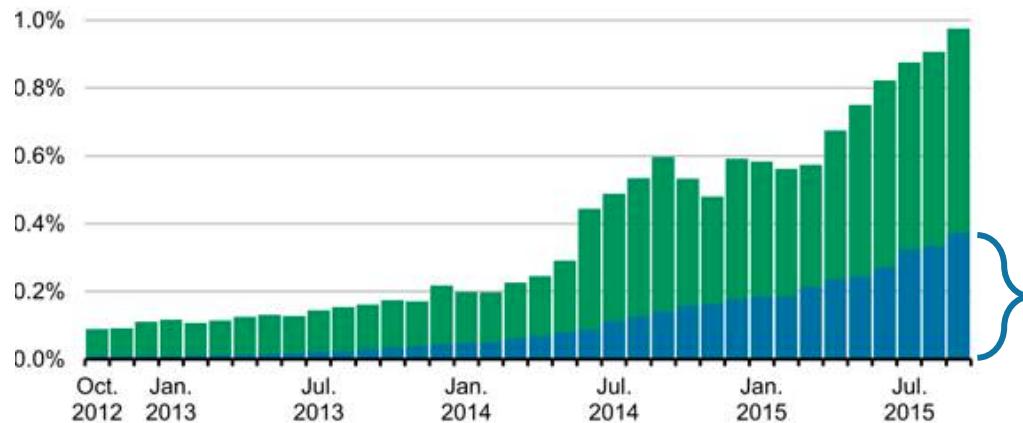


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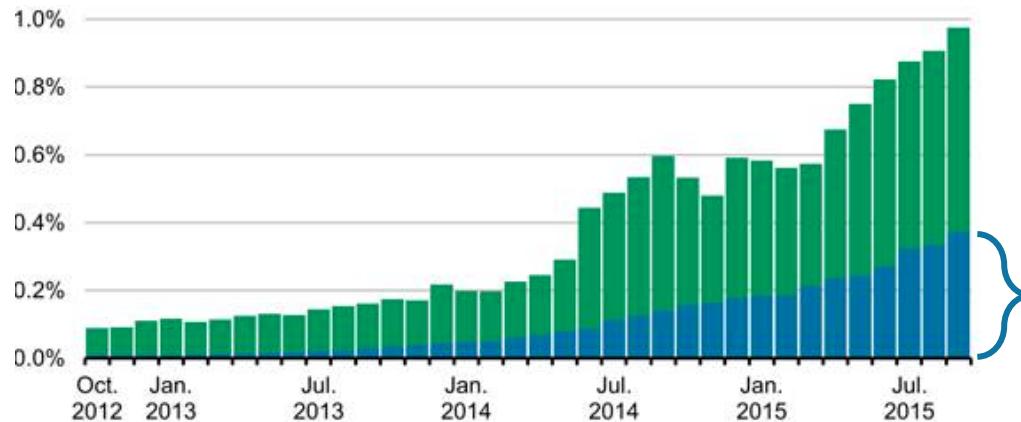


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Gig Economy

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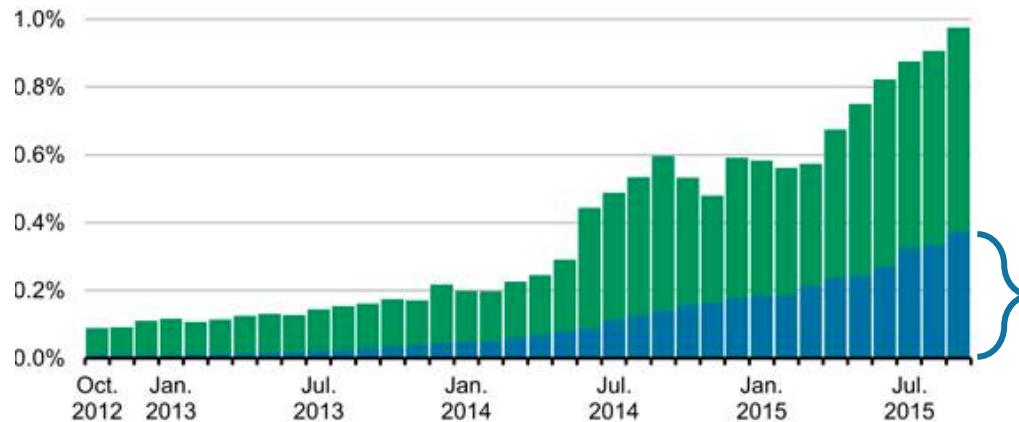


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Gig Economy

Share of US adults earning income in a given month via online platforms



2015
44M people
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Who are Gig Workers?

70% by choice



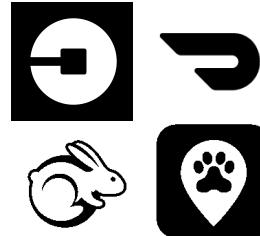
when to work?

44% primary income



how long?

~50% millennials



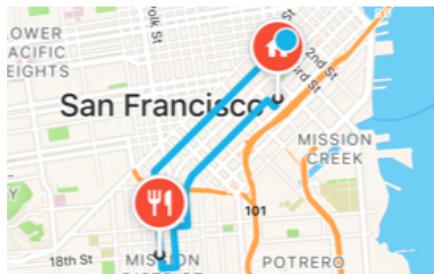
which platforms?

Workers decide work schedules

In Practice

Real-time “surge pricing”

Deliver by 6:15pm Decline



Mission Chinese Food
\$22.78 subtotal (2 items)

BUSY PAY: +\$1.50

4.1 miles total

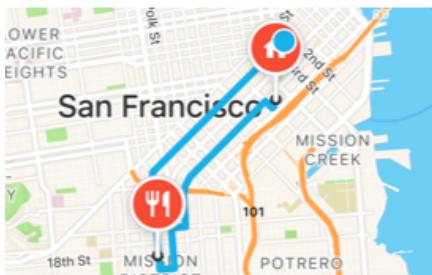
Accept Order



In Practice

Real-time “surge pricing”

Deliver by 6:15pm Decline



4.1 miles total

Accept Order

 DOORDASH

Pre-announced bonus

5:00 PM–6:00 PM

 +10% (5:00pm - 5:30pm)
+30% (5:30pm - 6:00pm)

6:00 PM–7:00 PM

 +30% (6:00pm - 6:30pm)
+40% (6:30pm - 7:00pm)

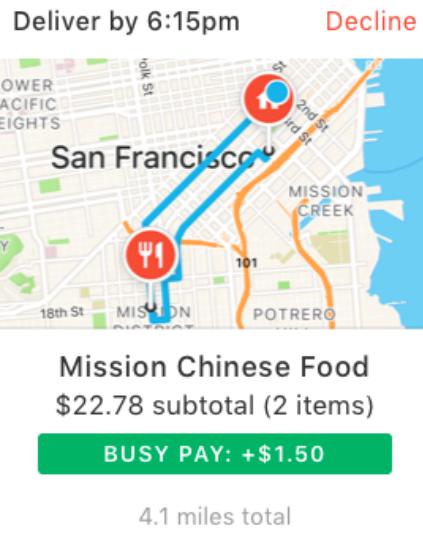
caviar

<https://dasherhelp.doordash.com/busy-pay>

https://courierhelp.trycaviar.com/customer/en/portal/articles/2821000-peak-hour-pay?b_id=9619/

In Practice

Real-time “surge pricing”



DOORDASH

Pre-announced bonus



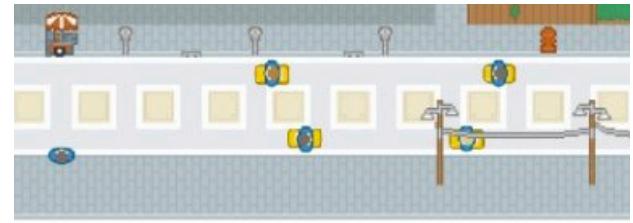
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+40% (6:30pm - 7:00pm)

caviar

“You’re so close to your precious target”



How Uber Uses
Psychological Tricks to
Push Its Drivers’ Buttons

Research Question

How do gig economy workers
make labor decisions?

Theories of Labor Supply

Neoclassical

- Maximize lifetime utility
- **Positive** income elasticities

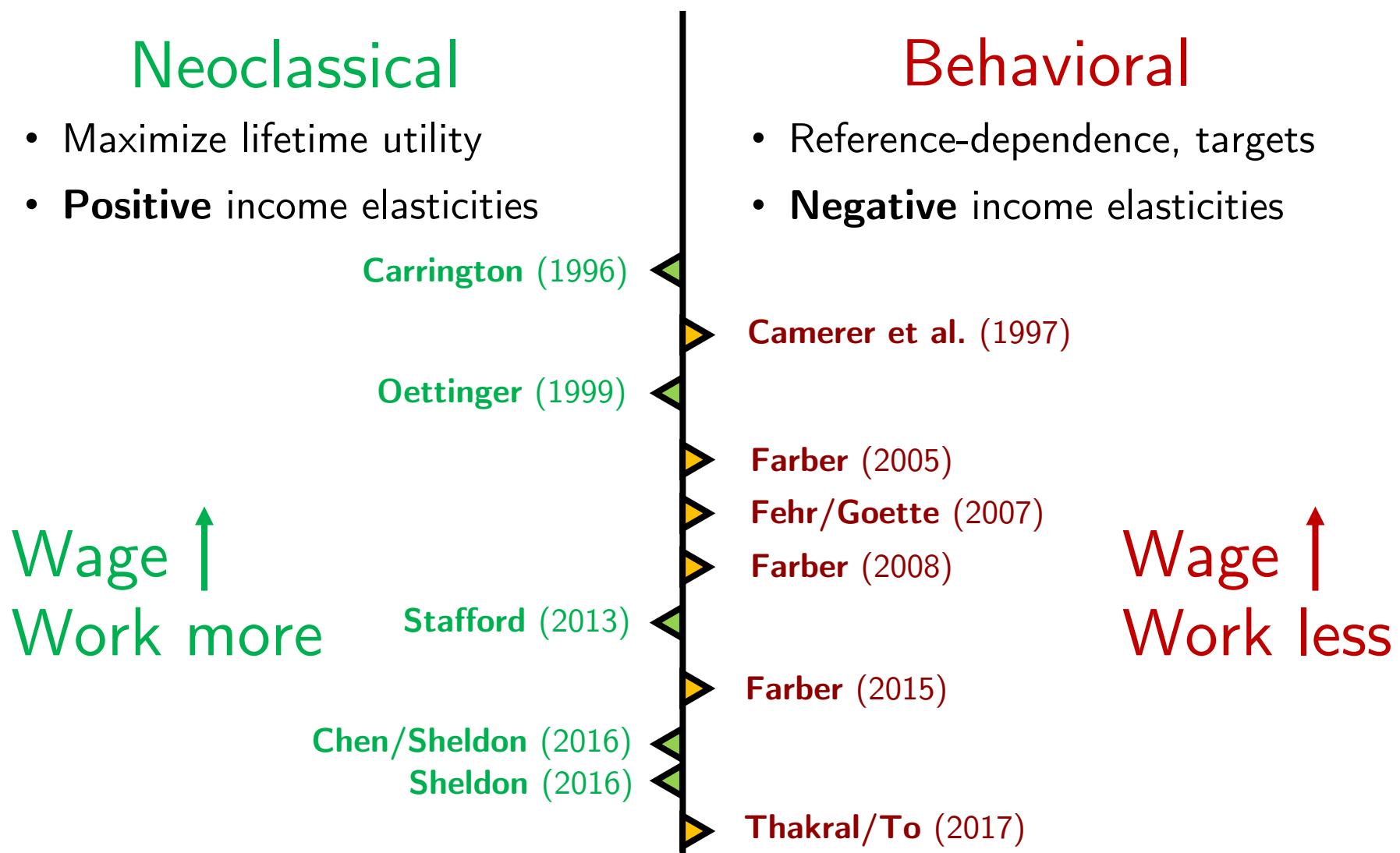
Wage ↑
Work more

Behavioral

- Reference-dependence, targets
- **Negative** income elasticities

Wage ↑
Work less

Theories of Labor Supply



Data

US ride-hailing firm

Drivers are guaranteed an hourly

Base Rate

+ Promotions

“Offer”

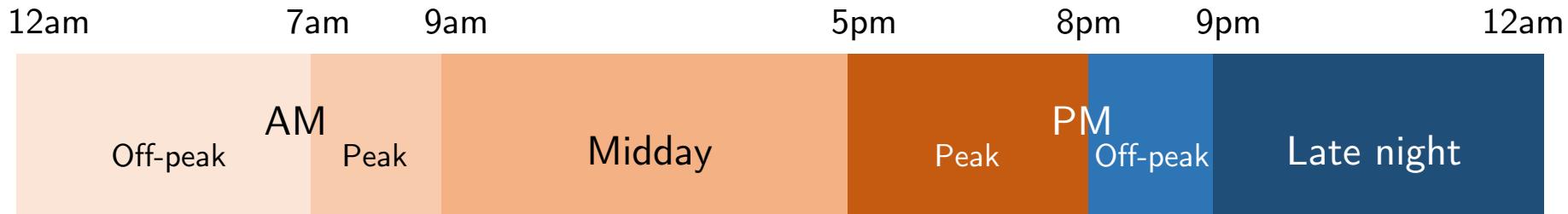
Data

US ride-hailing firm

Drivers are guaranteed an hourly

Base Rate

+ Promotions



Shift-level financial incentives and driving activity *for all*

5.5M

Observations

358

Days

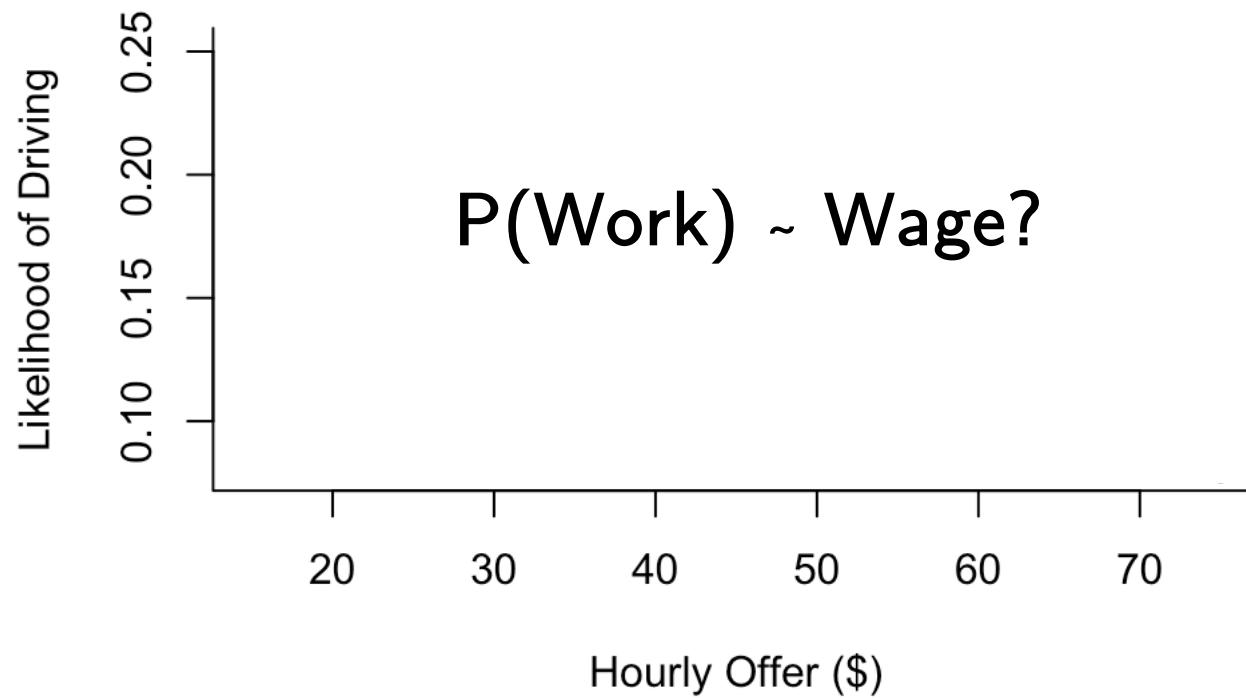
Oct 2016 – Sep 2017

7,826

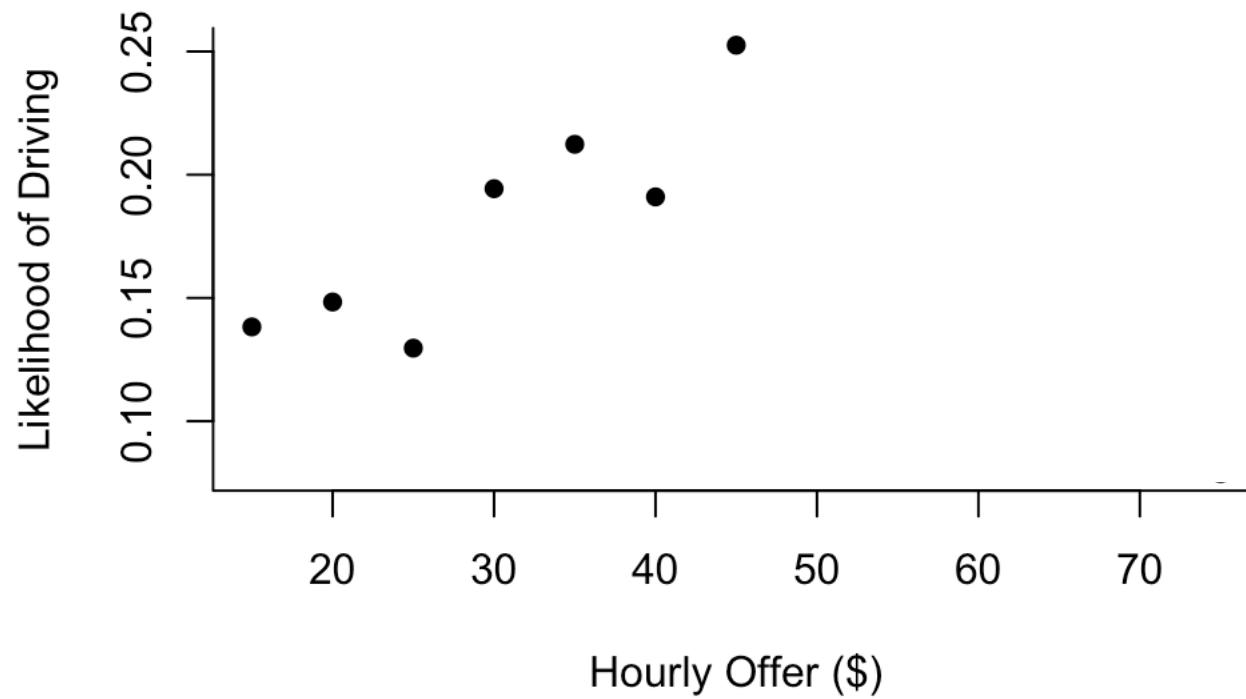
Unique drivers

SUV/Sedan/Van

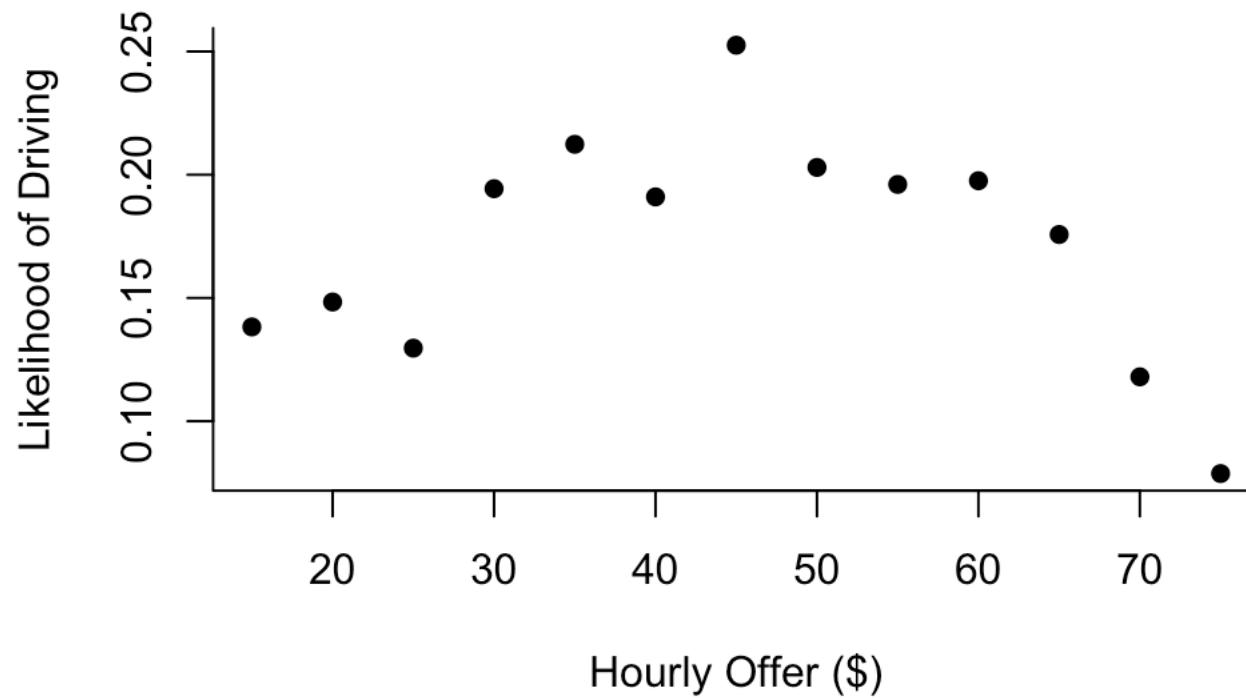
Empirical Strategy Challenges



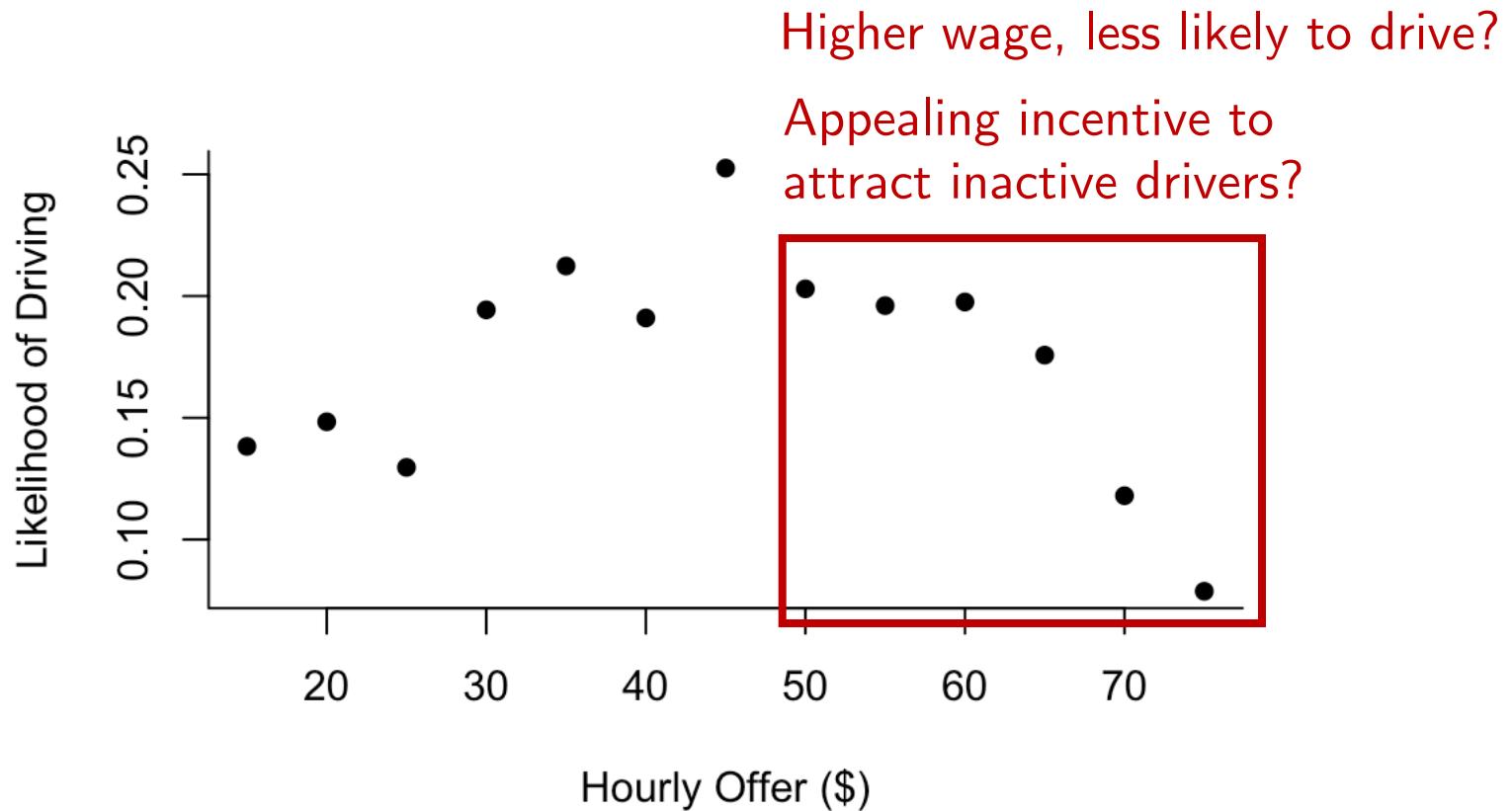
Empirical Strategy Challenges



Empirical Strategy Challenges

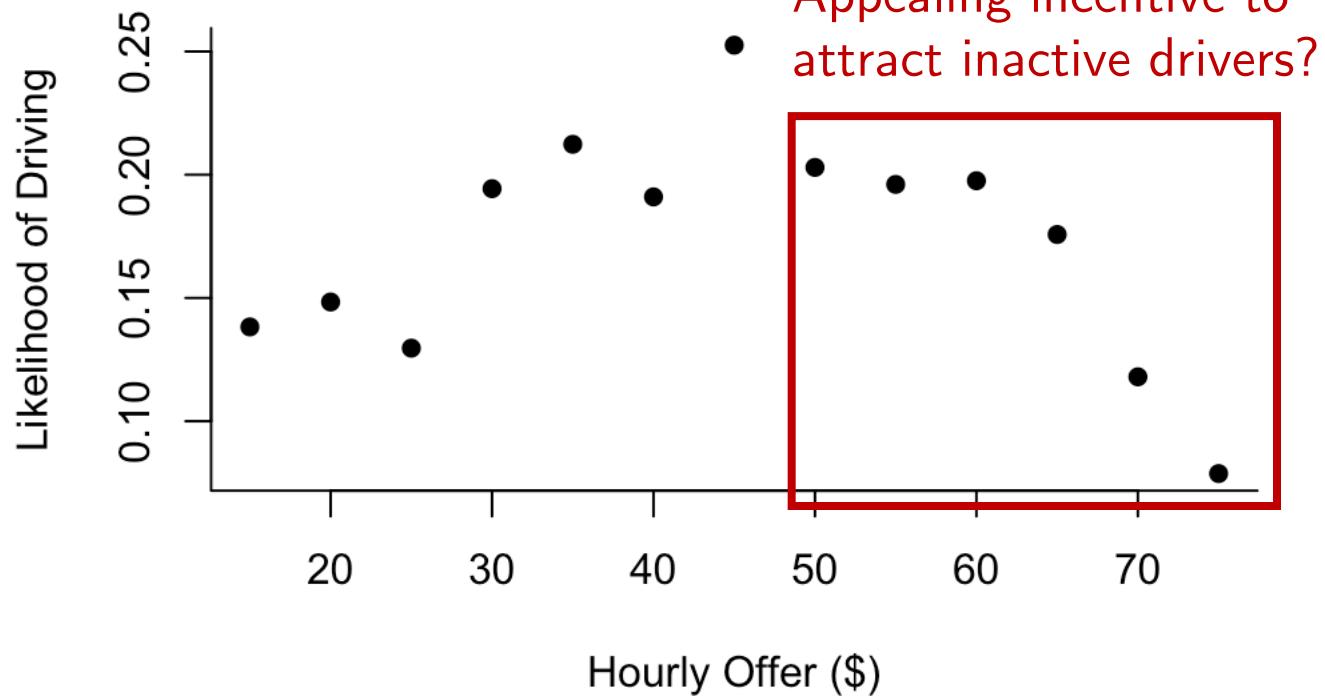


Empirical Strategy Challenges



Empirical Strategy Challenges

Simultaneity



Higher wage, less likely to drive?

Appealing incentive to attract inactive drivers?

Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

Endogenous Variable

Financial offer

Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

Endogenous Variable

Instrument

Financial offer

Average offers of “co-workers”

Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

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Instrument

Financial offer

Average offers of “co-workers”



sedan



Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

Endogenous Variable

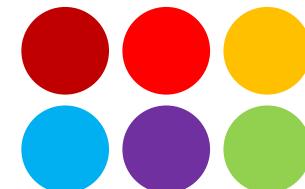
Instrument

Financial offer

Average offers of “co-workers”



sedan



non-sedan

Empirical Strategy Challenges

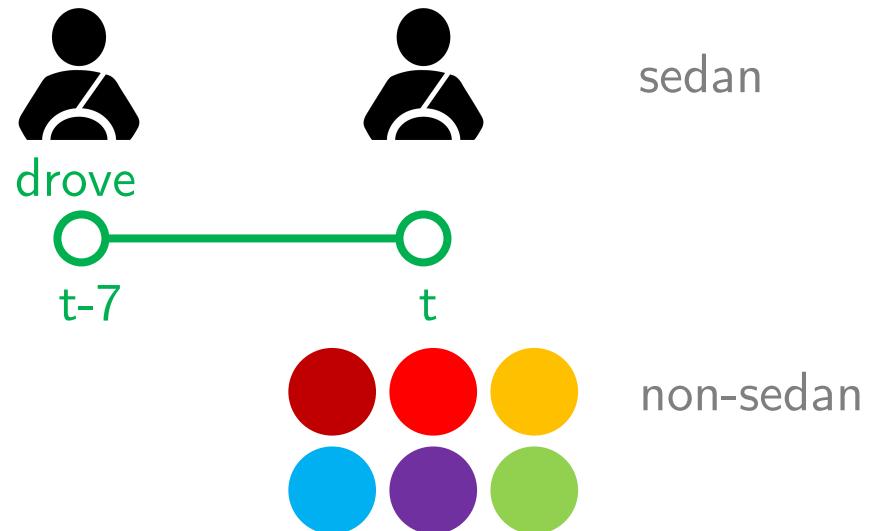
Simultaneity

Solution: Instrumental Variables

Endogenous Variable	Instrument
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Financial offer

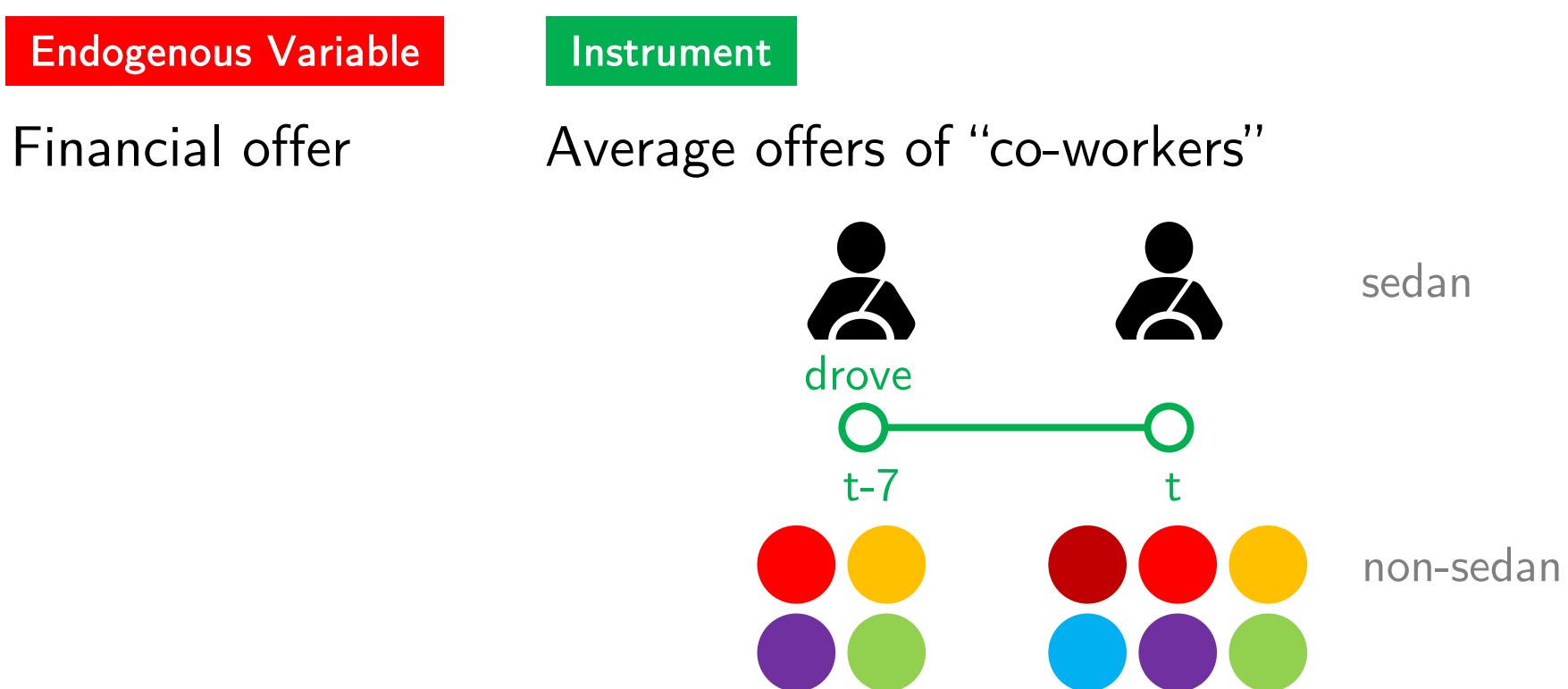
Average offers of “co-workers”



Empirical Strategy Challenges

Simultaneity

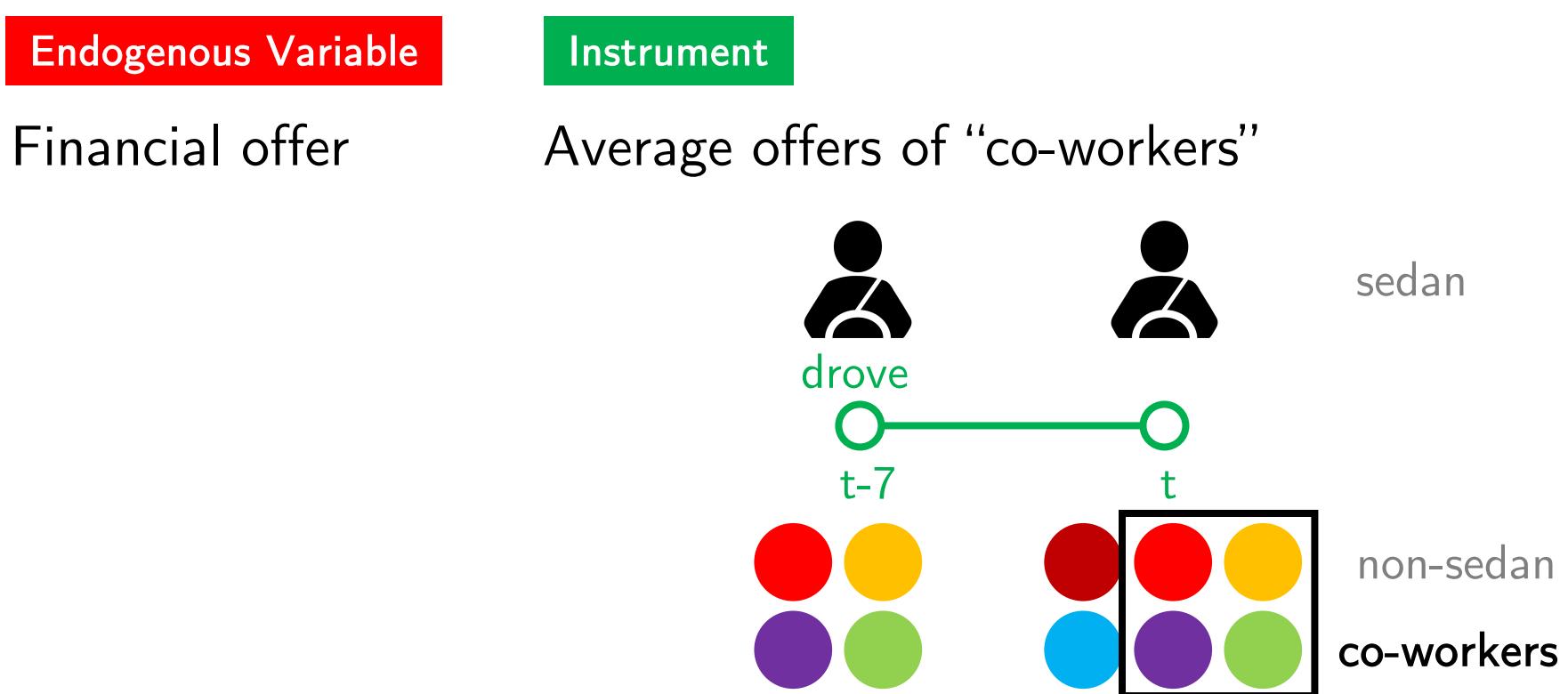
Solution: Instrumental Variables



Empirical Strategy Challenges

Simultaneity

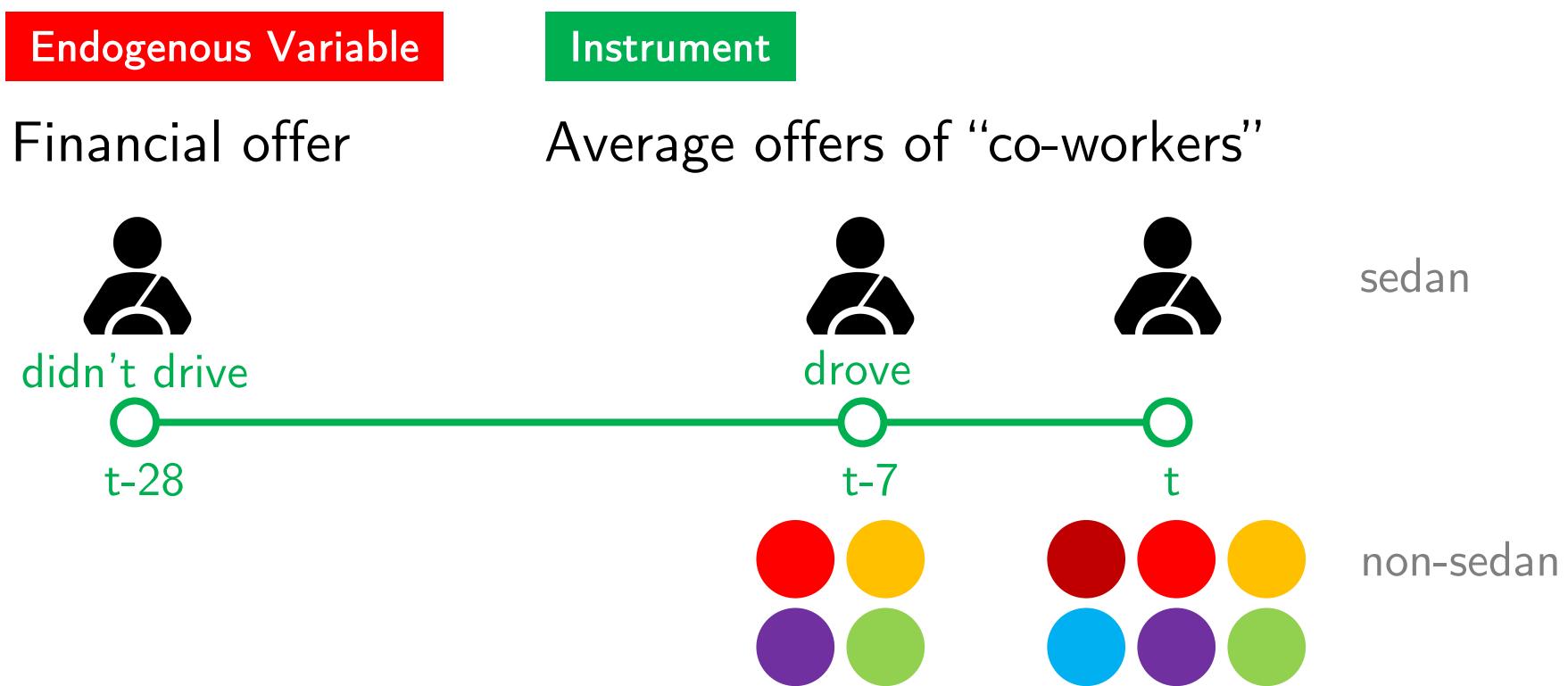
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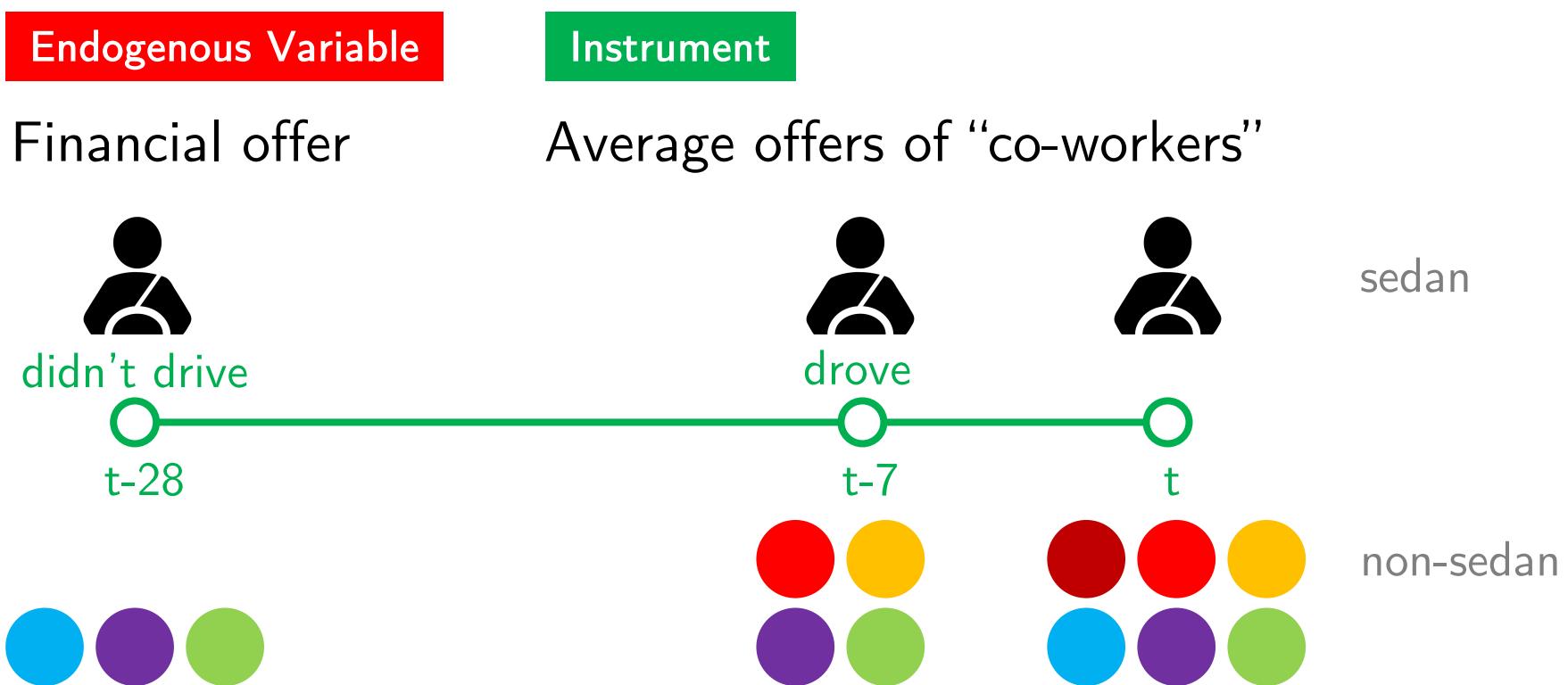
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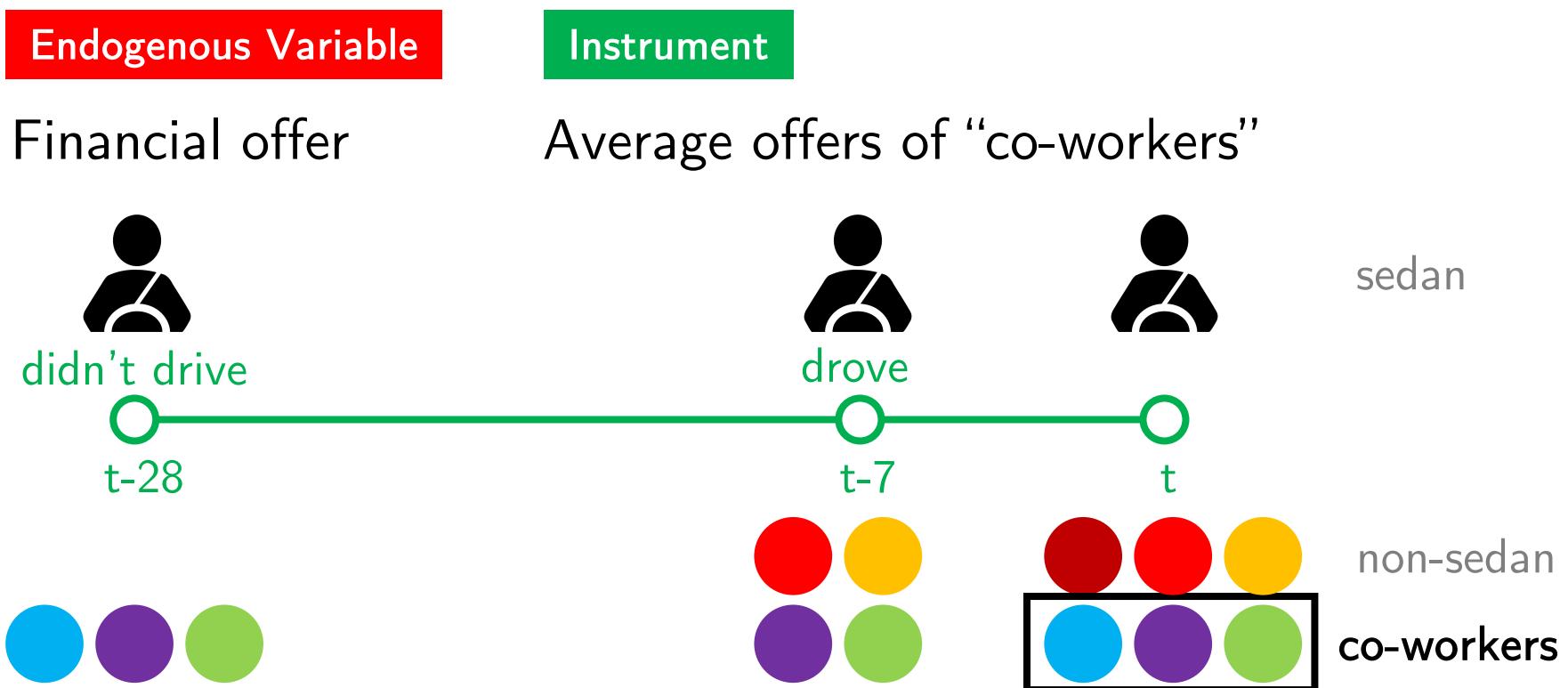
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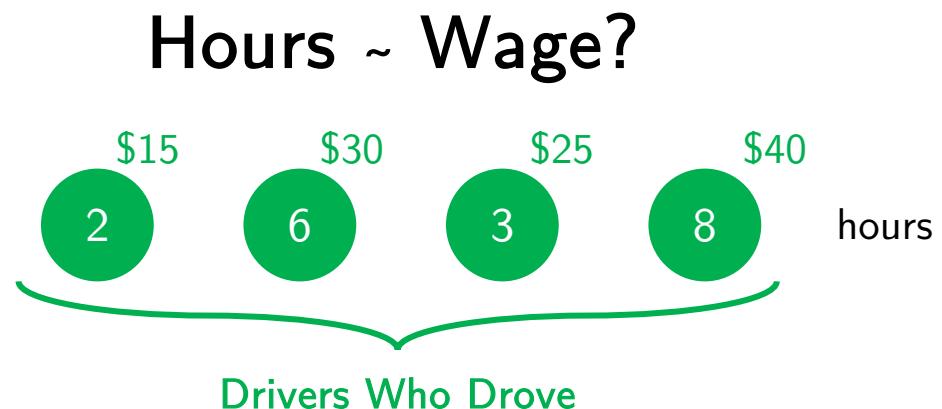
Solution: Instrumental Variables



Empirical Strategy Challenges

Simultaneity

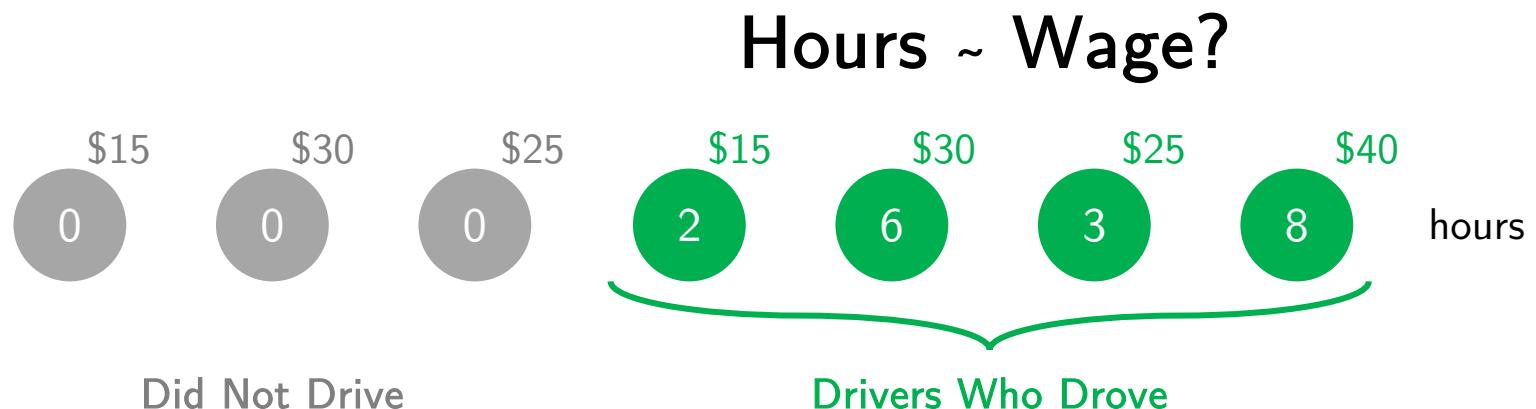
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Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

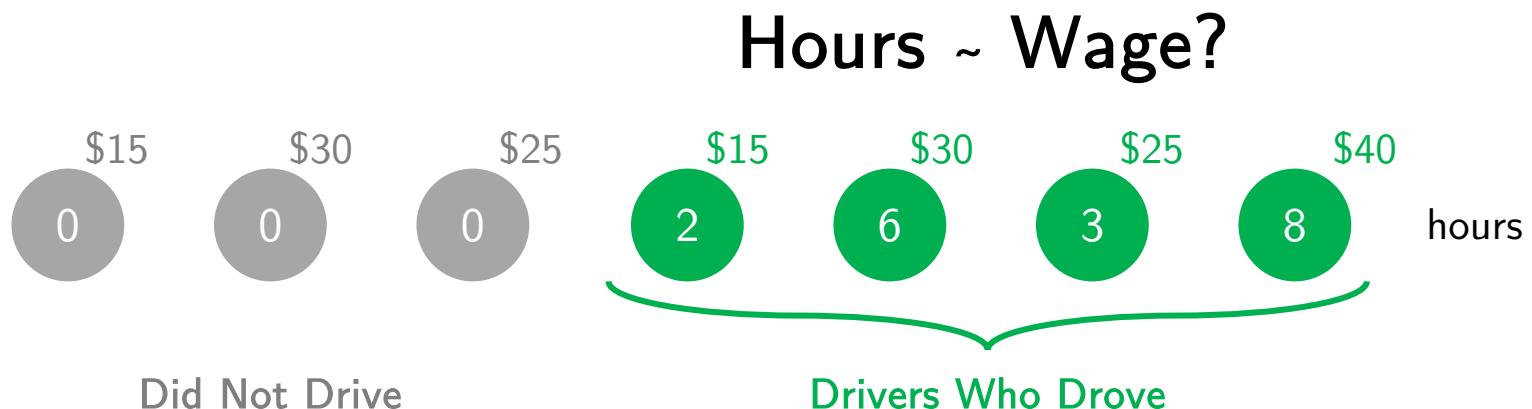


Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

Decision to work is **not random**

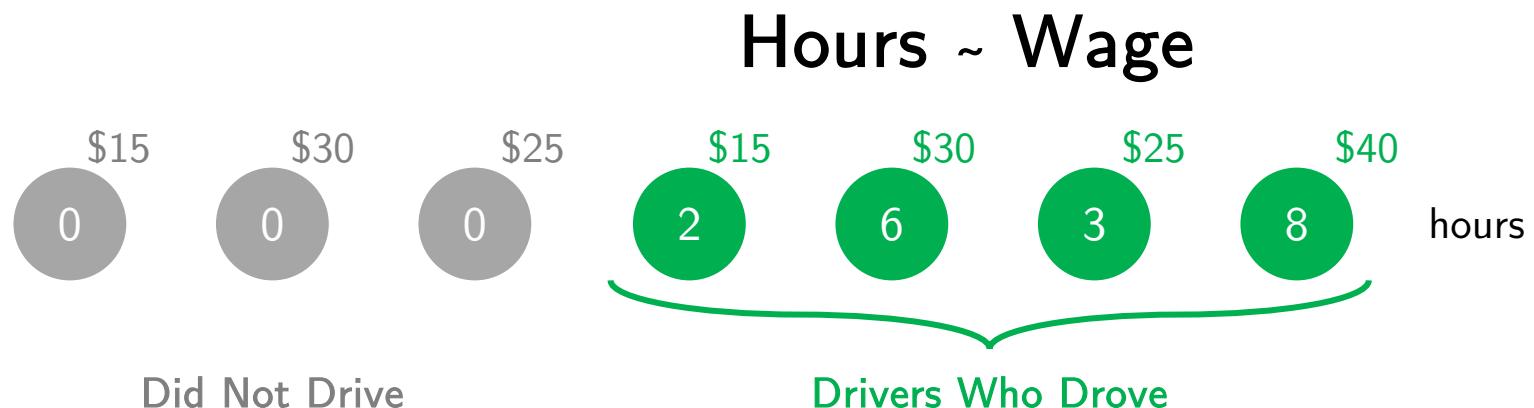


Empirical Strategy Challenges

Simultaneity

Solution: Instrumental Variables

Selection Bias



Empirical Strategy Challenges

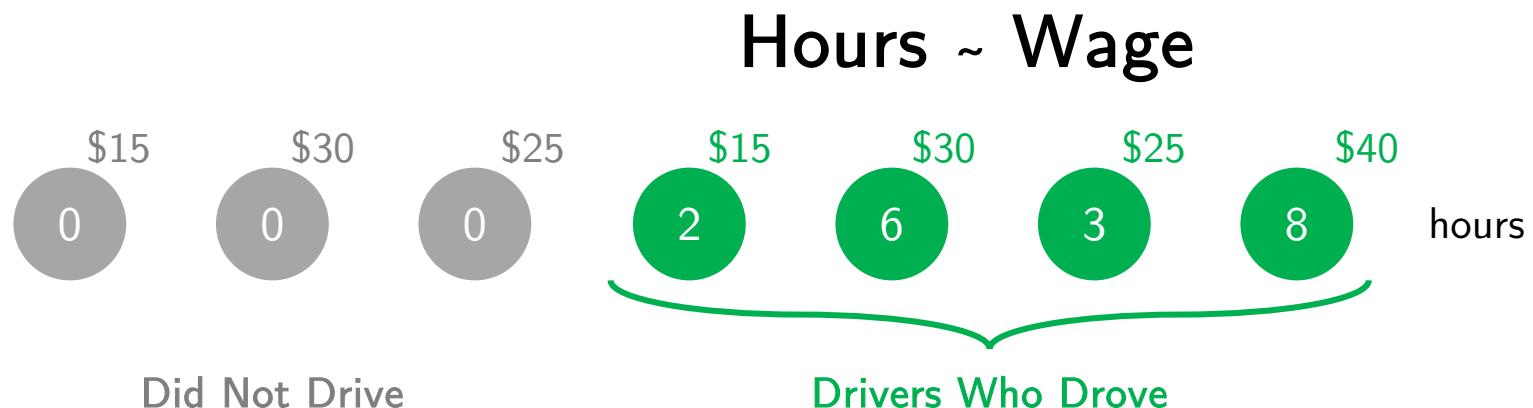
Simultaneity

Solution: Instrumental Variables

Selection Bias

Solution: Heckman Two-Stage Method

("Heckit" - Heckman 1979)



Empirical Strategy

Heckman + IV

1

Work or not?

Control Function Probit:
 $P(\text{drive})$ on *Offer*

Bias corrected with
panel jackknife
(Hahn & Newey 2004)

Empirical Strategy

Heckman + IV

1) Work or not?

Control Function Probit:

$P(\text{drive}) \text{ on } \textit{Offer}$

+ Controls₁



Empirical Strategy

Heckman + IV

1 Work or not?

Control Function Probit:

$P(\text{drive}) \text{ on } \textit{Offer} + \text{ISF}$ + Controls₁

Income So Far

= accumulated income since beginning of day

Empirical Strategy

Heckman + IV

1 Work or not?

Control Function Probit:

$P(\text{drive}) \text{ on } \textit{Offer} + \text{ISF}$ + Controls₁

|
Income So Far
= intensity of work

Empirical Strategy

Heckman + IV

1) Work or not?

Control Function Probit:

$P(\text{drive}) \text{ on } \textit{Offer} + \textit{ISF} + \textit{HSF} + \text{Controls}_1$

Income So Far
= intensity of work

Hours So Far
= accumulated time
logged in since beginning of day

Empirical Strategy

Heckman + IV

1 Work or not?

Control Function Probit:

$P(\text{drive}) \text{ on } \textit{Offer} + \textit{ISF} + \textit{HSF} + \text{Controls}_1$

|
Income So Far
= intensity of work

|
Hours So Far
= amount of active time

Empirical Strategy

Heckman + IV

1 Work or not?

Control Function Probit:

$P(\text{drive}) \text{ on } \textit{Offer} + \text{ISF} + \text{HSF} + \text{Controls}_1$

Income So Far Hours So Far

Conditional
on working

2 How long to work?

2SLS with Fixed Effects

Hours on $\textit{Earning}$ + ISF + HSF + Controls₂

Empirical Strategy

Heckman + IV

1 Work or not?

Control Function Probit:

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Income So Far Hours So Far

Conditional
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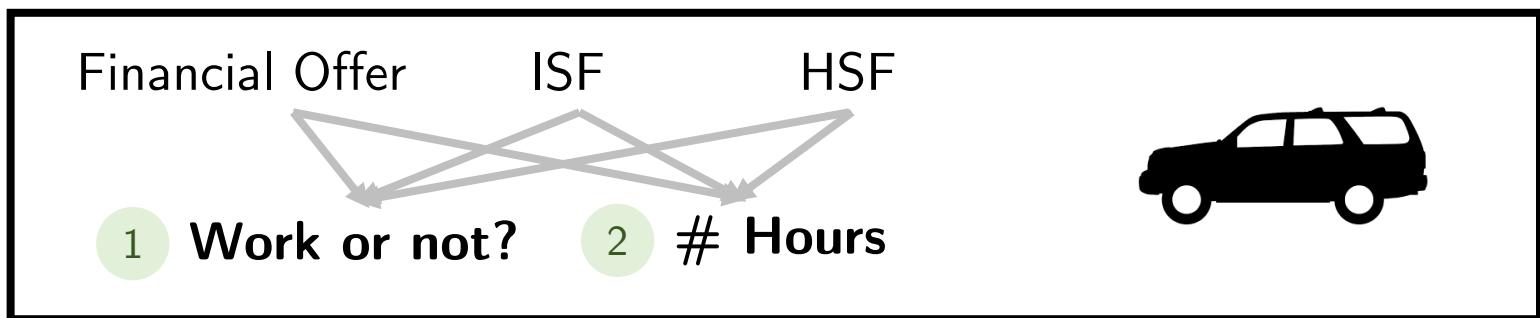
2 How long to work?

2SLS with Fixed Effects

Hours on $\textit{Earning} + \text{ISF} + \text{HSF} + \text{IMR} + \text{Controls}_2$

Inverse Mills Ratio
= correct for selection bias

Results



Within-Day

Midday



Late Night

Across-Days

Tuesday



Sunday



Results Within Day

1

Work or not?

Offer

Midday	+
PM peak	+
PM off	+
Late night	+

Financial incentives have
a **consistently positive**
impact.

Results Within Day

1

Work or not?

	Offer	ISF
Midday	+	+
PM peak	+	-
PM off	+	-
Late night	+	-

Income
Target

Income Target:
The more you earned,
the less likely you'll work
a new shift.

The negative impact of
income target kicks in
later in the day.

Results Within Day

1

Work or not?

	Offer	ISF	HSF
Midday	+	+	+
PM peak	+	-	+
PM off	+	-	+
Late night	+	-	+

Income
Target

Inertia

Inertia: The longer you've been active, the more likely you'll work another shift.

Inertia has a consistently positive impact.

Results Within Day

	1			2		
	Work or not?			# Hours		
	Offer	ISF	HSF	Earning	ISF	HSF
Midday	+	+	+	-	+	+
PM peak	+	-	+	+	-	+
PM off	+	-	+	+	-	+
Late night	+	-	+	+	-	+

Income Inertia Income Inertia

Target Target

The negative impact of income target kicks in later in the day for both stages.

Results Across Days

	1			2		
	Offer	ISF	HSF	Earning	ISF	HSF
Tuesday	+	+	-	+	+	+
Wednesday	+	+	+	+	-	+
Thursday	+	-	+	-	+	+
Friday	+	+	+	+	-	+
Saturday	+	-	+	+	-	+
Sunday	+	-	+	+	-	+

Income Target Inertia Income Target Inertia

The results are consistent across days as well.

Results Summary

Neoclassical
Financial Incentive

As day/week proceeds...



encourages working

Results Summary

As day/week proceeds...

Neoclassical
Financial Incentive

encourages working

Behavioral
Income Target

discourages working later on

Results Summary

As day/week proceeds...

Neoclassical
Financial Incentive

encourages working

Behavioral
Income Target

discourages working later on

New
Inertia

encourages working

Summary

How do gig economy workers make labor decisions?

Approach

- Shift-level data from ride-hailing company
- Modified Heckman estimation w/ IVs and fixed effects

Findings

As day/week proceeds...

Neoclassical

Financial Incentive

encourages working

Behavioral

Income Target

discourages working later on

New phenomenon

Inertia

encourages working

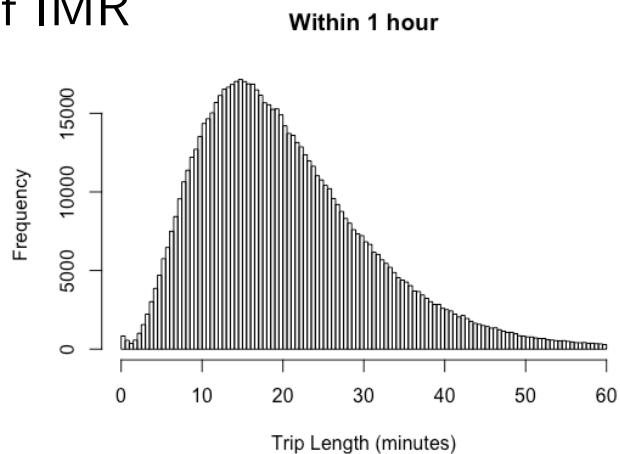
Implications

- Compared to current practice, our approach can improve service capacity without incurring extra cost or maintain the same capacity at a lower cost

Appendix

Robustness Tests

- Isolating ISF and HSF effect
 - Positive HSF (inertia) effect dominates ISF effect.
- Controlling on types of promotions
 - Same insights for rate-based promotions
- Other approaches to sample selection
 - Two-part models: insights stay the same in both parts
 - Dahl's correction: using B-splines instead of IMR
- Looking at granular log-on/log-off data
 - Smaller sample of sedan and SUV drivers
 - The longer the previous active session is, the longer the current active session is.



Optimal Targeted Incentive

Ranking each driver by her
minimum work-inducing incentive

= how much to trigger working decision



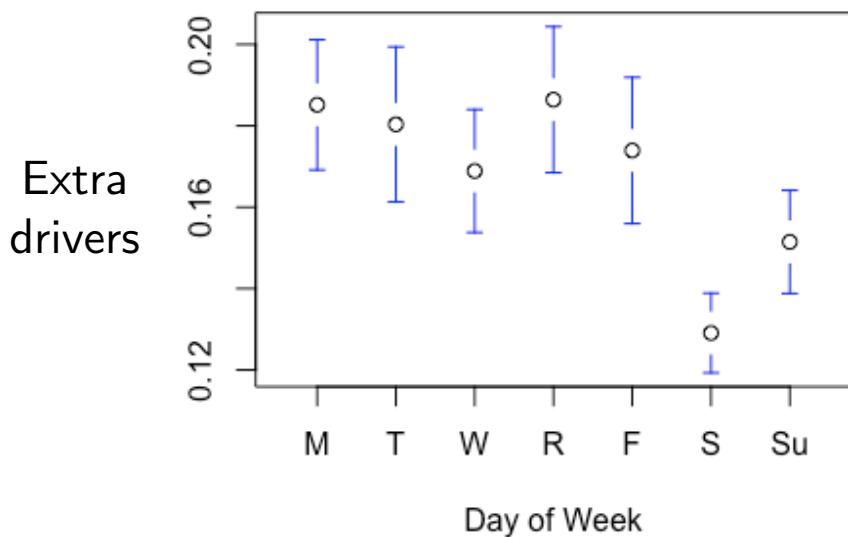
Reallocating Incentives

Compared to current practice from Jan to Sep 2017 out-of-sample
(Using data from Oct 2016 to right before the focal date as training)

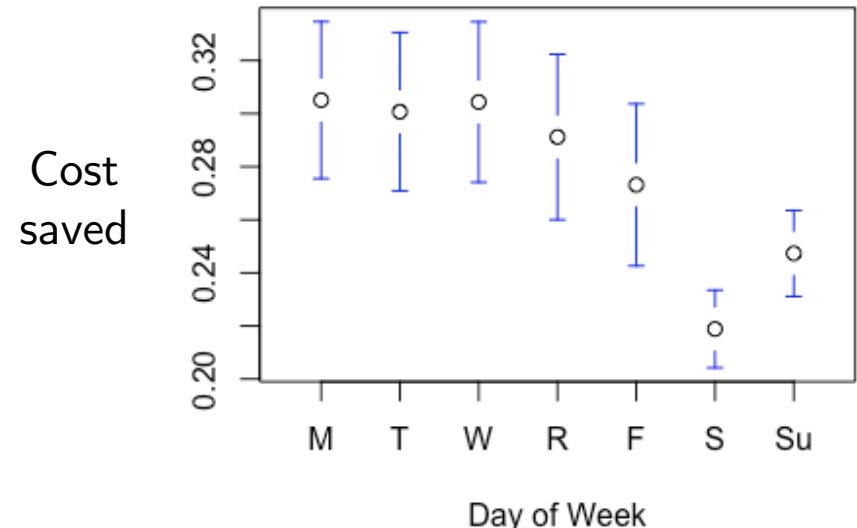
Reallocating Incentives

Compared to current practice from Jan to Sep 2017 out-of-sample

Given the same budget



Given the same capacity



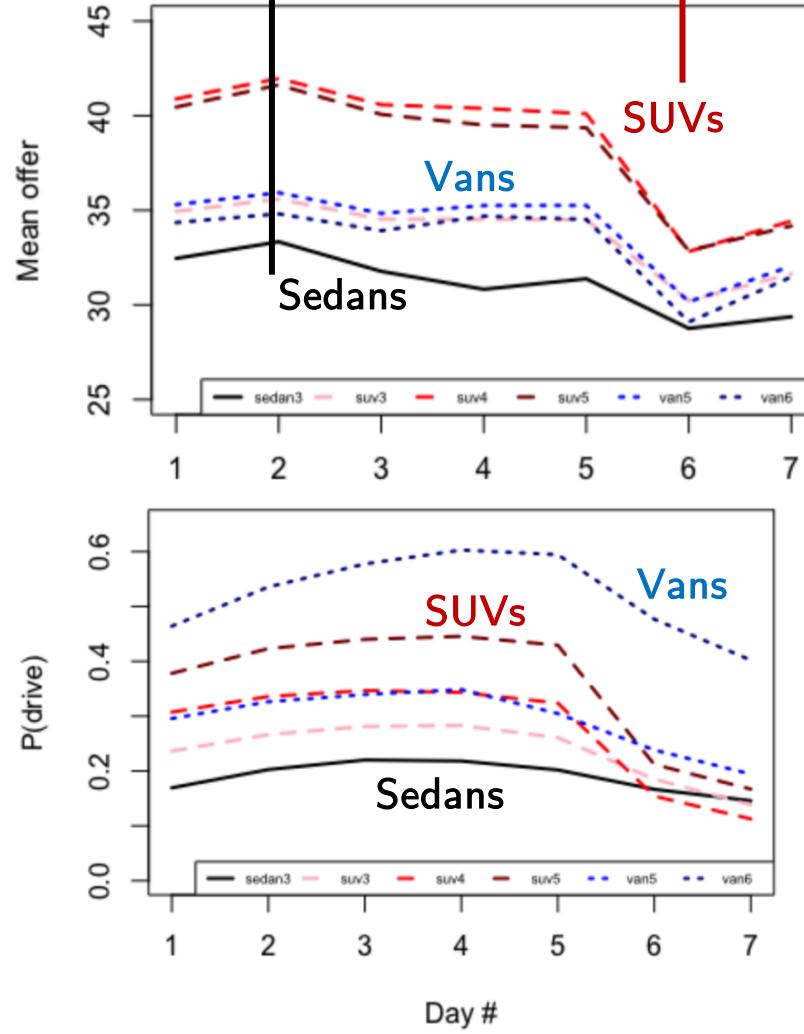
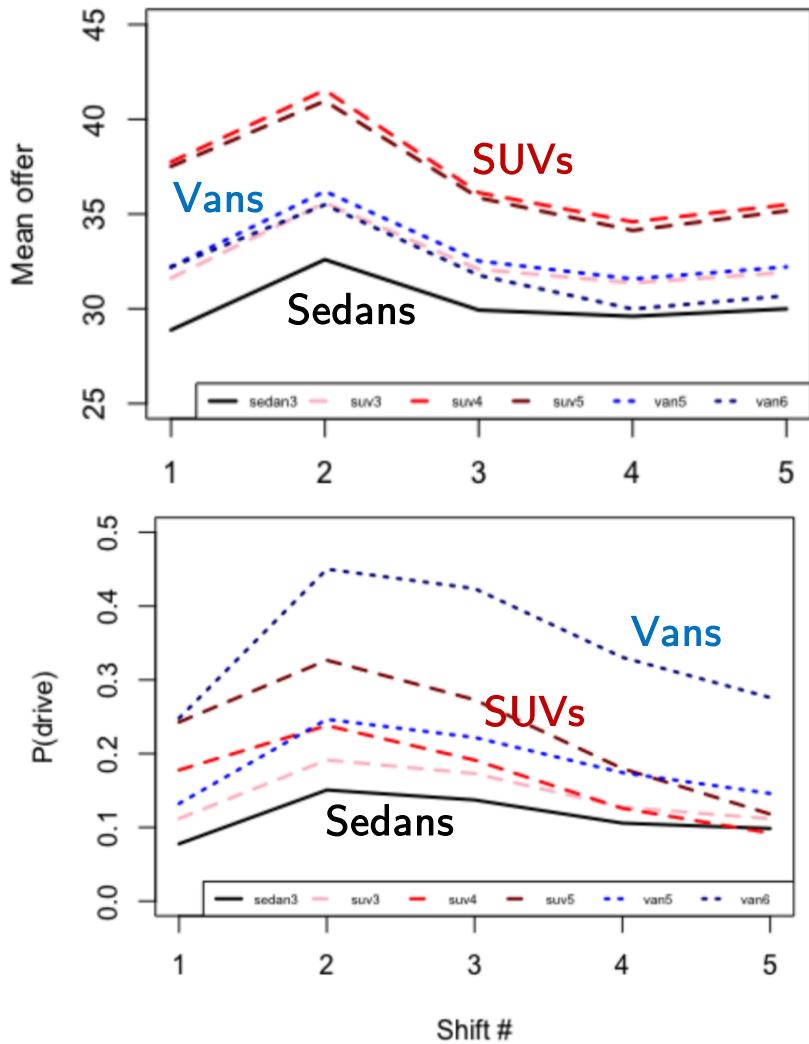
Can recruit **17% more drivers**
Average promo: 1.61x

Costs 28% less to maintain capacity

Drivers

5.33 hrs/day, 12.65 hrs/wk

4.86 hrs/day, 5.86 hrs/wk



Gig Work in Retail



- **Retail candidates value flexible shift patterns** and shorter work weeks over compensation and benefits.
- Benefits of adopting flexible workforce: **Seasonality, resolving high turnover, matching consumer trend, high quality/fresh perspective**
- Many have already adopted/worked closely with gig companies
 - Delivery business: Walmart x Uber/Lyft, GM x Lyft, Apple x Didi
 - Flexible staffing: IKEA x TaskRabbit, Samsung x Upwork

